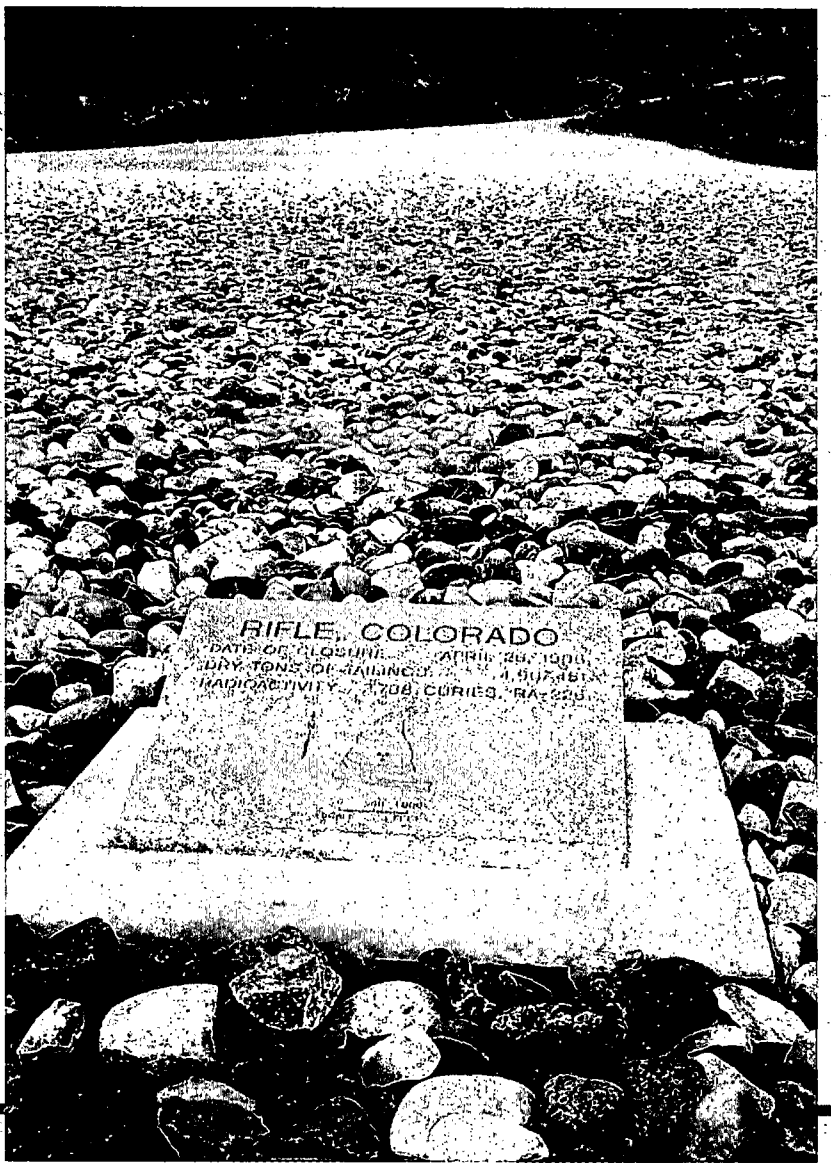
Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites

Annual Report for the Period January 1, 1998, Through December 31, 1998

February 1999



Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites

1998 Annual Report

February 1999

Prepared for
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC 99-06
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Summary

This report presents results of annual inspections in 1998 at 17 uranium mill tailings disposal sites established under Title I of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978. Sixteen of these sites are under general license by the U.S. Nuclear Regulatory Commission (NRC); the 17th site will not be licensed until fully closed in, perhaps, 2023.

All 17 sites were inspected by the Long-Term Surveillance and Monitoring (LTSM) Program established at the U.S. Department of Energy (DOE) Grand Junction Office (GJO), Grand Junction, Colorado, to fulfill DOE's long-term stewardship commitment at these sites.

Site inspections are conducted in accordance with the site-specific Long-Term Surveillance Plan (LTSP) and procedures established at GJO to comply with U.S. Nuclear Regulatory Commission (NRC) regulations at 10 CFR 40.27. Results of ground-water monitoring are included for each site where ground-water monitoring is required. Table Intro-1 (p. vii) summarizes LTSP-related findings and observations of interest or regulatory concern to NRC.

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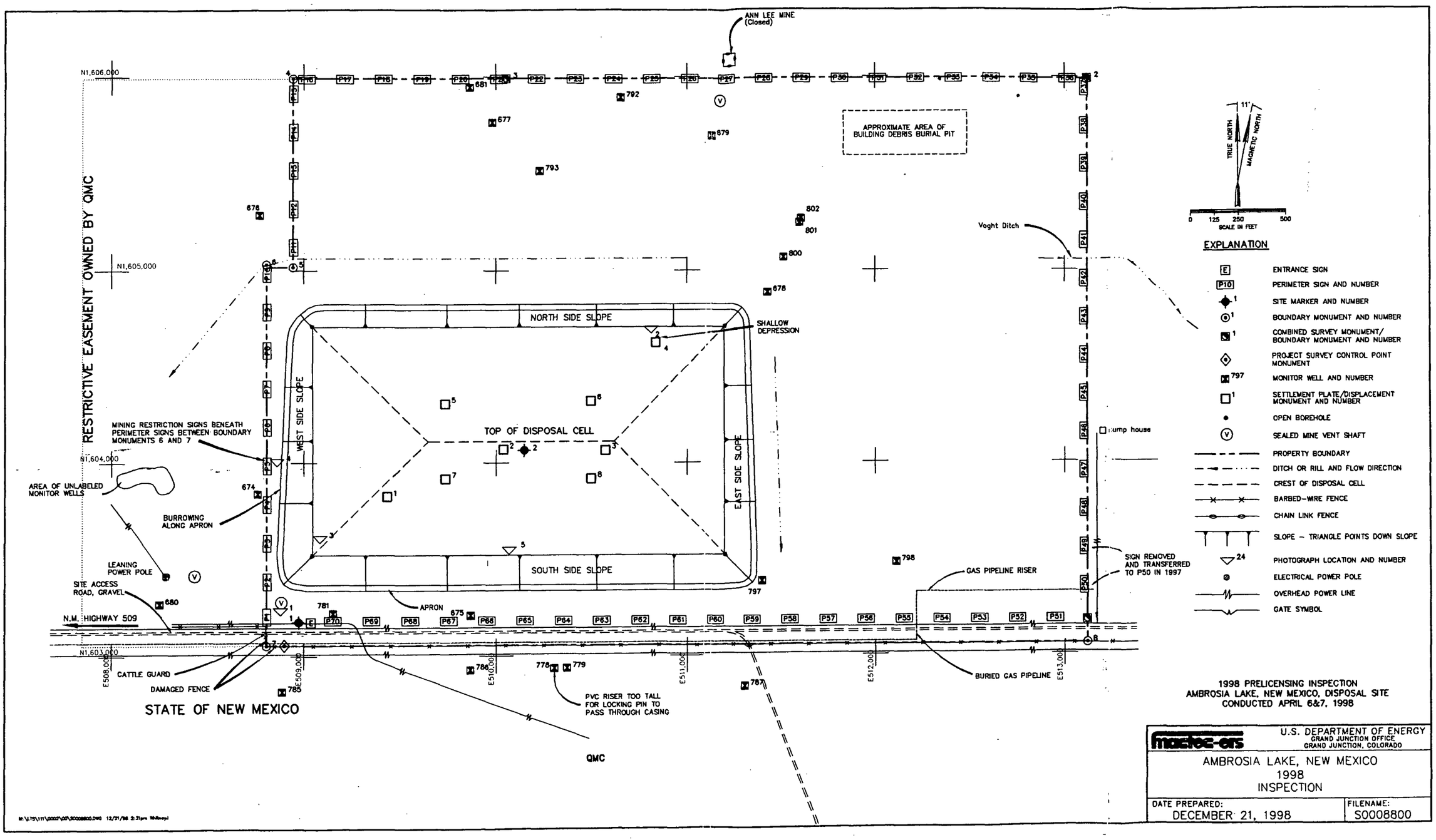

1998 PRELICENSING INSPECTION
AMBROSIA LAKE, NEW MEXICO, DISPOSAL SITE
CONDUCTED APRIL 6&7, 1998

mactec-ers

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE,
GRAND JUNCTION, COLORADO

AMBROSIA LAKE, NEW MEXICO
1998
INSPECTION

DATE PREPARED:	FILENAME:
DECEMBER 21, 1998	S0008800

down. The depression is subtle and may be noticeable only under certain lighting conditions. The area around DM-4 will be inspected again next year.

Annual weeds on top of the disposal cell were withered and dead (AMB PL-3). The plants, probably kochia, were remnants from the 1997 growing season. The weeds dried out and died before reaching maturity and producing seeds. The plants are not generally distributed but concentrated in linear strips and patches. This suggests that the plants grew where the riprap was thin or contained fine-grained materials, as artifacts of installation. The fine-grained material (sand and dirt) retains moisture and provides a rooting medium. Evidence of moisture retention can be seen in AMB PL-3. The photograph was taken shortly after a brief snow shower. The weeds, so far, are not a problem because they die at an immature stage before developing deep root systems.

The presence of these plants, however, suggests that under the right conditions, i.e., ample rainfall, plant encroachment could increase and plant establishment (biointrusion) could occur. Study of the effect of biointrusion on the long-term performance of rock-covered disposal sites in the western United States is currently under way by the Long-Term Performance Monitoring and Cover Assessment Project at GJO.

Side Slopes and Apron

Side slopes and the rock apron around the disposal cell are in excellent condition and show no evidence of cracking, settling, slumping, erosion, or significant plant encroachment. A few plants were observed on the east side slope, leeward to prevailing wind.

There are animal burrows along the rock apron on the west side of the disposal cell (AMB PL-4) and a few burrows along the east side. None of the burrows is in the rock, and all are a significant distance from the buried tailings. The volume of dirt displaced is small, and none of it consists of sandy material or clay-rich material that could represent tailings or slimes. Burrowing will, however, continue to be evaluated.

Standing water (runoff from recent precipitation) was present at places along the rock apron on the south side of the disposal cell (AMB PL-5). The water apparently evaporates or dissipates into the soil. It does not flow, and there is no erosion associated with it. It is not considered a problem.

Graded and Revegetated Site Area

In general, vegetation in regraded areas on the site is healthier than vegetation in areas surrounding the site. Vegetation is sparse in a few places; but, in general, revegetation is successful.

The barbed-wire fence south of the cattle guard near the site entrance is damaged. There was evidence of cattle on site, and they may have damaged the fence by finding a way into it. There was also ample evidence that elk graze the site in winter. Now that vegetation is well

established, grazing may benefit the grass. Unless over grazing becomes a problem, repair of the fence is not required.

Two open boreholes were discovered in the northeast part of the site during previous inspections. No additional open boreholes were discovered during this year's inspection.

The access road and a power line cross the site near and parallel to the southern boundary of the site. There is also a gas pipeline riser in the southeastern part of the site. This riser is associated with an underground pipeline. GJO assumes that there are easements for both the power line and pipeline, although the LTSP does not mention the easements. The pipeline easement would be closest to the disposal cell. It is, however, far enough away from the disposal cell so that excavation along the pipeline would not disturb the disposal cell.

Outlying Areas

The area outward for a distance of 0.25 mile from the site boundary was visually inspected. One change was noted. The Ann Lee mine opening, immediately north of the site, has been permanently closed, filled with soil, and reclaimed. No other building, construction, or change in land use was seen.

3.0 Ground-Water Monitoring

Ground-water monitoring is not required by the LTSP for this site.

4.0 Conclusions

The Ambrosia Lake site is in excellent condition. Revegetation of graded areas around the disposal cell is successful to date. Inspectors this year continued to note the shallow depression around one of the old displacement monuments, burrowing activity by small mammals, and minor growth of weeds on top of the disposal cell. These features will continue to be monitored. No maintenance is required. No cause for a follow-up inspection was identified.

5.0 Photographs

Table AMB-1. Photographs taken at Ambrosia Lake, New Mexico, Disposal Site

Photograph Location Number	Photograph Description/Remarks
AMB PL-1	Animal burrows at mine vent in southwest corner of site.
AMB PL-2	Shallow depression around displacement monument, DM-4.
AMB PL-3	Patches of previous year's kochia on top of the disposal cell.
AMB PL-4	Animal burrows along west apron.
AMB PL-5	Standing water along south toe.

PL-1 AMB 4/98 Animal burrows at mine vent in SW corner of site.

PL-2 AMB 4/98 Shallow depression around DM-4.

PL-3 AMB 4/98 Patches of previous year's Kochia on top of disposal cell.

PL-4 AMB 4/98 Animal burrows along W apron.

PL-5 AMB 4/98 Standing water along S toe.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Burrell, Pennsylvania, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
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Summary

The Burrell site, inspected October 13, 1998, is in good condition. Encroachment of vegetation on the disposal cell is a continuing concern. Inspectors identified several minor maintenance tasks, but no cause for a follow-up inspection was found.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I vicinity property disposal site at Burrell, Pennsylvania.

M.K. Kastens, Chief Inspector, and M.P. Plessinger, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on October 13, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Burrell, Pennsylvania, Vicinity Property Long-Term Surveillance Plan*, September 1993, Revised. U.S. DOE Albuquerque, N.M., DOE/AL-3F) for the site and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is required by the LTSP at this site. The results of ground-water monitoring in 1998 are reported in Section 3.0 Ground-Water Monitoring.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into four areas referred to as transects: (1) the disposal cell; (2) area adjacent to the disposal cell; (3) site perimeter; and (4) the outlying area. Each transect, except the outlying area transect, was inspected by walking a series of traverses. Part of the outlying area transect was visually inspected from the edge of the disposal site.

Within each transect, inspectors examined specific site surveillance features, such as monitor s, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure BUR-1.

2.1 Site Access and Specific Site Surveillance Features

Site Access Gate. Two gates must be negotiated to reach the site: the site access gate and the site entrance gate. The site access gate, at Strangford Road, and the chain-link fence on both sides of the gate are in excellent condition. The gate is secured by a chain and padlocks. Although this is a DOE gate, both DOE and ConRail have padlocks on the chain. ConRail has another gate farther down Strangford Road but, on occasion, apparently uses DOE's gate as well. A DOE entrance sign, placed on the gate in July 1998, is in excellent condition. ConRail has also attached one of its "no trespassing" signs to the access gate next to DOE's entrance sign.

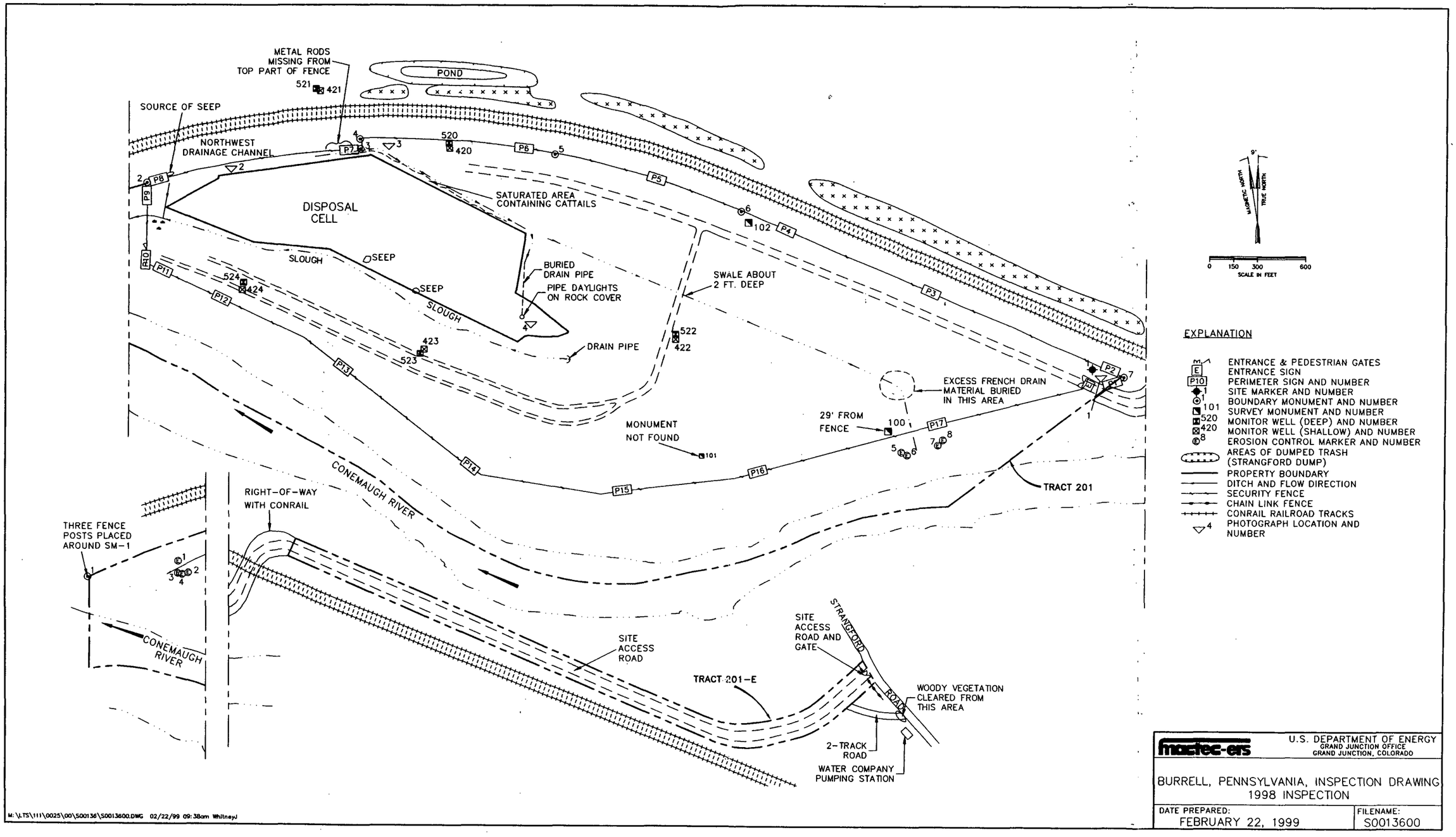
Directly south-southeast of the site access gate, an area of woody vegetation was recently cleared during installation of a new sewer line and pumping station. Clearing of this vegetation has allowed trespassers to by-pass DOE's gate and access the old Strangford dump and private property behind DOE's gate. (DOE's perpetual right-of-way, Tract 201-E, crosses the same private property.) There is now a dirt track around the DOE gate, and this track is used by persons bent on illegal dumping and by users of dirt bikes and ATVs. To avoid potential liabilities associated with both kinds of trespass, DOE will consider some kind of barricade where the woody vegetation was cut down to discourage trespassers from driving around DOE's gate and using DOE's right-of-way for unlawful purposes.

The site access road is in good condition. The hard-packed road leads from Strangford Road, through the site access gate, then southwest across Tract 201-E to DOE's right-of-way across ConRail tracks and on to the site entrance gate. There are a number of fairly long deep ruts in the access road north of the railroad tracks. These ruts fill with water during storms, but so far the road remains passable for passenger cars.

Site Entrance Gate. The site entrance gate is in excellent condition. Just inside the gate is site marker, SMK-1, also in excellent condition. The site marker is overgrown by dense woody vegetation (BUR PL-1). The area around the marker will be cleared periodically.

The LTSP refers to a second site marker, a marker on the top of the disposal cell. This marker was never installed. Reference to the second marker will be deleted when the LTSP is revised.

There are three survey monuments and seven boundary monuments at this site. Attempts to locate two boundary monuments, BM-2 and BM-4, along the northwest fence line, were unsuccessful. Areas where these boundary monuments are located are heavily overgrown. Two other boundary monuments, BM-3 and BM-7, located along the north fence line were also difficult to locate because of thick vegetation. During the next inspection, inspectors will locate these four boundary monuments; for each monument, they will establish an easily identifiable reference feature, such as a specific fence or witness post. This action will allow these monuments to be easily located during future inspections.



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BURRELL, PENNSYLVANIA, INSPECTION DRAWING 1998 INSPECTION	
DATE PREPARED: FEBRUARY 22, 1999	FILENAME: S0013600

Four pairs of erosion control markers, ECM-1 and 2, ECM-3 and 4, ECM-5 and 6, and ECM-7 and 8, are in good condition. There is no erosion around any of these markers.

Five pairs of ground-water monitor wells are all in good condition. Locations of these wells are shown on Figure BUR-1. DOE annually cuts a path through the grass and shrubbery to each pair of wells to facilitate sampling. Ground water was sampled at these wells a few days before the annual inspection. (See Section 3.0 Ground-Water Monitoring.)

2.2 Transects

Disposal Cell

The disposal cell is covered with riprap in excellent condition. Trees and large shrubs, however, continue to encroach on the disposal cell. With the exception of a 0.5-acre plot on the south side of the cell, preserved as a test plot, DOE has cut or sprayed the vegetation with herbicide on several occasions. The most recent spraying was July 1998. Although spraying is more or less successful with some years more successful than others, the vegetation always grows back and will continue to do so (BUR PL-2). Clearly, a rock-covered disposal cell that is not designed to accept and accommodate the natural succession of native plants, in this case, a deciduous woodland, is not an optimum design for the eastern part of the U.S.

A biointrusion study, currently underway by DOE, has shown that a particularly aggressive plant, deep-rooted Japanese knotweed, has increased the hydraulic conductivity of the radon barrier by two to three orders of magnitude, from 10^{-7} centimeters per second (cm/sec) to as much as 10^{-5} cm/sec in the areas affected by the roots. A risk assessment, part of the biointrusion study, will examine risks associated with the encroachment of deep-rooted plants.

Seeps. There are two seeps, sometimes more, along the base of the south side slope of the disposal cell. On the basis of observations going back to 1990, the rate of flow depends, at least in part, on recent precipitation. Both seeps were nearly dry at the time of this year's inspection (fall). The seeps are a potential concern because the water flowing from the seeps may not be exclusively meteoric; and because the flow could eventually destabilize the south side slope of the disposal cell by spring sapping. These seeps are included in the DOE's ground-water monitoring program. (See Section 3.0 Ground-Water Monitoring.)

Area Adjacent to Disposal Cell

Since the disposal cell was built in 1986, rainwater and snowmelt have collected in a shallow depression along the base of the north side slope of the disposal cell. Saturated soils and wetland vegetation (mainly cattails) are present in a 3-ft-wide band along this depression. Design drawings show that this part of the site was intended to drain to the east. Final grading of the area around the northeast corner of the disposal cell left a high spot so that the intended drainage did not occur. It is possible that water in this depression may supply the seeps along the south side slope of the disposal cell.

To drain this low-lying area and possibly reduce the water supply to the seeps, a French drain was installed, in July 1998, along the base of the north side slope and around the east end of the disposal cell (BUR PL-3). At the time of inspection, the drain was newly built and in excellent condition. The low-lying area along the base of the north side slope was dry.

The outlet to the French drain is at the southeast corner of the disposal cell. Inspectors fashioned an end cap from wire mesh and placed it over the end of the drain pipe to keep small animals out (BUR PL-4). Location of the outlet was then marked by a small rock cairn.

The graded area surrounding the disposal cell inside the security fence is covered by thick grass, scattered trees and shrubs, and thickets of woody plants. Access to the four pairs of monitor wells inside the security fence (east and south of the disposal cell) is maintained by annually mowing the grass and clearing heavier vegetation as needed.

Site Perimeter

This transect comprises the security fence and the bank above the Conemaugh River.

The condition of the security fence was generally good. Some sections of the fence are beginning to rust, and barbed wires along the top of the fence were broken at one place (between perimeter signs P3 and P4). Near perimeter sign P7, a number of the metal brackets or spacers that support the three strands of barbed wire are missing. The broken strands of barbed wire will be repaired and the missing spacers replaced.

The fence, where it passes through thickly wooded areas along the southern edge of the site, is subject to damage from falling trees or limbs and by growth of trees through the fence fabric. Density of vegetation at this location also makes adequate inspection of the fence difficult. To extend the life of the fence and make inspections easier, trees and shrubs were cleared from a 5-ft-wide corridor along the fence in June 1998. After cutting and clearing the vegetation, herbicide was applied along the base of the fence. This process will have to be repeated every 2 or 3 years to stay ahead of the plant growth.

Seeps along the north security fence, about 60 ft east of perimeter sign P8 (just west of the disposal cell), were flowing at several places along the fence at the bottom of the railroad embankment. Source of the water in these seeps may be the "blue hole" (see below under Outlying Areas page BUR-7). This area warrants continued monitoring to ensure that the seeps do not destabilize the security fence or the railroad embankment.

The pedestrian gate at the west end of the site was in good condition. Perimeter sign P10, directly adjacent to the pedestrian gate, was missing and will be replaced.

Outlying Areas

The area beyond the site boundary, for a distance of 0.25 mile, was visually inspected for erosion, development, and other changes that might affect the site. There were none.

A dirt road parallels the ConRail railroad tracks on the north side. DOE uses this road to reach monitor wells MW-421 and MW-521. The road also provides access to a long, narrow wooded area along the railroad tracks that has been used for many years as an illegal dump, known as the Strangford dump. Since construction of DOE's access gate and ConRail's pole gate at Strangford Road, it appears that dumping is less frequent than before. However, none of the refuse has been removed. Local authorities are aware of the problem. At the east end of the dump area, several piles of refuse, previously exposed, appear to have been covered with dirt. No other changes were observed in the dump area.

The "blue hole," a deep depression partly filled with water at the west end of the dump area, continues to hold water. The blue hole may supply the seeps along the north side of the site.

3.0 Ground-Water Monitoring

DOE monitors ground water at this site as a best management practice to evaluate the performance of the disposal cell and demonstrate compliance with the ground-water protection standards.

Monitor Wells

The ground-water monitoring network consists of ten wells in five pairs:

Monitor Wells	Location
MW-420 & MW-520	Upgradient, or background wells
MW-421 & MW-521	Upgradient, or background wells
MW-422 & MW-522	Crossgradient, point-of-compliance wells
MW-423 & MW-523	Downgradient, point-of-compliance wells
MW-424 & MW-524	Downgradient, point-of-compliance wells

Each pair of wells consists of a shallow well, completed in unconsolidated fill and alluvium (400-series wells); and a deeper well, completed in the shallow bedrock of the Casselman Formation (500-series wells). In addition, two seeps at the bottom of the south side slope of the disposal cell are also sampled whenever they yield sufficient water.

Location of wells and seeps is shown in Figure BUR-1.

Frequency of Monitoring

The wells and seeps are sampled annually in the fall.

Analytes

Ground-water samples are analyzed for the following analytes:

ammonium	magnesium	selenium
calcium	manganese	sodium
chloride	molybdenum	sulfate
gross alpha	potassium	total dissolved solids
iron	radium-226 + radium-228	uranium
lead	nitrate	vanadium

Results of Ground-Water Monitoring in 1998

Ground-Water Sample Analytical Results. Ten wells were sampled in October 1998. The seep locations along the southern margin of the cell were dry and could not be sampled.

Of the 18 analytes listed above, 7 with MCLs were detected in the samples. Results from wells completed in the unconsolidated fill and alluvium are in Table BUR-1; results from the deeper bedrock wells are in Table BUR-2. The MCL for each analyte is also in the tables. The MCLs are used as benchmarks for evaluating water quality data at the Burrell site.

Table BUR-1. Summary of Alluvial Ground-Water Sample Results

Analyte	MCL	Alluvial Ground-Water Sample Location				
		MW-420 (upgradient)	MW-421 (upgradient)	MW-422 (crossgradient)	MW-423 (downgradient)	MW-424 (downgradient)
Gross alpha	15 [a]	9.23 U[b]	17.14 U	7.92 U	24.93 U	14.57 U
Lead	0.05	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Molybdenum	0.10	0.001 U	0.001 U	0.001 U	0.0153	0.021
Nitrate as NO_3	44	0.0294	0.011 U	0.0245	0.0208	0.0188
Radium-226 Radium-228	5, combined	0.15 U 0.93	0.13 U 0.62 U	0.14 U 0.66 U	0.51 0.67 U	0.13 U 0.64 U
Selenium	0.01	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Uranium	0.044	0.001 U	0.001 U	0.001 U	0.022	0.0019

All results in mg/L except Ra-226, Ra-228, and gross alpha are in pCi/L.
[a]Excludes contributions from uranium and radon-222 decay. Ground-water sample results include uranium and radon-222 decay.
[b]U = undetected at respective laboratory reporting limit.

Table BUR-2. Summary of Bedrock Ground-Water Sample Results

Analyte	MCL	Bedrock Ground-Water Sample Location				
		MW-520 (upgradient)	MW-521 (upgradient)	MW-522 (crossgradient)	MW-523 (downgradient)	MW-524 (downgradient)
Gross alpha	15 [a]	5.93 U[b]	10.73 U	7.37 U	14.22 U	9.23 U
Lead	0.05	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Molybdenum	0.10	0.0014	0.0143	0.001 U	0.0138	0.0012
Nitrate as NO_3	44	0.0361	0.0113	0.0194	0.0224	0.011 U
Radium-226 Radium-228	5, combined	0.15 U 1.27	0.19 U 1.05	0.14 U 0.68 U	0.14 U 0.69 U	0.14 U 0.66 U
Selenium	0.01	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Uranium	0.044	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

All results in mg/L except Ra-226, Ra-228, and gross alpha are in pCi/L.
[a]Excludes contributions from uranium and radon-222 decay. Ground-water sample results include uranium and radon-222 decay.
[b]U = undetected at respective laboratory reporting limit.

Gross alpha, lead, and selenium were not detected in any sample collected in October 1998. Since September 1987, the first year the wells and seeps were sampled by the Long-Term Surveillance and Monitoring Program, these analytes have been at or below the laboratory detection limit at all locations. Anomalously high concentrations of lead, ranging from 0.02 to 0.15 milligrams per liter (mg/L), were detected in samples collected over 10 years ago, in June 1987, when the wells were first sampled. This condition obviously no longer exists.

The concentration of nitrate and radium in the downgradient wells continues to be very low, barely above detection level, and consistent with background values. That condition has persisted since monitoring began in June 1987.

Molybdenum in alluvial ground water downgradient (southwest) of the disposal cell is elevated relative to up- and crossgradient locations, where molybdenum was not detected. The levels in the downgradient samples are well below the MCL. Molybdenum concentrations in downgradient well MW-424 have not varied appreciably since monitoring began in June 1987. At downgradient well MW-423, molybdenum has decreased by more than one half to present values since maximum concentrations of approximately 0.06 mg/L to 0.08 mg/L were detected in 1987 and 1988.

Uranium is also above background levels at downgradient well MW-423. At that location, the uranium concentration increased from 0.0016 mg/L in December 1996 to 0.022 mg/L in October 1998. A similar fluctuation occurred at MW-423 in 1991 and 1992. In the 1991-1992 interval, uranium increased from less than 0.0003 mg/L (detection limit) to 0.019 mg/L, then decreased again to 0.003 mg/L. The remaining sample results indicate that uranium concentrations at well

MW-423 range between approximately 0.001 mg/L and 0.008 mg/L. There is no overall trend in the uranium results for MW-423 since monitoring began in 1987 (Figure BUR-2).

At downgradient well MW-424, the 1998 uranium result only marginally exceeded the detection limit of 0.001 mg/L. Uranium concentrations at well MW-424 have historically been either near or below the detection limit, or were consistent with up gradient sample results. Uranium concentration in ground water at all sampling locations continues well below the MCL.

The results for samples from the bedrock wells (Table BUR-2) indicate that only molybdenum, nitrate, and radium were above detection limits. The concentrations of these analytes in samples from downgradient wells are consistent with those in upgradient bedrock wells; all are far below the respective MCL for each analyte.

Ground-Water Level Monitoring. Ground-water level data extend back to 1987. Since then, ground-water levels have remained relatively uniform at all well locations. Flow in the seeps has varied; further suggestion that flow in the seeps is primarily meteoric water and responsive to recent weather. The constancy of water levels suggests that ground-water mounding within the cell, as result of increased infiltration (i.e., cell failure), has not occurred. Equally, there is no evidence of previous mounding and subsequent dissipation of water from within the cell.

Summary. Information from DOE's monitoring of ground water indicates:

- The limited amount of site characterization (or preremediation) water quality data available (c. 1982) indicates that uranium concentrations then were comparable to the maximum values for uranium observed now during the 1987 to 1998 postremediation period. The concentration of uranium in ground water has not increased since the disposal cell was constructed.

- The concentrations of two important hazardous constituents, uranium and molybdenum, have decreased slightly (molybdenum) or essentially unchanged (uranium) since the disposal cell was completed. All contaminant concentrations have remained well if not far below their respective MCL.

- There are no trends in the analytical or water level data to indicate that seepage from the disposal cell degrades ground-water quality relative to contaminant levels that existed in ground water prior to cell construction.

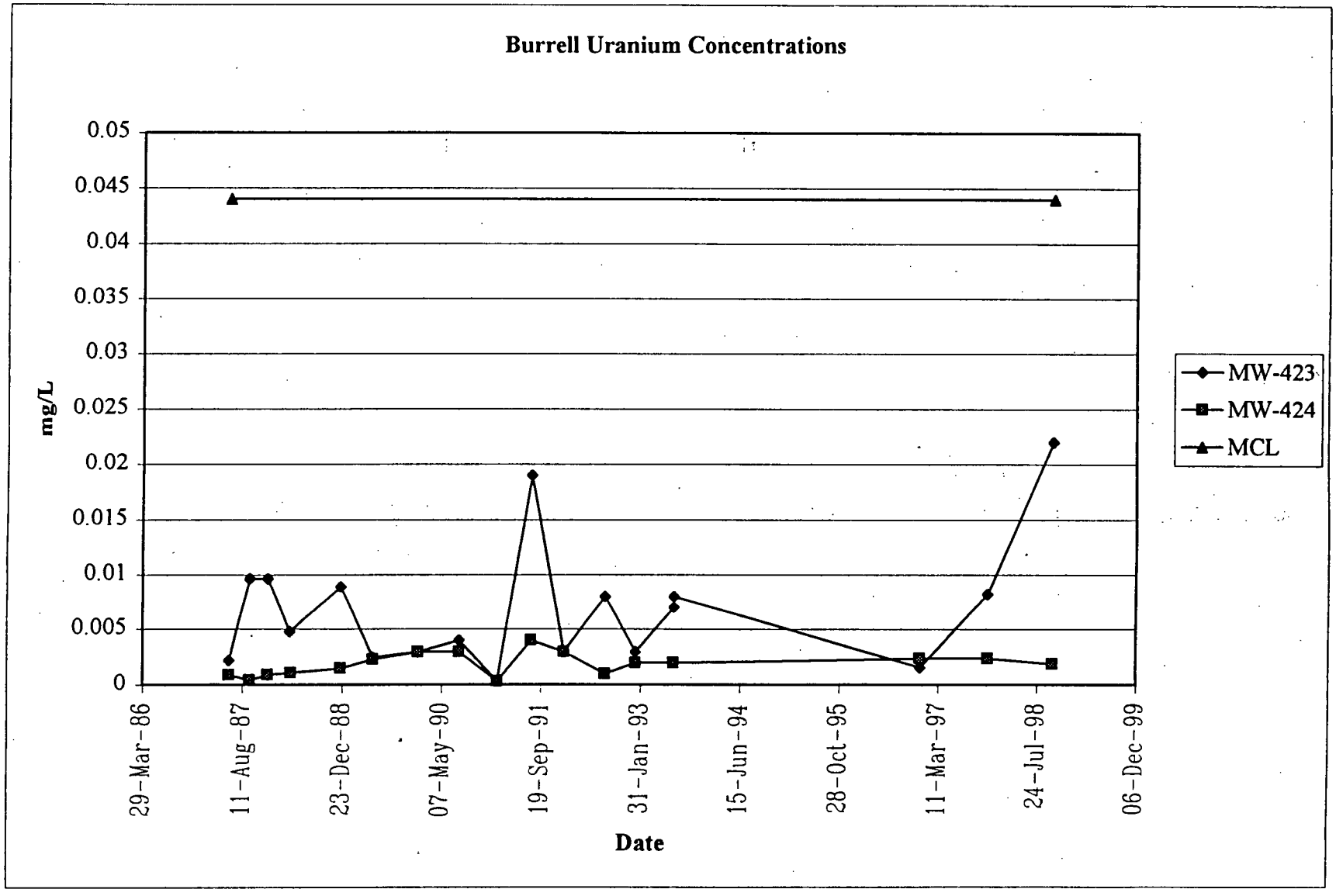


Figure BUR-2. Burrell, Pennsylvania, Disposal Site Uranium Concentrations

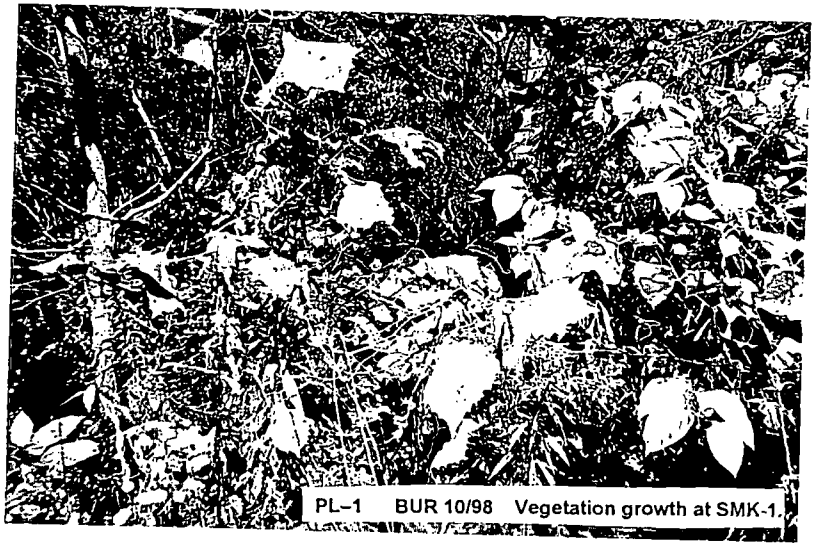
4.0 Conclusions

The site is in good condition. The primary concern is plant encroachment on the disposal cell. A biointrusion study and risk assessment are currently underway to evaluate the long-term effect of plant encroachment on the disposal cell. Inspectors identified several minor maintenance tasks, but no cause for a follow-up inspection was found.

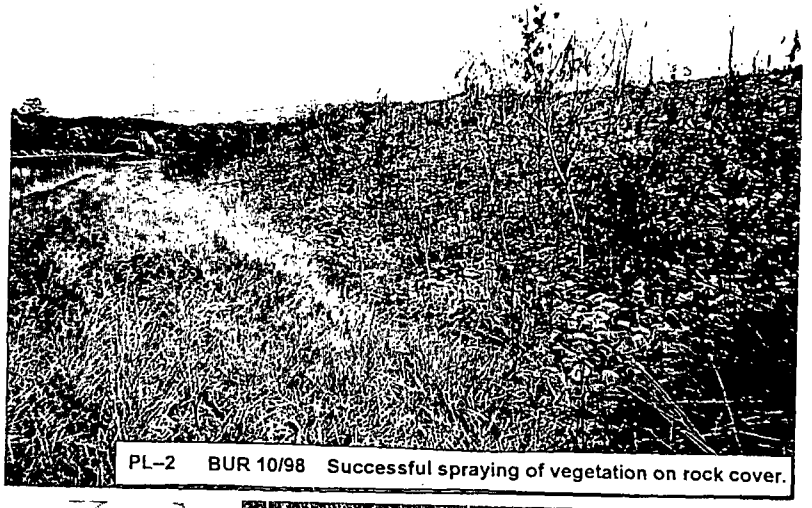
5.0 Photographs

Table BUR-3. Photographs taken at Burrell, Pennsylvania, Disposal Site

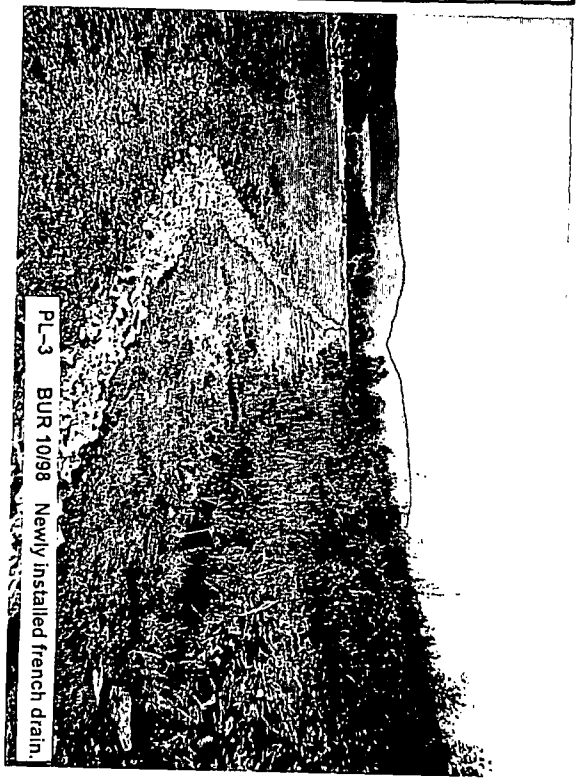
Photograph Location Number	Photograph Description/Remarks
BUR PL-1	Vegetation growth at SMK-1
BUR PL-2	Successful spraying of vegetation on the rock cover
BUR PL-3	Newly installed french drain
BUR PL-4	Wire mesh cover on the french drain outlet



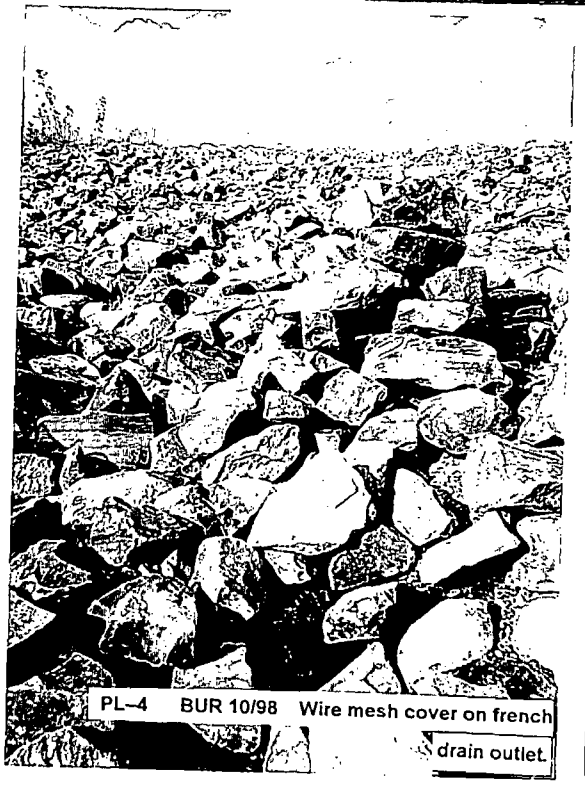
PL–1 BUR 10/98 Vegetation growth at SMK-1.



PL–2 BUR 10/98 Successful spraying of vegetation on rock cover.



PL–3 BUR 10/98 Newly installed french drain.



PL–4 BUR 10/98 Wire mesh cover on french drain outlet.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Canonsburg, Pennsylvania, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Summary

The Canonsburg site, inspected on October 13, 1998, is in excellent condition. DOE continues to cut the grass and manage encroaching vegetation along fence lines, diversion channels, and drainage ditches. No need for a follow-up inspection was identified. Uranium continues at or above the maximum concentration limit in three wells, but there is no uranium contamination in Chartiers Creek.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Canonsburg, Pennsylvania.

M.P. Plessinger, Chief Inspector, and M.K. Kastens, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on October 13, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Canonsburg, Pennsylvania, Disposal Site*, October 1995. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-203, Rev. 0) for this site, and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is required by the LTSP at this site. Results of ground-water monitoring in 1998 are in Section 3.0 Ground-Water Monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into six areas referred to as transects: (1) the disposal cell, (2) grassed areas surrounding the disposal cell, (3) diversion channels and perimeter ditches, (4) the security fence, (5) outlying areas, and (6) Area C, east of the disposal site. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure CAN-1.

2.1 Specific Site Surveillance Features

The entrance gate, entrance sign, and the auxiliary gate on the north side of the site are in good condition. Padlocks on gates and monitor wells are corroded and rusted, and will have to be replaced from time to time.

The two site markers, three survey monuments, and four boundary monuments are likewise in good condition. (Not all monuments were physically examined because they are in densely vegetated areas. Inspectors examined the immediate area around each monument to determine that the ground was undisturbed.)

All four pairs of erosion control markers are undisturbed with one exception. Erosion control marker ECM-4A, near the edge of Chartiers Creek, was lost to erosion sometime in 1997. High water apparently caused the bank to erode or slump into the creek. ECM-4A does not need to be replaced because the other marker in the pair, ECM-4, is still in place and can be used for reference.

There are eight monitor wells in the Long-Term Surveillance and Monitoring (LTSM) and Uranium Mill Tailings Remedial Action (UMTRA) Ground Water (UGW) Project monitoring networks. Each well is secured with a cap-and-pin locking system and a standard padlock. In general, the steel casings, concrete collars, caps, and pins are in good condition at all wells. Padlocks on the caps are corroded or rusted and will have to be replaced from time to time. The concrete collar and surface casing for one well, MW-412, are leaning in the down-slope direction. UGW personnel advise that the displaced collar is not a problem because the casing is grouted farther down the borehole, and this provides a seal to prevent contamination of the well from surface runoff. Replacement of the collar is not required.

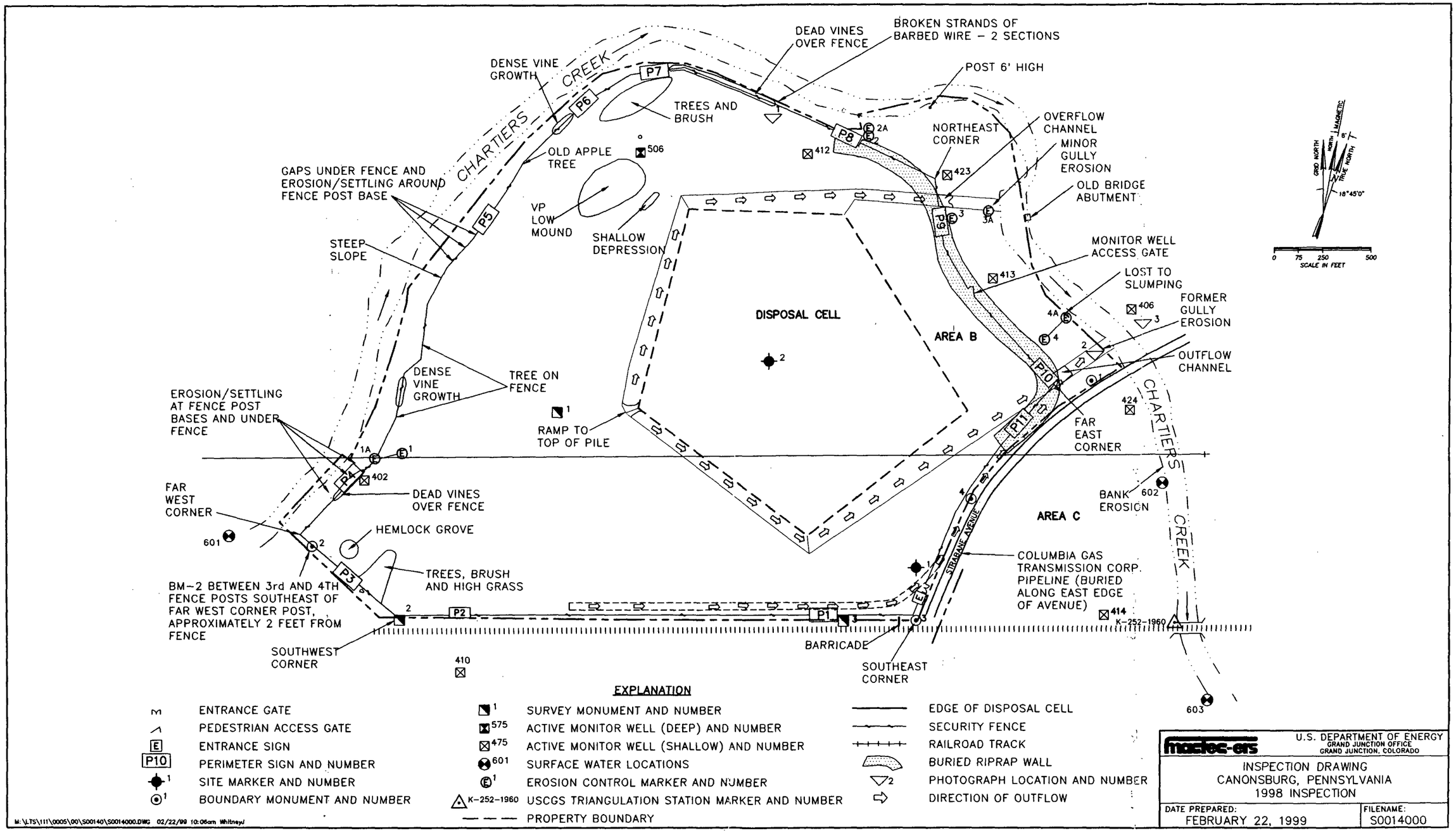
2.2 Transects

Disposal Cell

The disposal cell itself is in excellent condition. There is no evidence of erosion, slope instability, or animal burrowing.

Grassed Areas Surrounding the Disposal Cell

The thick grass that covers the disposal cell also covers the area surrounding the disposal cell and extends beyond the security fence on the north side of the site to the bank of Chartiers Creek. The grass, which is mowed and mulched annually in summer, is in excellent condition.



macfac-ers	U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE GRAND JUNCTION, COLORADO
INSPECTION DRAWING CANONSBURG, PENNSYLVANIA 1998 INSPECTION	
DATE PREPARED: FEBRUARY 22, 1999	FILENAME: S0014000

There are several groves of brush and large trees in this transect. In August 1996, dead trees and branches were removed from these groves. The entire area inside the fence is now park-like and appears well kept. Dead trees and branches may have to be removed from these groves periodically.

Diversion Channels and Perimeter Ditches

The rock in the diversion channels surrounding the disposal cell is in excellent condition. Vegetation was cleared from these channels in July 1994 and August 1996. Inspectors in 1997 found that cutting the trees and bushes is not effective: The plants sprout profusely from their cut stumps. Spraying with herbicide when the plants are fully leafed out may be the only effective recourse. Regrowth and new growth was sprayed with herbicide in August 1998. The 1998 spraying resulted, apparently, in a near 100 percent kill of the trees and shrubs growing in the diversion channels. The plants will return, however, because of a constant seed supply. Regular spraying and some clearing will continue to be necessary.

Security Fence

Except for two continuing concerns, the security fence is generally in excellent condition. From the far western corner of the site, north along the top of the bank above the creek, to about the position of perimeter sign P5, the concrete "boot" at the bottom of several fence posts is exposed. Inspectors have noted this condition since the site was first inspected in 1990. So far, all of the posts are still firmly in place despite the concrete being exposed.

The cause of the exposed concrete seems to be the settling of soil from around the posts. There is no evidence of erosion, settlement, or slumping around the posts. The soil around the posts may not have been compacted after final grading. Settling of the uncompacted soil from around these fence posts may account for most of the exposed concrete. The problem does not appear to be increasing.

The bank along Chartiers Creek from the far western corner of the site to about the location of ECM-2 and ECM-2A is heavily forested right up to the security fence. The biomass is considerable, and the forest is old enough that dying trees and branches are commonplace. Deadfalls continually batter the fence. Truckloads of material were removed from the fence line in 1996. During this inspection, inspectors removed dead fall from the fence near perimeter sign P4 and from between perimeter signs P7 and P8. The barbed wire above two sections of the security fence is broken (CAN PL-1) and will eventually be repaired. The broken wire is not a security risk.

At the northeast corner of the site, the northeast outflow channel and the eastern perimeter ditch, both armored with riprap, converge to form one spillway. Erosion below this spillway has increased yearly since first noted in 1991. In April 1998, the eroded channel below the spillway was armored with riprap and upper portions of the banks were revegetated (CAN PL-2).

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development or disturbance that could affect the site was observed.

One recent change in land use was noted during the 1998 inspection. Across Chartiers Creek, northeast of the disposal cell, down the lane used to access MW-406 and MW-505 and near the abandoned West Penn Power substation building, there is a new metal building advertised for rent (CAN PL-3). This development should not interfere with the disposal cell, although two monitor wells are close by. The monitor wells are protected by stanchions installed in 1996. Monitor well MW-406 is in the ground-water monitoring network; No other changes in land use were observed within 0.25 mile of the site boundary.

Area C

Area C is a triangular, grass-covered piece of vacant property across Strabane Avenue east of the site. It is bounded by Strabane Avenue, Chartiers Creek, and the railroad. Area C is owned by the state; it is not part of the Canonsburg disposal site, although it was involved in the remedial action. DOE understands that the state intends to convey Area C to the Borough of Canonsburg for recreational or other purposes.

DOE further understands that the state will place a restriction on the future use of Area C. The restriction will preclude residential development or excavation below a depth of 6 feet (ft). The reason for this restriction is that during remedial action two thorium anomalies were discovered at a depth of about 8 ft.

Area C is in good condition. DOE still cuts the grass each year in Area C, as a courtesy to the state. Two wells in Area C are still part of the LTSM monitoring network.

A small amount of erosion continues, as a natural process, along the bank of Chartiers Creek where it bounds Area C on the east. DOE will evaluate the risk of continued bank erosion affecting the two thorium anomalies.

3.0 Ground-Water Monitoring

DOE monitors ground water at this site as a best management practice to evaluate contaminant trends in the unconsolidated aquifer that lies beneath the disposal cell.

The Canonsburg site was completed in 1985. U.S. Environmental Protection Agency (EPA) standards for ground-water protection at mill-tailings sites went into effect 10 years later, in January 1995. Therefore, the Canonsburg disposal cell was grandfathered from compliance with the EPA standards, and there are no point-of-compliance wells at the site.

Monitor Wells. There are six wells in the LTSM ground-water monitoring network. Samples are also collected at three locations in Chartiers Creek at the same time that the wells are sampled.

The six wells are all completed in shallow, unconsolidated materials (unconfined) aquifer:

Upgradient well	MW-410	
Downgradient wells	MW-406	MW-412
	MW-413	MW-424
Crossgradient well	MW-414	

Wells and stream sample locations are shown in Figure CAN-1.

Frequency of Monitoring.

The LTSP requires the sampling of the 6 monitor wells and 3 surface sample locations for 2 years following licensing of the site by NRC. The site was licensed in January 1996. It was sampled in December 1996, and again in November 1997. The 2-year requirement is fulfilled. However, because the concentration of uranium in some of the wells continues above the EPA Maximum Concentration Limit (MCL), DOE continues to sample the wells on a year-to-year basis.

Analytes

The LTSP specifies two hazardous constituents for monitoring at this site: molybdenum and uranium. All samples are analyzed for these two analytes as well as standard water quality indicators and field parameters.

Results of Ground Water and Surface Water Monitoring in 1998

Ground-Water Sample Analytical Results. Analytical results for molybdenum and uranium in ground-water samples collected in October 1998 are shown in Table CAN-1. The MCLs for these analytes are included in the table. The MCLs are benchmarks for evaluating water quality data at the site.

Molybdenum Results. Among the October 1998 samples, molybdenum was detected in all downgradient wells, MW-406, MW-412, MW-413, and MW-424, and in the crossgradient well, MW-414. Molybdenum in the upgradient well was below the detection limit. Except in the crossgradient well, the concentrations of molybdenum were near the laboratory detection limit, and all, including the result from the crossgradient well, were well below the MCL.

Table CAN-1. Summary of Ground-Water Sample Results

Analyte	MCL	Ground Water Sample Location						
		MW-410 (up-gradient)	MW-406 (east of creek)	MW-412 (down-gradient)	MW-413 (down-gradient)	MW-414 (cross-gradient)	MW-424 (down-gradient)	MW-506 (bedrock)
Molybdenum	0.10	0.001 U	0.0039	0.0011	0.0034	0.019	0.001	0.0018
Uranium	0.044	0.001 U	0.0034	0.113	0.140	0.0441	0.001 U	0.192

All results in mg/L.
U = undetected at respective laboratory reporting limit.

At the crossgradient well, MW-414, the result for molybdenum was 0.019 milligrams per liter (mg/L), 5 to 10 times higher than at the other wells (Table CAN-1). The 1998 result for this well is consistent with the historic data for the well that go back approximately to 1987. This well is in Area C, where liquid wastes were impounded when the mill was in operation. The well is hydraulically across the gradient (crossgradient) from the disposal cell. The disposal cell is, therefore, not a credible source of the molybdenum.

Molybdenum concentrations at the other wells have generally decreased since about 1991. Prior to that time, molybdenum concentrations commonly ranged between 0.02 and 0.03 mg/L, except at the upgradient well, where molybdenum was typically below detection limits.

Prior to construction of the disposal cell, molybdenum concentrations in the ground water were as high as 0.15 mg/L. Molybdenum, currently detected, is probably a residual of the higher levels present when the mill was actively contaminating the aquifer. Ambient molybdenum may also derive, in part, from unencapsulated source materials that were not remediated and placed inside the disposal cell.

Uranium Results. Uranium concentrations in the 1998 samples were approximately 2.5 to 4 times greater than the MCL at two downgradient locations, MW-412 and MW-413. At crossgradient well MW-414, the concentration of uranium was 0.0441 mg/L, equal to the MCL. Uranium was below the detection limit in the upgradient well and in downgradient well MW-424, a result consistent with historical results for these wells. Uranium concentration at well MW-406 was slightly above the detection limit but far below the MCL.

Figure CAN-2 shows variation in uranium for wells MW-412, MW-413, and MW-414 since 1986. At well MW-412, uranium was below the MCL prior to mid-1990 and has since risen and remained above the MCL. The MCL was exceeded at well MW-413 in all but one sample since 1986. Uranium in MW-414 was consistently below the MCL until early 1994, after which the concentration of uranium has fluctuated above and below the standard.

The apparent increasing concentration of uranium in some wells, and the generally elevated concentration of uranium in the local area, are probably unrelated to cell performance for the following reasons: (1) contaminant source material is known to lie outside the disposal cell,

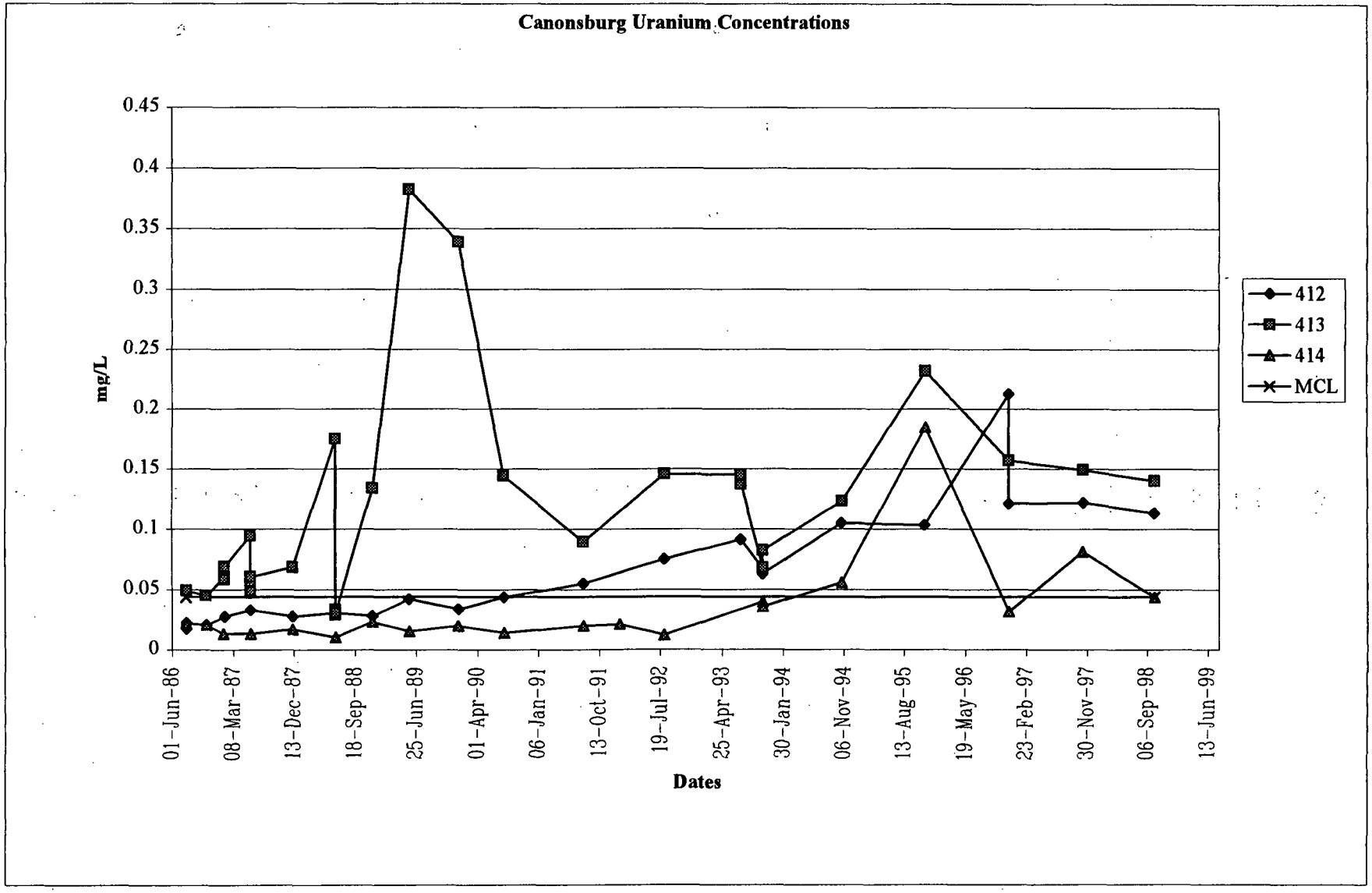


Figure CAN-2. Canonsburg, Pennsylvania, Disposal Site Uranium Concentrations

(2) the geochemistry of ground water and unconsolidated materials beneath and downgradient from the site may be favorable to the mobilization of uranium, and (3) high levels of uranium contamination existed in ground water prior to construction of the disposal cell. As discussed below, these factors may account for the levels of uranium in ground water and probably make definitive evaluation of the disposal cell performance impossible.

The DOE's completion report for this site states that a layer of deeply buried contaminated material was left in place east of the disposal cell. Radiological characterization of this material, obtained before the site was remediated, indicate that this material is widespread throughout this area. It was not remediated because it averages less than 150 picocuries per gram (pCi/g) of radium-226 (DOE 1984). The layer was reported to be from 2- to 6-ft thick and overlain by 4- to 8-ft of clean fill. Later, during site remediation, contaminant levels in this layer were found to be greater than previously estimated (DOE 1986).

Waste material in Area B consisted of heterogeneous mixtures of unprocessed ore and concentrated milling residues interspersed with fill and soil (DOE 1981). Analysis of soil samples collected in Area B prior to remediation showed both moderate levels of radium-226 and elevated concentrations of uranium-238. For example, two samples contained 18 pCi/g and 160 pCi/g radium-226, and 85 pCi/g and 290 pCi/g uranium-238, respectively. This is equivalent to approximately 255 milligrams per kilogram (mg/kg) radium-226 and 870 mg/kg uranium-238. These data indicate that high uranium concentrations were neither isolated nor anomalous occurrences in Area B. The background concentration of uranium-238 in soils at the Canonsburg site is about 3 to 5 mg/kg.

If the above soil sample results are representative of materials comprising the layer of contaminated material left in place, then this layer is the likely source of ground-water contamination. Ground-water elevations are typically about 5 ft below the surface of the ground in Area B and have not declined since the disposal cell was constructed. Therefore, the contaminated layer may frequently be in contact with ground water.

Furthermore, geochemical conditions at the site may tend to favor mobilization of uranium, in that the ground water is (1) acidic (pH ranges between about 5.5 and 6.5), (2) moderately high in alkalinity (300 to 400 mg/L), and (3) possibly oxidizing, at least from time to time.

The continued high levels of uranium in ground water may also be the result of incomplete flushing of dissolved and sorbed uranium since the aquifer was initially contaminated by mill operations. Historic records (DOE 1983a) document that in 1982 and 1983, ground water east or upgradient from MW-414 contained 3,950 pCi/L uranium-238. This is equivalent to approximately 12 mg/L uranium-234 + uranium-238. In the former mill area, which was located primarily upgradient from the present disposal cell, a concentration of 1,100 pCi/L uranium-238 was reported. This is approximately equivalent to 3.3 mg/L uranium-234 + uranium-238. At many other sampling locations, uranium concentrations were well above the MCL. For example, in the area near downgradient wells MW-412 and MW-413, uranium concentrations were on the order of 0.2 to 0.4 mg/L.

There are several hydrologic factors that could potentially account for the observed fluctuations and apparent trends in uranium concentrations over time. For example, water-level measurements taken before the start of remedial action show that the piezometric surface and ground-water flow directions varied significantly (DOE 1983b). Piezometric surface maps, based on 1979, 1982, and 1983 water level data, show directional variations of as much as 45 to 90 degrees within Areas B and C (DOE 1983b). Prior to remediation, a prominent ground-water mound existed beneath the mill area. The data also indicate that the hydraulic gradient between Chartiers Creek and the aquifer experienced periodic reversals in eastern portions of the site.

Recent ground-water level measurements indicate that the elevation of the water table upgradient or southwest of the disposal cell has not changed significantly from pre-remediation levels. This indicates that the amount of underflow to the site has not changed.

Water level measurements also indicate that water table elevations over most of the site are not significantly different from pre-remediation conditions, although water levels appear to have decreased by several feet in Area C since construction of the disposal cell. Significant fluctuations of up to 5 to 6 ft or more at a given well are indicated in water level data collected prior to and after construction of the disposal cell.

There do not appear to be dramatic differences in water table conditions prior to and after site remediation. The observed fluctuations and apparent trends in uranium concentrations could therefore be the result of variations in ground water flow directions over time, particularly because source material is likely within the areas of concern. However, the current monitoring network does not provide sufficient detail to determine if ground water flow directions have changed as a result of site remediation, or if flow directions vary since the disposal cell was constructed. The current data indicate that the general direction of flow is to the northeast. There is insufficient data to determine if the former ground water mound in the area of the former mill has dissipated.

Surface Water Sample Analytical Results. Analytical results for molybdenum and uranium in surface water samples collected in October 1998 are shown in Table CAN-2. Surface water sampling locations are shown in Figure CAN-1.

Table CAN-2. Summary of Surface Water Sample Results

Analyte	MCL	Surface Water Sample Location		
		601 (upgradient)	602 (downgradient)	603 (downgradient)
Molybdenum	0.10	0.119	0.112	0.104
Uranium	0.044	0.001 U	0.001 U	0.001 U

All results in mg/L.
U = undetected at respective laboratory reporting limit.

Although Chartiers Creek is an aquifer discharge boundary, the amount of discharge relative to the volume and rate of water flow in the creek (dilution) maintains uranium concentrations below detectable levels in the creek. Similarly, there is no increase in molybdenum as a result of discharge from the site. Sources upgradient of the site apparently account for the relatively high levels of molybdenum in Chartiers Creek in the site area.

Summary. Performance of the Canonsburg disposal cell cannot be evaluated unambiguously on the basis of the available ground-water data for the following reasons: 1) elevated concentrations of uranium and molybdenum were present in ground water prior to construction of the disposal cell, and residual levels may mask any possible contribution from the cell; 2) contaminated material remains in unremediated areas of the site and may continue for a very long time to release uranium to ground water; and 3) ground-water travel paths may vary significantly over time and, with continued release from on site source material, concentrations at a given location would be expected to vary.

DOE will continue to monitor at this site, as required by the LTSP, but DOE considers the risk associated with the uranium in ground water to be negligible and insignificant in that the ground water (1) is institutionally controlled, i.e., isolated from inadvertent use, and (2) has no detectable effect on the chemistry of water in the creek. The UGW is using similar arguments in its effort to comply with EPA standards for ground water in Area C. UGW has an alternate concentration level (ACL) application pending with NRC. The ACL application includes a deed restriction on the use of ground water beneath Area C. Thus, public health, safety and the environment will adequately be protected now and in the future.

4.0 Conclusions

The site is in excellent condition. Several routine maintenance tasks are identified, but no requirement for a follow-up inspection is needed.

5.0 Photographs

Table CAN-3. Photographs taken at Canonsburg, Pennsylvania, Disposal Site

Photograph Location Number	Photograph Description/Remarks
CAN PL-1	Damaged barbed wire on north fence line.
CAN PL-2	Recently armored outflow channel.
CAN PL-3	New building near MW-406 and MW-505.

6.0 References

U.S. Department of Energy (DOE) 1981. *Geochemical Investigation of UMTRAP Designated Site at Canonsburg, Pennsylvania.* UMTRA-DOE/ALO-226, GECR #R-811. May.

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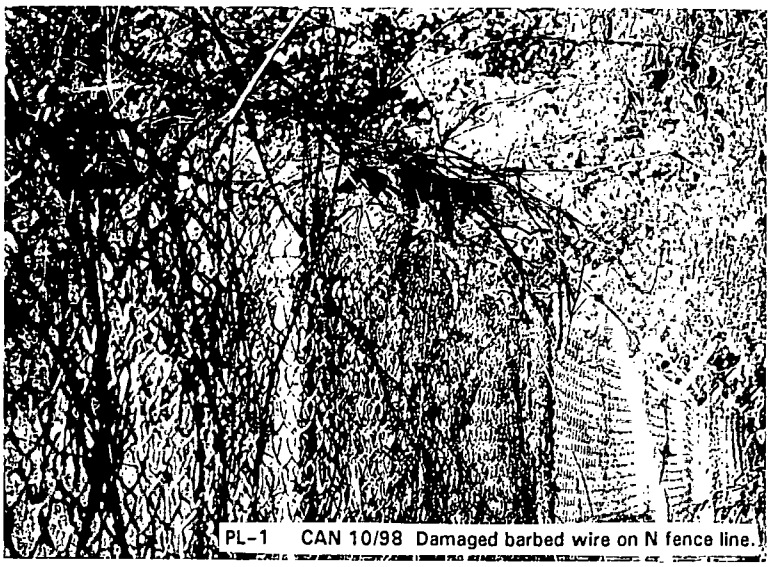
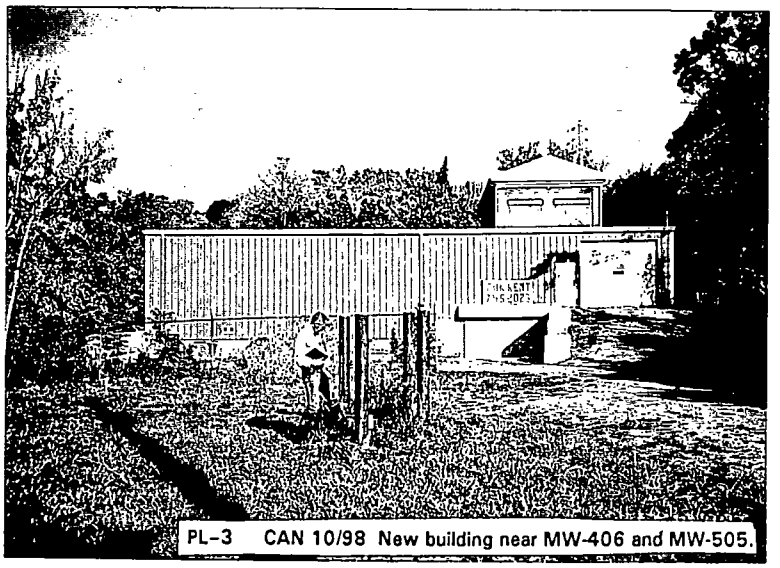


PL-1 CAN 10/98 Damaged barbed wire on N fence line.

PL-2 CAN 10/98 Recently armored outflow channel.



PL-3 CAN 10/98 New building near MW-406 and MW-505.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Durango, Colorado, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Summary

The Durango site, inspected on June 16, 1998, was in good condition. Plant encroachment on the top and side slopes of the disposal cell was noted, and minor rill erosion continues at several places. Inspectors identified sign and sign post replacement as the only maintenance requirement. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Durango, Colorado.

W.J. Waugh, Chief Inspector, and M.J. Gardner, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on June 16, 1998. W. Naugle of the Colorado Department of Public Health and Environment participated during part of the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (*Long-Term Surveillance Plan for the Bodo Canyon Disposal Site, Durango, Colorado*, November 1995. U.S. Department of Energy, Albuquerque, N.M., DOE/AL/62350-77, Rev. 1) for this site, and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is required by the LTSP at this site. The results of ground-water monitoring are include in Section 3.0 Ground-Water Monitoring.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into five areas referred to as transects: (1) the top of the disposal cell, (2) the side slopes of the disposal cell, (3) diversion and drainage channels, (4) the site boundary, and (5) the remainder of the site. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Efforts to control state-listed noxious weeds were also evaluated. Features mentioned in this report are shown on the drawing, Figure DUR-1.

2.1 Specific Site Surveillance Features

Entrance Gate, Entrance Signs, Perimeter Signs

The entrance gate, marred by vandals' bullets, is unchanged and remains operational.

At the disposal site, there are 1 entrance sign and 82 perimeter signs. The entrance sign and perimeter sign at P1 are missing. The sign post at P1 is lying on the ground (DUR PL-1). Ten perimeter signs are missing: P1, P3, P4, P53, P72, P76, P77, P78, P79, and P81. The sign post at P1A is bent to the ground and the sign post at P53 is missing (DUR PL-2). Thirteen perimeter signs—P5, P16, P19, P24, P33, P36, P62, P64, P67, P70, P71, P73, and P80—have bullet holes but remain readable. Signs P1A and P2 are unreadable because of gunshot damage. The concrete base of perimeter sign P40 is undercut about 6 inches (in.) by erosion (DUR PL-3). The missing entrance sign, missing or severely damaged perimeter signs, bent sign post, and missing sign post will be replaced. Vandalism shows no signs of abating.

Site Markers, Survey and Boundary Monuments

There are 2 site markers, 4 survey monuments, 5 boundary monuments, and 14 settlement plates at this site. All are in excellent condition, with the following exceptions: (1) the granite site marker, SMK-1, near the entrance gate, is pocked from gunshot but remains readable (DUR PL-4); and (2) the concrete base of boundary monument BM-3 and two of the reference monuments for BM-3, all of which are located in the middle of a small draw at the southeast corner of the site, are undercut by erosion. Inspectors placed rock around the concrete base of BM-3 to slow erosion (DUR PL-5). Two previously unrecorded survey markers were found along the site perimeter: one approximately 40 feet (ft) southwest of perimeter sign P12, and the other approximately 54 ft south-southwest of P75 (DUR PL-6). Vandalism of the site marker and erosion around BM-3 will continue to be monitored.

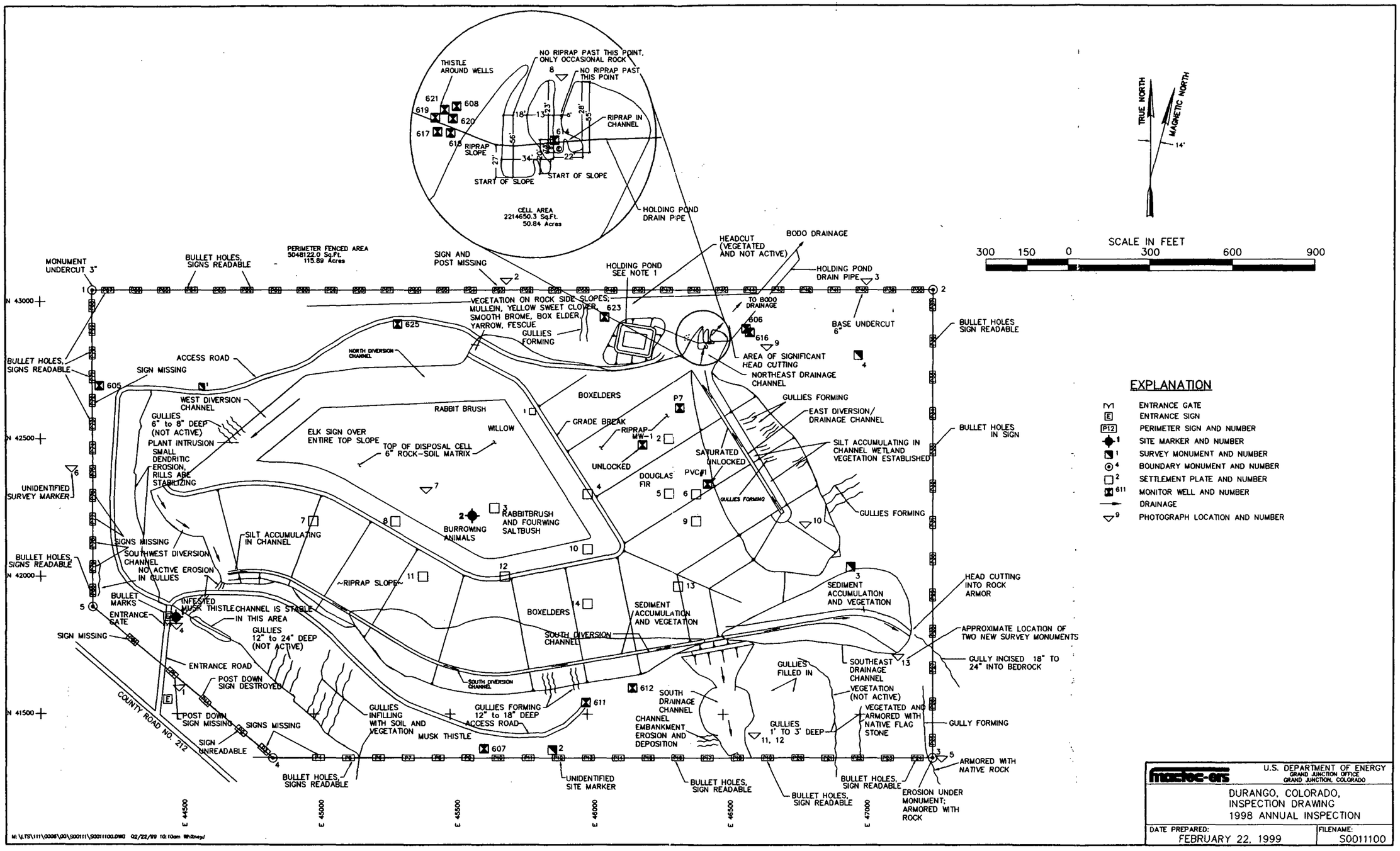
Monitor Wells

There are six wells in the ground-water monitoring network. All were inspected, are locked, and are in excellent condition. (See Section 3.0 Ground-Water Monitoring.)

2.2 Transects

Top of Disposal Cell

The Durango disposal cell is unique in that the cover placed over the tailings includes a compacted soil layer (CSL) at a depth of 2.5 ft. The purpose of the CSL is to limit water infiltration. No cracking, settling, slumping, or erosion was observed on top of the disposal cell.



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DURANGO, COLORADO, INSPECTION DRAWING 1998 ANNUAL INSPECTION	
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Vegetation on the top of the disposal cell has changed significantly since the 1997 inspection. Yellow sweetclover dominates the plant community, and perennial grasses, once well-established, appear stressed or dead (DUR PL-7). This may be a response to changes in precipitation or depletion of soil nutrients. Rabbitbrush and four-wing salt bush, both deep-rooted shrubs, grow near the east end of the top slope. Occasional deep-rooted rabbitbrush and willow grow along the edge of the top slope. Because these plants are few in number, they do not currently threaten the performance of the cover.

Small mammal burrows were observed near site marker SMK-2. Burrowing will continue to be monitored.

Side Slopes of Disposal Cell

The riprap-covered side slopes of the disposal cell are in excellent condition. Potentially detrimental disturbances such as subsidence, rock deterioration, or slope failures were not observed. Occasional plants, including box elder, thistle, mullein, smooth broke, yarrow, and a lone Douglas fir, are present at some places on the side slope.

Diversion and Drainage Channels

Diversion and drainage channels around the perimeter of the disposal cell direct runoff into natural drainage areas surrounding the site. Headcutting, gullying, and displacement of riprap, as well as minor disturbances such as sediment accumulation and plant encroachment, were observed at several locations.

The area of most pronounced erosion is at the mouth of the northeast drainage channel, the largest drainage channel at the site. Inspectors have noted erosion at the mouth of this channel since the site was first inspected in 1992. Erosion has migrated headward from Bodo Draw into the northeast drainage channel. The result is that the knickpoint (where the drainage channel once entered Bodo Draw) is erased, the gradient is significantly lowered, and riprap that lined the drainage channel has dropped into the eroded areas. This riprap now seems to be armoring the headcuts and slowing further erosion in the drainage channel. This result was anticipated in the site design and seems to be working.

Inspectors photographed the headcut area from permanent photograph stations (DUR PL-8 and DUR PL-9) and measured the configuration of the mouth of the drainage channel, where headcutting is most active, to record the progress of erosion. The dimensions of the headcut area are sketched on the attached drawing for comparison with past observations (Figure DUR-1).

The drawing (see the enlargement in the balloon) shows that there are two "lobes" of headward erosion: a larger western lobe and a smaller eastern lobe. During the past year, the western lobe has progressed about 6 ft and the eastern lobe has progressed about 1.5 ft. The western lobe is 4 ft wider and the eastern lobe is 2 ft wider than in 1997. GJO believes that the rate of erosion at this location may continue to vary from year to year depending on precipitation and intensity of

runoff. As stated above, the two headcuts are armored with displaced riprap and the gradient appears to have flattened. The GJO will continue to monitor and record this process.

Erosion of channel embankments, sediment accumulation, and plant growth in sediment deposits were observed in all diversion channels. All active rills and gullies on channel embankments noted in 1995, 1996, and 1997 have stabilized with one exception. Several rills on the west-facing bank of the east diversion and drainage channel are active, and fine-grained sediment is accumulating below these rills along the bottom of the channel. Much of the riprap in the bottom of the channel is covered with a thin deposit of detritus. Cattails, bulrushes and other wetland vegetation are beginning to establish in this deposit (DUR PL-10). In 1998, vegetation appeared less abundant in the north, west, and south diversion channels than in previous years. Monitoring of the embankment, sediment accumulation, and plant encroachment will continue.

Site Boundary

The site boundary is not fenced, but it is delineated by 5 boundary monuments and 83 warning signs. With the exception of the missing and vandalized signs and sign posts (see page DUR-2), no disturbance along the boundary was observed.

Remainder of Site

Areas of erosion noted during previous inspections in the drainage north of the entrance gate, the gravel-covered, east-facing embankment immediately east of the entrance gate, and the southwest-facing embankment in the drainage between the entrance gate and perimeter sign P5 are now stabilized by vegetation at most places.

Movement of riprap down the hill below the south drainage channel outlet appears to have slowed, but the east-facing bank of the south drainage channel continues to erode. Sediment has accumulated in the channel; vegetation, including spotted knapweed (see Section 2.4), grows in the channel near perimeter sign P18 (DUR PL-11 and DUR PL-12).

Erosion of the very steep slope below the mouth of the southeast drainage channel outlet has exposed sandstone and shale bedrock. No new erosion was noted here except along the break at the end of the rock-covered channel outlet. Headcutting here has displaced riprap and caused migration of riprap down the slope (DUR PL-13). These areas will continue to be monitored.

Area Adjacent to Site

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development or disturbance that could affect the site was observed.

The primary use of land around the site is wildlife habitat, and this has no impact on the site. The proximity of the site to county roads, however, coupled with the fact that this site is not fenced, makes trespass and vandalism easy. Vandalism, theft of perimeter and entrance signs, and littering are a consequence and are likely to continue.

3.0 Ground-Water Monitoring

DOE monitors ground water at this site to verify the performance of the disposal cell. The design and location of the disposal cell are believed sufficient to minimize the migration of hazardous constituents from the disposal cell into underlying rock and soil formations.

Monitoring Network and Frequency of Monitoring

The array of wells in the monitoring network consists of two upgradient wells and four downgradient, point-of-compliance wells:

MW-605	Upgradient, northwest
MW-623	Upgradient, alluvial, north
MW-607	Downgradient, south
MW-608	Downgradient, alluvial, northeast
MW-612	Downgradient, south
MW-621	Downgradient, northeast

Wells are sampled annually. Location of wells is shown in Figure DUR-1.

Analytes

The performance standard is the maximum concentration limit (MCL) established by the U.S. Environmental Protection Agency at Title 40 *Code of Federal Regulations* Part 192.04 for three hazardous constituents: molybdenum, selenium, and uranium. Samples are also analyzed for standard water quality indicators and field parameters.

Results of Ground-Water Monitoring

Analytical results for the three target analytes, molybdenum, selenium, and uranium, in ground-water samples collected in June 1997 and June 1998, are shown in Table DUR-1. MCLs, the performance criteria for this site, are included in the table. Most results are less than the laboratory detection limit for both years.

Molybdenum was above the detection limit in one upgradient (background) well, MW-605, in 1997; in the other upgradient well, MW-623, in both 1997 and 1998. MW-605 is a bedrock well; MW-623 is completed in alluvium. At both wells, molybdenum was just above the detection limit and well below the 0.1 milligram per liter (mg/L) MCL for molybdenum. Molybdenum was below the detection limit in all downgradient wells in both years.

Selenium was detected both years in samples from the downgradient alluvial well MW-608. The highest concentration, 0.01 mg/L, in the June 1998 sample equals the MCL. The concentration of selenium from all other wells, both years, was below the detection limit. Since monitoring began in September 1987, selenium in all downgradient wells has ranged between "below

Table DUR-1. Summary of Ground-Water Sample Results, June 1997 and 1998

Analyte	MCL	Ground-Water Sample Location											
		MW-605 (upgradient bedrock)		MW-623 (upgradient alluvial)		MW-607 (downgradient bedrock)		MW-608 (downgradient alluvial)		MW-612 (downgradient bedrock)		MW-621 (downgradient bedrock)	
		6/97	6/98	6/97	6/98	6/97	6/98	6/97	6/98	6/97	6/98	6/97	6/98
Molybdenum	0.1	0.0014	0.001U	0.0011	0.0017	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U
Selenium	0.01	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U	0.0047	0.010	0.001U	0.001U	0.001U	0.001U
Uranium	0.044	0.001U	0.001U	0.0027	0.0013	0.001U	0.001U	0.0029	0.0075	0.001U	0.001U	0.001U	0.001U

All results in mg/L.
U = undetected at respective laboratory reporting limit.

detection limit" and 0.023 mg/L. The highest concentration was in a 1989 sample. Selenium concentrations have decreased since then. Most samples collected during the 1987 to 1998 period contained, typically, about 0.008 mg/L selenium, an order of magnitude below the MCL for selenium.

Uranium was detected in an upgradient well, MW-623, and a downgradient well, MW-608, in both June 1997 and 1998. Although above detection limit, the results for both wells during both years were an order of magnitude below the MCL. Since October 1989, uranium concentrations are generally similar for both upgradient and downgradient wells, with the results for the downgradient wells slightly, but not significantly, higher.

There are no statistically significant trends in the analytical data to suggest an increasing trend in the concentrations of molybdenum, selenium, or uranium in the downgradient well locations. On the basis of results of ground-water monitoring during the past decade, the disposal cell is performing as designed.

4.0 Conclusions

Overall, the Durango site was in good condition. Plant encroachment occurs on the top and side slopes of the disposal cell; erosion, mostly minor, continues at several places. Several maintenance tasks were identified, all related to repairing damage by vandals. No cause for a follow-up inspection was identified.

5.0 Photograph Log

Table DUR-2. Photographs taken at Durango, Colorado, Disposal Site

Photograph Location Number	Photograph Description/Remarks
DUR PL-1	Missing entrance sign and perimeter sign P1
DUR PL-2	Missing perimeter sign and sign post for P53
DUR PL-3	Erosion of perimeter sign P40 base
DUR PL-4	Gunshot pockmarks on site marker SMK-1
DUR PL-5	Rock placed under base of boundary marker BM-3
DUR PL-6	Unidentified survey marker near perimeter sign P75
DUR PL-7	Yellow sweetclover and stressed grasses on top slope
DUR PL-8	Rock filling northeast channel headcut
DUR PL-9	Northeast channel headcut
DUR PL-10	Wetland vegetation in east diversion channel
DUR PL-11	Embankment erosion in south drainage channel
DUR PL-12	Vegetation in south drainage channel
DUR PL-13	Headcutting of southeast drainage channel outlet

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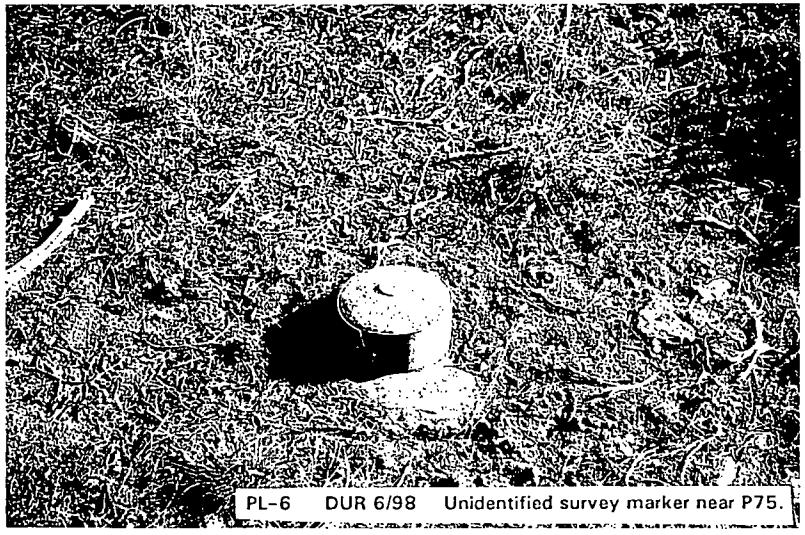
PL-1 DUR 6/98 Missing entrance sign and P1.

PL-2 DUR 6/98 Missing perimeter sign and sign post for P53.

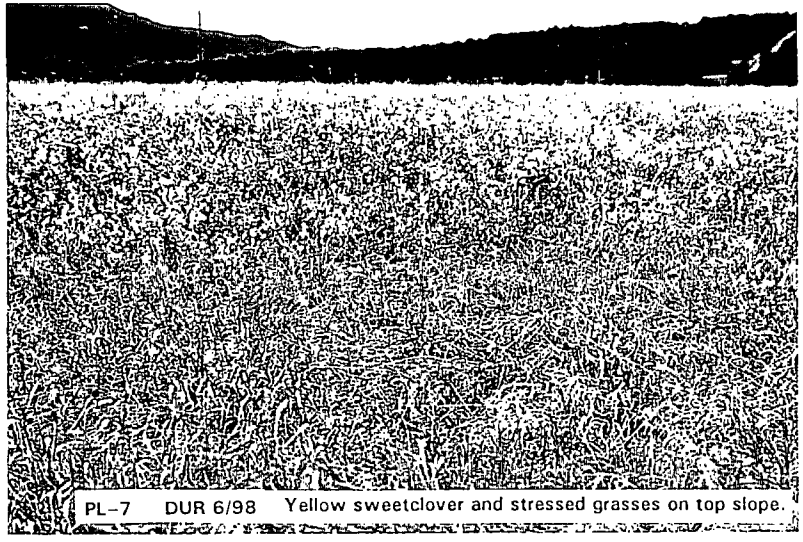
PL-3 DUR 6/98 Erosion of P40 base.

PL-4 DUR 6/98 Gunshot pockmarks on SMK-1.

PL-5 DUR 6/98 Rock placed under base of BM-3.

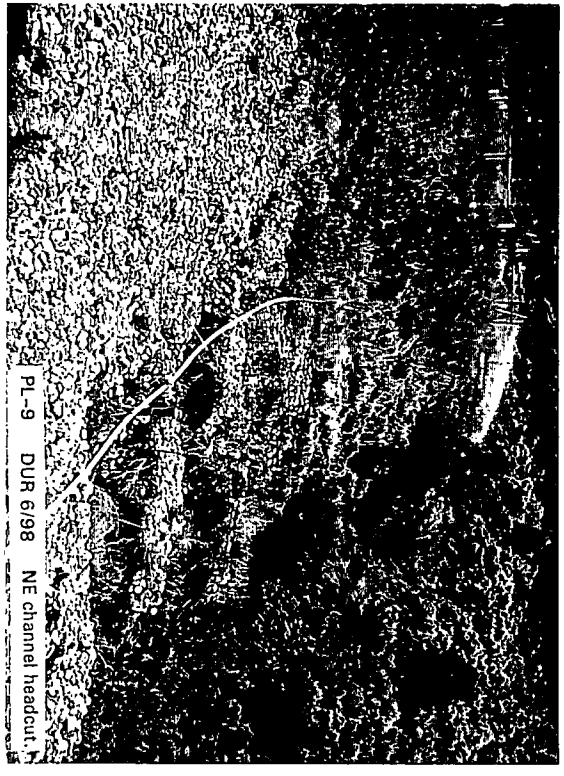


PL-6 DUR 6/98 Unidentified survey marker near P75.

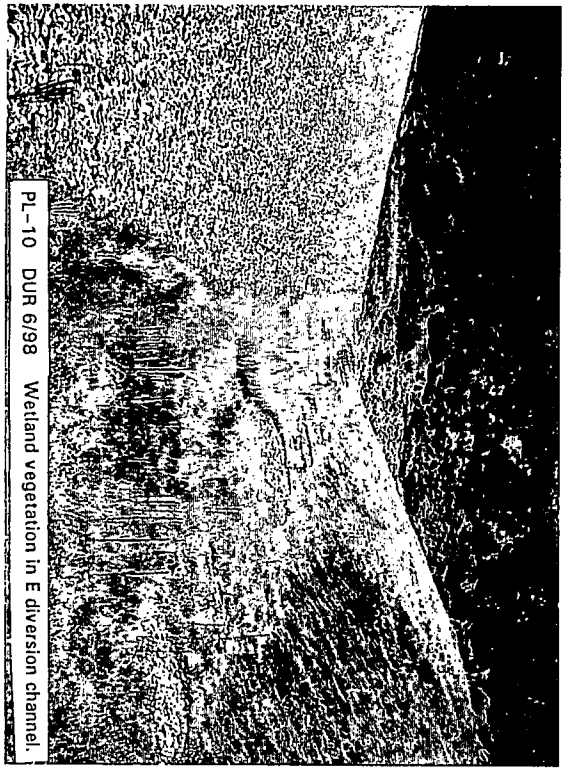


PL-7 DUR 6/98 Yellow sweetclover and stressed grasses on top slope.

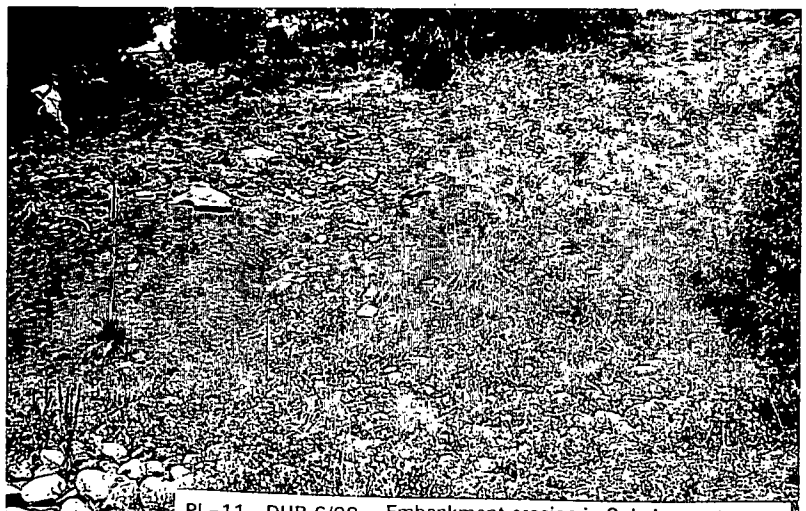
PL-8 DUR 6/98 Rock filling NE channel headcut.



PL-9 DUR 6/98 NE channel headcut.

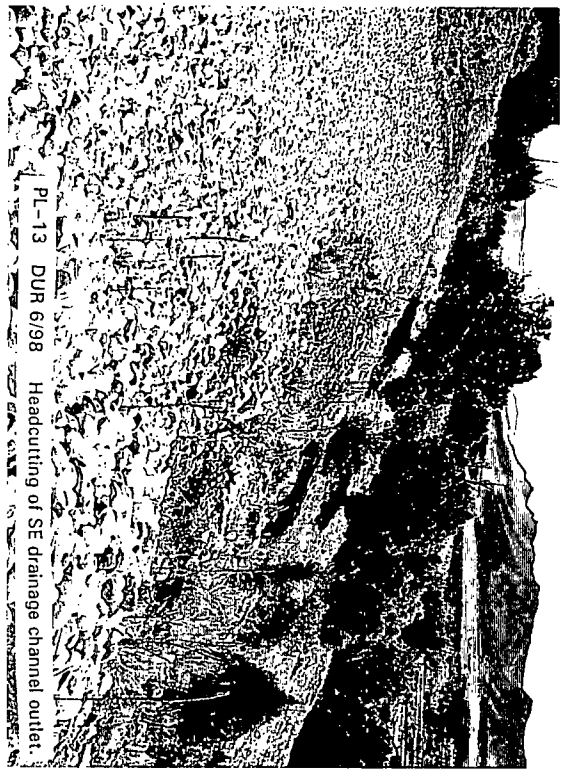


PL-10 DUR 6/98 Wetland vegetation in E diversion channel.



PL-11 DUR 6/98 Embankment erosion in S drainage channel.

PL-12 DUR 6/98 Vegetation in S drainage channel.



PL-13 DUR 6/98 Headcutting of SE drainage channel outlet.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Falls City, Texas, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
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Summary

The Falls City site was inspected on January 21, 1998. The site was in excellent condition. Perimeter signs along the main road continue to be stolen. Inspectors cut down scattered small trees and bushes beginning to grow on the northeast and southeast side slopes of the disposal cell. Grass is encroaching on the rock drains. Inspectors identified three monitoring or maintenance tasks: (1) annual replacement of perimeter signs as necessary, (2) continued monitoring of grass encroachment on the rock drains, and (3) continued control of small trees and bushes on the side slopes. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Falls City, Texas.

M.P. Plessinger, Chief Inspector, and C.A. Jones, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on January 21, 1998. R.W. Edge of DOE participated in the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Falls City Disposal Site, Falls City, Texas*, August 1995, U.S. DOE, Albuquerque, N.M., DOE/AL/62350-187, Rev. 1) for this site, and (2) procedures established by DOE to comply with Title 10 *Code of Federal Regulations* Part 40.27.

On the afternoon of January 21, GJO inspectors met at the site with B. Calder and G.A. Gonzalez, Jr., Texas Department of Health, and owners of two properties adjacent to the site to discuss reclamation-related issues. On January 22, the inspection team returned to the site to cut down scattered woody vegetation growing on the side slopes of the disposal cell.

The purposes of this inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is not required at this site. However, DOE monitors ground water as a best management practice. Results of monitoring in 1998 are in Section 3.0 Ground-Water Monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) site perimeter, (2) top and side slopes of the disposal cell, and (3) the outlying area between the site and Tordilla Creek southwest of the site. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure FCT-1.

2.1 Specific Site Surveillance Features

The entrance sign and entrance gate are in excellent condition. There are 64 perimeter signs along the site boundary. Nine of these signs, stolen from posts along Farm-to-Market (FM) Road 1344, were replaced in April by ground-water monitoring personnel. Theft of these signs is expected to continue. They will be replaced as necessary.

The two site markers, SM-1 at the entrance gate and SM-2 on top of the disposal cell, are in excellent condition.

Three survey monuments and two boundary monuments situated at the corners of the site are likewise undisturbed and in excellent condition.

One monitor well, MW-709, is inside the site boundary. It was locked and in excellent condition.

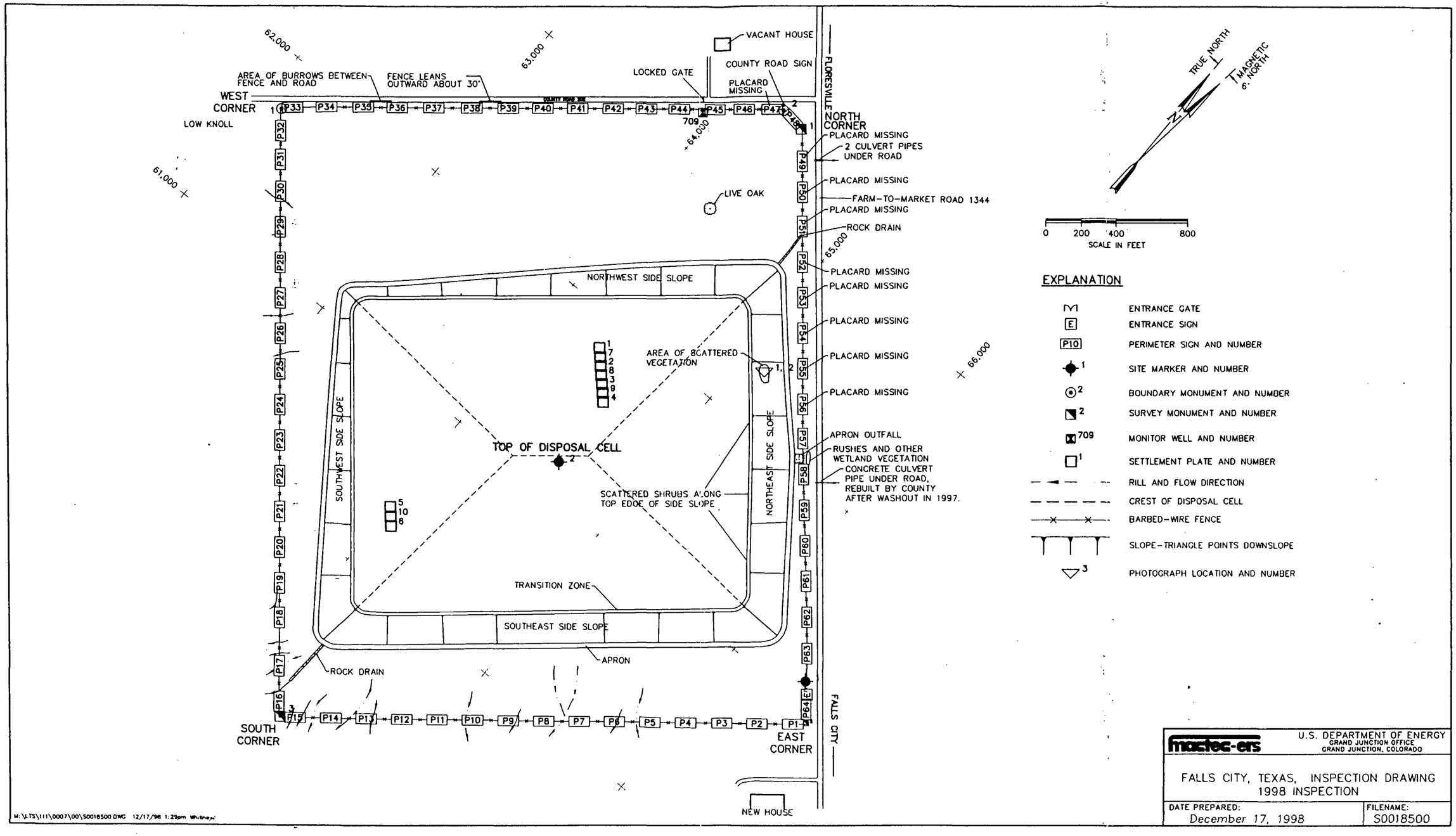
2.2 Transects

Site Perimeter

The barbed-wire fence around the site is in good condition. Along the northwest boundary, the fence leans outward above a steep bank. The fence seems stable in this position and is sufficient to keep cattle and casual intruders out. It does not need to be repaired.

The area between the fence and the toe of the disposal cell is covered with well-established grass, primarily Kleingrass with some coastal bermuda grass. Kleingrass is a bunch grass and coverage of the ground is not yet 100 percent. Coverage seems to increase each year, and there are no large areas of bare soil.

Grass is managed by cutting and baling two or three times each year, depending on the weather. Some bales were still on site. The cutting and baling is clean and thorough. A swath of grass was left uncut along the fence and also along rock drains and around some of the as-built features, such as the site markers. The site has a well-cared for appearance. The subcontract for grass cutting expired on September 30, 1998. DOE will use the opportunity to review its grass management strategy.



mactec-ers

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

FALLS CITY, TEXAS, INSPECTION DRAWING
1998 INSPECTION

DATE PREPARED:	FILENAME:
December 17, 1998	S0018500

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Grass is beginning to grow in the north and south rock drains. The apron outfall, midway along the northeast side slope, is not yet affected. If control of the grass becomes necessary, a controlled burn or herbicide may be used.

Minor gully erosion in areas south of the disposal cell was noted immediately after the site was completed. Gullies are still present, entrenched in the gumbo soil; but they are, for the most part, shallow and stabilized by grass. Gully erosion is no longer considered a problem.

Top and Side Slopes of the Disposal Cell

The top and side slopes of the disposal cell are in excellent condition. The top of the cell is covered with well-established coastal bermuda grass. Small amounts of Kleingrass and other species are interspersed. The grass is in excellent condition. Thin and bare spots in the vegetation, noted previously, along the edge of the top of the disposal cell are filling in with grass and are no longer a concern.

The side slopes are riprapped and in excellent condition except that a few small scattered trees and bushes (greasewood, "upland willow," Palo verde, and possibly others) are appearing on the northeast and southeast side slopes. Greasewood, and similar species, are a concern because they are deep-rooted.

Inspectors cut the trees and bushes down (FCT PL-1 and FCT PL-2) and treated the surrounding soil with a pellet-form herbicide. GJO visited the site again on February 13 and inspected the cut stumps to see if the herbicide was effective. It was not. New growth was flourishing on all stumps. A systemic herbicide, applied directly to plant tissues rather than to the soil, will be tried during the next site inspection.

There are no trees on top of the disposal cell or in grassed areas around the disposal cell. Grass cutting appears to be an effective control of these plants. Unfortunately, the side slopes of the disposal cell are riprapped and can not be cut.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development or disturbance that could affect the site was observed.

As in past inspections, the area south and southwest of the site, between the site and Tordilla Creek, was inspected for springs, seeps, or erosion. None was found. There is minor headcutting along Tordilla Creek, but the creek was dry at the time of the inspection.

3.0 Ground-Water Monitoring

Ground-water monitoring is required by the LTSP for this site. DOE monitors ground water as a best management practice and in response to a request from the state that DOE demonstrate, by performance monitoring, the effectiveness of the disposal cell.

Monitor Wells

There are seven wells in DOE's ground-water monitoring network:

- Four wells, MW-709, MW-858, MW-906, and MW-921, are screened in the Conquista sandstone. The Conquista sandstone is the uppermost aquifer upgradient and beneath most of the disposal cell.

- One well, MW-880, is screened in the Deweesville sandstone, the uppermost aquifer in the downgradient direction.

- Two wells, MW-908 and MW-916, are screened in the unsaturated zone of the Conquista sandstone. These wells have never produced water and are used only to detect a rise in ground-water level should such rise occur.

Location of monitor wells is shown in Figure FCT-1.

Frequency of Monitoring

The LTSP specifies that DOE will monitor ground water twice yearly for 5 years for a total of 10 sampling events. Twice yearly monitoring began in 1997 and will continue through 2001.

Analytes. During efforts to determine baseline ground water conditions at the site, DOE measured hazardous constituents in the tailings pore water. Should contaminants ever leach out of the disposal cell, the chemistry of the leachate would be similar to tailings pore water.

Hazardous constituents (analytes) in the tailings pore water that have maximum concentration limits (MCLs) specified in U.S. Environmental Protection Agency ground-water protection standards are listed below.

arsenic	nitrate
cadmium	selenium
chromium	uranium
lead	radium-226 and radium-228
molybdenum	gross alpha

Results of Monitoring in 1997 and 1998

Results of ground-water monitoring in January and October 1997 and in April 1998 are shown in Table FCT-1. Analyte concentrations in the tailings pore fluid are also shown in Table FCT-1.

Performance monitoring is based on hazardous inorganic constituents in ground water that have an MCL. MCLs provide a convenient reference for discussing contaminant concentrations; however, comparison of sample results to MCLs is otherwise arbitrary because specific ground-water compliance standards are not applicable to this site.

Ground-Water Sample Analytical Results. The following constituents were detected above the respective MCL in one or more samples collected in 1997 and 1998: cadmium, selenium, uranium, and combined radium-226 and radium-228. The gross alpha standard (15 picocuries per liter [pCi/L]) excludes the contributions from uranium and radon-222 decay. However, those sources are included in the gross alpha results for the ground-water samples shown in Table FCT-1. Subtracting the uranium activity (1 μg uranium ≈ 0.68 pCi uranium-234 + 238) from the gross alpha activity indicates that most or all of the alpha activity is attributable to uranium in the ground water.

Each well included at least one sample in which the MCL for selenium and uranium was exceeded. The MCL for radium-226 plus radium-228 was exceeded at all locations except monitor well MW-921, where concentrations ranged between 3.7 and 4.8 pCi/L. Cadmium concentrations were greater than the MCL in all samples collected from wells MW-880, MW-906, and MW-921. Cadmium was not detected in any sample from MW-709 and was below the MCL at MW-858.

In general, the maximum contaminant concentrations were present in samples from MW-880, which is screened in the Deweesville sandstone near the east corner of the cell. With the exception of cadmium, contaminant concentrations at that location are less than the median value detected previously in tailings pore fluid samples.

At each well location, the concentration of a given analyte remained relatively uniform during 1997 and 1998. However, order-of-magnitude variations are observed for chromium and nitrate at MW-880, and for selenium at MW-858. To date, there are insufficient data for a detailed analysis of concentration variation with respect to time.

The overall distribution of contaminants reflects radially outward transport of contaminants from the disposal cell in response to ground-water mounding beneath the cell. The mound was created as a result of mining and milling operations at the site. As implied in the preceding paragraph, MCLs are exceeded in the Deweesville sandstone and the underlying Upper Conquista clay. Both the Deweesville sandstone and Upper Conquista clay outcrop beneath the disposal cell.

Ground-Water Level Measurement Results. Analysis of water level measurements from monitor wells MW-709, MW-858, MW-880, and MW-921 indicates that the elevation of the water table has declined by several feet since the disposal cell was constructed. The water table at MW-906 has exhibited periods of lowering and rising elevation since that time. However, because MW-906 is located a greater distance from the cell and is adjacent to Tordilla Creek, the water table may be less influenced by conditions beneath the cell (mounding) than at the remaining wells. The declining water table trend is also not evident at MW-922, which is screened in the Deweesville sandstone at a location that is assumed to be beyond the influence of the ground-water mound (see well locations in Figure FCT-1). Ground water in the Deweesville sandstone is unconfined at MW-922 and MW-880.

Table FCT-1. Summary of Ground-Water Sampling Analytical Results

Analyte	MCL	Tailings Pore Fluid	MW-709	MW-858	MW-880	MW-906	MW-921
		Low - High Median	January 1997 October 1997 April 1998	January 1997 October 1997 April 1998	January 1997 October 1997 April 1998	January 1997 October 1997 April 1998	January 1997 October 1997 April 1998
Arsenic	0.05	<0.01 - 6.5 0.12	0.0008 0.001U [a] 0.001U	0.0023 0.001U 0.001U	0.0368 0.024 0.0366	0.0008 0.001U 0.001U	0.0057 0.0015 0.003
Cadmium	0.01	<0.01 - 0.58 0.17	0.001U 0.001U 0.001U	0.0039 0.0051 0.0078	0.337 0.362 0.456	0.0182 0.0185 0.0177	0.0111 0.0211 0.022
Chromium	0.05	<0.01 - 0.50 0.05	0.004U 0.005U 0.004U	0.004U 0.005U 0.004U	0.0351 0.005U 0.0179	0.004U 0.005U 0.004U	0.004U 0.005U 0.0043
Gross alpha	15 [b]	-17,309 - 18,996 [b] 102 [b]	344.8 372.3 154.8	151.9U 123.4 70.4U	2015 1584 1013	147.6U 136.8 80.09U	293.6 238.6 205.3
Lead	0.05	<0.005 - 0.08 <0.03	0.0042 0.001U 0.001U	0.001 0.001U 0.0027	0.0063 0.0044 0.0017	0.001U 0.001U 0.001U	0.0017 0.001U 0.001U
Molybdenum	0.10	<0.01 - 11.4 0.14	0.0343 0.0341 0.0311	0.0051 0.0043 0.0029	0.0021 0.0027 0.0012	0.0035 0.0035 0.0042	0.0487 0.0309 0.033
Nitrate as NO_3	44	<0.1 - 340 2.1	36.4 36.7 32.9	1.94 4.15 7.12	0.008U 0.285 3.86	0.185 0.571 1.03	23.8 22.7 22.4
Radium-226 + 228	5	~3 - ~950 ~115	7.5 5.9 6.5	20.9 20.15 23.89	17.9 16.65 10.83	10.3 11.11 9.04	3.7 4.79 4.56
Selenium	0.01	<0.005 - 0.60 <0.05	0.0438 0.0519 0.0424	0.0052 0.0227 0.0468	0.0172 0.0249 0.0137	0.0244 0.0267 0.0192	0.20 0.236 0.193
Uranium	0.044	0.044 - 109 7.57	0.663 0.611 0.453	0.0633 0.0225 0.0127	3.02 2.68 1.79	0.111 0.135 0.187	0.591 0.395 0.361

All results in mg/L except Ra-226 + 228 and gross alpha in pCi/L.
(a) U = undetected at respective laboratory reporting limit.
(b) Excludes contributions from uranium and radon-222 decay. Ground-water sample results include uranium and radon-222 decay.

The water level data indicate that water table lowering in the vicinity of the cell is probably not part of a regional trend but is instead a localized occurrence resulting from dissipation of the ground-water mound beneath the cell.

Ground-water level measurements for MW-916 are not available for 1997 and 1998. During that period, the depth to ground water at MW-908 was measured only in January 1997. At that time, a small amount of water was detected within the unscreened well sump, indicating a dry well.

Summary

Ground water beneath and surrounding the disposal cell is contaminated from mining and milling operations and from naturally occurring mineralization. Redistribution of uranium and related contaminants in ground water is a naturally occurring process. This is one of the reasons the upper aquifer is designated Class III, unusable.

Results of continued ground-water monitoring show that certain analytes, specifically cadmium, selenium, uranium, radium-226, radium-228, and gross alpha continue to exceed their respective MCL. But, as stated above, MCLs are not relevant standards at this site. More relevant is that the concentration of each of these five contaminants, during recent monitoring, is either below the median value established for the tailings pore fluid (selenium, uranium, and both radium isotopes) or slightly above the median value (cadmium and gross alpha). None of the results from recent monitoring was above the highest concentration determined for the tailings pore fluid.

In addition, the water table beneath the disposal cell is dropping. This condition would not occur if the cover over the tailings in the disposal cell were allowing moisture to enter the disposal cell and flow through the buried tailings. The data so far indicate that the cover is effectively preventing precipitation from entering the disposal cell. The cover is therefore judged to be performing as designed.

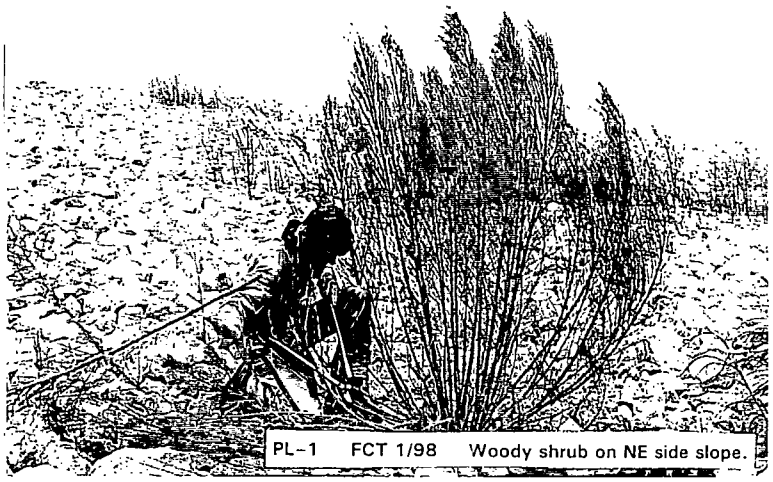
4.0 Conclusions

Overall, the Falls City site is in excellent condition. Maintenance items include replacement of perimeter signs, a new management plan for the grass, trees growing in the riprap on the side slopes, and grass encroachment in rock drains. No cause for a follow-up inspection was identified.

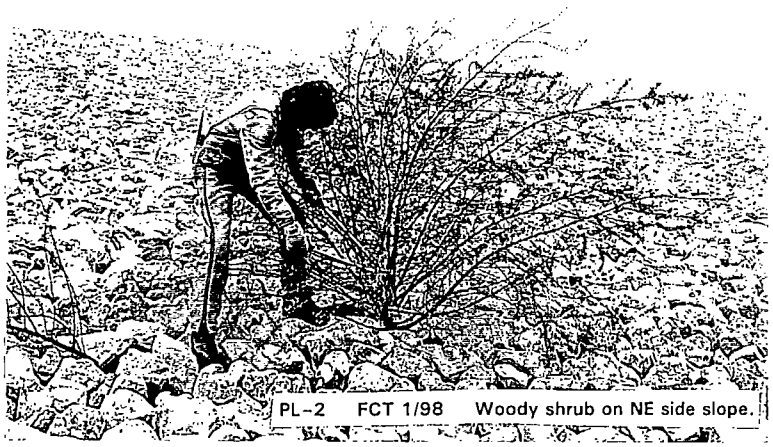
5.0 Photographs

Table FCT-2. Photographs taken at Falls City, Texas, Disposal Site

Photograph Location Number	Photograph Description/Remarks
FCT PL-1	Woody shrub on northeast side slope
FCT PL-2	Woody shrub on northeast side slope



PL-1 FCT 1/98 Woody shrub on NE side slope.



PL-2 FCT 1/98 Woody shrub on NE side slope.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Grand Junction (Cheney), Colorado, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Summary

The Grand Junction site, inspected on September 25, 1998, is generally in excellent condition. Part of the disposal cell remains open. The open cell is operated by the Long-Term Radon Management (LTRM) Project to receive additional residual radioactive materials from various sources. The annual inspection covers only the closed and completed parts of the disposal cell and surrounding disposal site. Inspectors noted that the access road, still usable, may occasionally need repairs. Perimeter signs and boundary monuments are temporary and will be replaced with permanent signs and monuments. Plants are beginning to encroach on the disposal cell, and there are minor erosion and drainage problems at several places on the disposal site. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) first annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site near Grand Junction, Colorado. (This site is sometimes referred to as the Cheney site because of a nearby physical feature, the Cheney Reservoir.)

M.J. Gardner, Chief Inspector, and C.L. Jacobson, Assistant Inspector, both of MACTEC-ERS, Technical Assistance and Remediation Contractor at the DOE Grand Junction Office (GJO), conducted the inspection on September 25, 1998. The inspection was conducted in accordance with (1) the interim or draft Long-Term Surveillance Plan (LTSP) (*Interim Long-Term Surveillance Plan for the Cheney Disposal Site Near Grand Junction, Colorado*, April 1998. U.S. DOE, Albuquerque, N.M., DOE/AL/6235C-243, Rev. 1) for this site, and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Special Status of the Grand Junction Disposal Site

A portion of the disposal cell, the "open cell," will remain open until 2023, or until filled to its design capacity, to accommodate additional residual radioactive materials (RRM) (mill tailings and associated byproduct materials). The open cell is operated by the LTRM Project, part of the DOE's Long-Term Surveillance and Monitoring Program. The LTRM Project operates the open cell to receive additional RRM under authority of House Rule (H.R.) 2967 Section 2(a)(1)(B).

Additional RRM is expected from such sources as (1) unremediated tailings buried with water, sewer, and utility lines under Grand Junction city streets, (2) sludge from water treatment plants, at Tuba City, Arizona, and Monticello, Utah; (3) private removals; and (4) additional tailings from Monticello.

The LTSP for the Grand Junction disposal site is implemented as an "interim" or draft document until the open cell is closed. The Nuclear Regulatory Commission (NRC) will not license the closed portion of the Grand Junction disposal cell until the open cell is closed and covered, and NRC has concurred with this closure in a final LTSP. The open cell, within a closed but unlicensed disposal cell, makes the Grand Junction disposal site unique among the 19 UMTRCA Title I disposal sites.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into five areas referred to as transects: (1) the closed portion of the disposal cell and riprapped side slopes of the disposal cell, (2) diversion structures and drainage channels; (3) the areas between the disposal cell and the site boundary, including temporary structures and stockpiles of cover materials; (4) site perimeter; and (5) outlying areas.

Within each transect, inspectors examined specific site surveillance features, such as survey markers, perimeter signs, monitor wells, and drainage structures. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the disposal cell.

In addition to permanent as-built features, temporary appurtenances associated with the operation of the open cell by the LTRM Project were inspected; but, only as they were encountered incidentally during the inspection of the closed and completed portions of the disposal cell and surrounding disposal site. LTRM structures and facilities include support trailers, temporary office buildings, a laundry building, and a vehicle decontamination station.

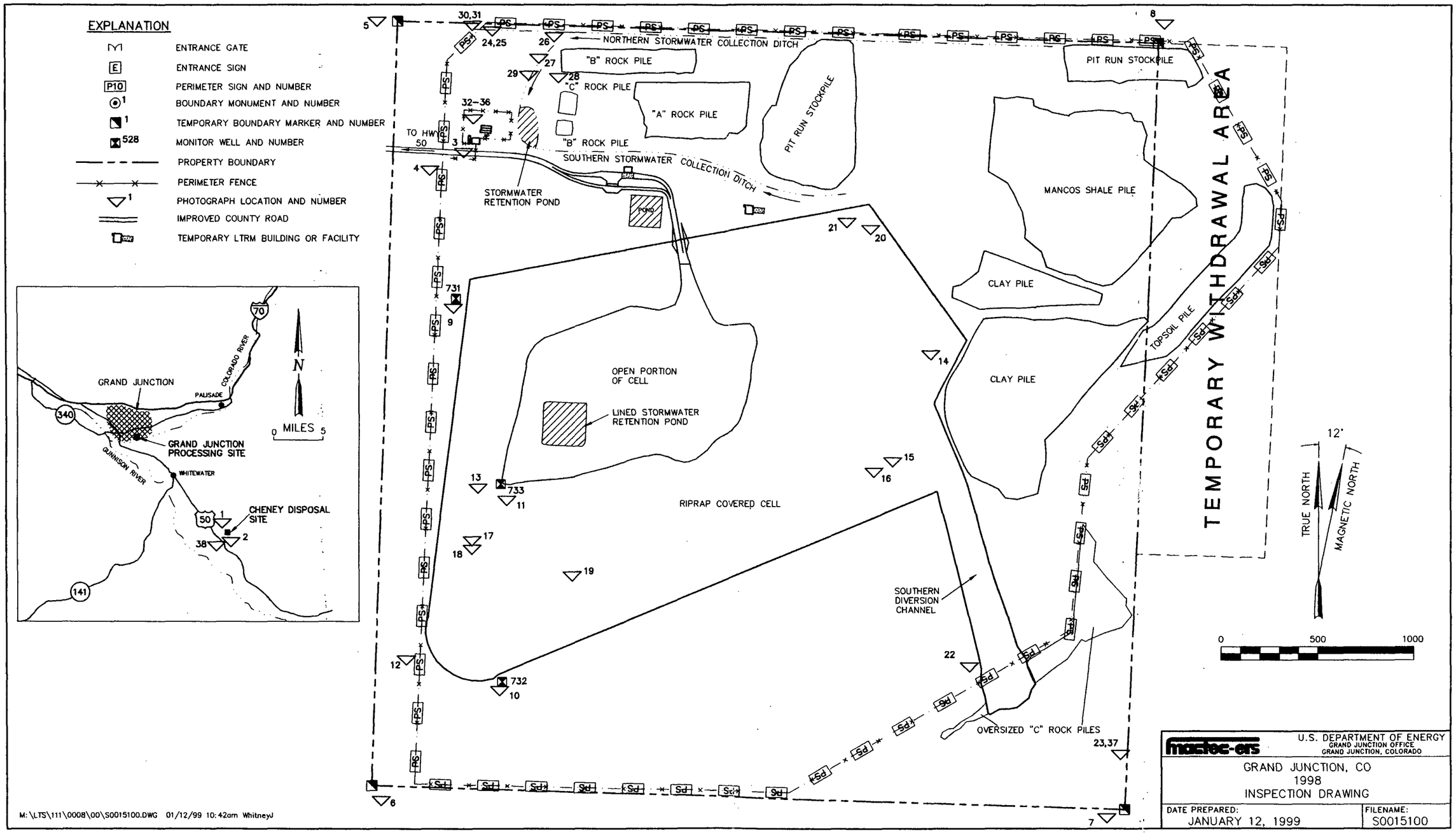
Because this was the first annual inspection of this site, 38 photographs were taken to record first-year or baseline conditions. Features mentioned in this report are shown on Figure GRJ-1.

2.1 Specific Site Surveillance Features

Site Access Gate, Access Road, and Entrance Gate

The site access gate is a steel, double-swing stock gate that is secured by a chain and DOE padlock (GRJ PL-1 and GRJ PL-2). The gate, in excellent condition, provides access to the site from U.S. Highway 50. A paved all-weather access road extends approximately 1.7 miles (mi) east along DOE's right-of-way to the site entrance gate (GRJ PL-3). This gate, a steel, double-swing chain link gate, is also in excellent condition and is secured by a DOE padlock keyed the same as the entrance gate.

The access road from the highway to the site is along a Right-of-Way Grant on federal land administered by the U.S. Bureau of Land Management (BLM). This road is the former two-lane haul road that was used to haul tailings and vicinity property materials from the railroad off-load


EXPLANATION
ENTRANCE GATE
ENTRANCE SIGN
PERIMETER SIGN AND NUMBER
BOUNDARY MONUMENT AND NUMBER
TEMPORARY BOUNDARY MARKER AND NUMBER
MONITOR WELL AND NUMBER
PROPERTY BOUNDARY
PERIMETER FENCE
PHOTOGRAPH LOCATION AND NUMBER
IMPROVED COUNTY ROAD
TEMPORARY LTRM BUILDING OR FACILITY
NORTHERN STORMWATER COLLECTION DITCH
"B" ROCK PILE
"C" ROCK PILE
"A" ROCK PILE
"B" ROCK PILE
PIT RUN STOCKPILE
PIT RUN STOCKPILE
TO HWY 50
SOUTHERN STORMWATER COLLECTION DITCH
STORMWATER RETENTION POND
POND
MANCOS SHALE PILE
CLAY PILE
CLAY PILE
TOPSOIL PILE
OPEN PORTION OF CELL
LINED STORMWATER RETENTION POND
RIPRAP COVERED CELL
SOUTHERN DIVERSION CHANNEL
OVERSIZED "C" ROCK PILES
TEMPORARY WITHDRAWAL AREA
TRUE NORTH
MAGNETIC NORTH
12°
0 500 1000
GRAND JUNCTION
PALISADE
COLORADO RIVER
GRAND JUNCTION PROCESSING SITE
GUNNISON RIVER
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JANUARY 12, 1999
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point to the disposal cell. The road is beginning to deteriorate as a result of years of heavy use. Buckles, ruts, and potholes occur at several places.

The road will no longer experience the heavy traffic it once did, but it will be used several times each year for delivery of new materials to the open cell. Road maintenance, such as the filling of potholes, may occasionally be required. The fence along the right-of-way corridor is in excellent condition.

Entrance and Perimeter Signs

Perimeter signs consist of two different signs mounted side-by-side on the barbed wire fence: a metal "Controlled Area" sign and a yellow plastic "No Trespassing" sign (GRJ PL-4). There are 75 perimeter sign locations, each about 200 feet (ft) apart along the site boundary. Sign locations are designated P1 through P75 on Figure GRJ-1. The signs are attached to the top strand of barbed wire about 4 ft above the ground.

Many of the yellow plastic "No Trespassing" signs are deteriorating; some have fallen to the ground. The existing signs will be replaced with standard aluminum perimeter signs DOE uses at other Title I sites. The signs will be mounted on steel posts, a more permanent arrangement than mounting the signs on the wire fence. A standard entrance sign with the DOE 24-hour telephone number will also be posted at the site entrance gate.

Site Marker and Boundary Monuments

Unlike other Title I sites, there is no granite site marker at this site. This is an acceptable variance because part of the site is still open and active.

The markers at the four corners of the property are not permanent boundary monuments (GRJ PL-5 through GRJ PL-8). Permanent boundary monuments will be set at all four corners of the site during the coming year.

One of the existing markers, the marker at the northeast corner, is in the middle of a dirt perimeter road or track. The permanent monument will be protected by stanchions and the perimeter road rerouted at this corner.

Monitor Wells

There are three monitor wells inside the site boundary. All are completed in the alluvium (unconfined aquifer) that overlies the Mancos Shale. Monitor wells MW-731 (GRJ PL-9) and MW-732 (GRJ PL-10) are downgradient wells located along the west apron of the disposal cell. Monitor well MW-733 (GRJ PL-11) is in the southwest corner of the open cell. All three wells are in excellent condition.

A large section of 14-inch (in.) metal casing sticks up about 6 ft out of the ground west of MW-732 in the southwest corner of the site (GRJ PL-12). The purpose of the casing is unknown. Eventually it will be treated like a well and properly decommissioned.

2.2 Transects

Closed Portion of the Disposal Cell and Riprapped Side Slopes

As explained above and in the interim LTSP, the open cell at the disposal site is to remain open until 2023 or until the cell is filled to its design capacity. The annual inspection required by the LTSP does not include the open cell or the temporary structures associated with the operation of the open cell—except as they are encountered incidentally during the inspection of the closed portion of the disposal cell and surrounding area.

The open cell occupies approximately 7 acres in the center of the disposal cell (Figure GRJ-1 and GRJ PL-13). A lined retention pond is at the bottom of the open cell to collect stormwater and prevent it from leaching downward through the cell and into the shallow (unconfined) alluvial aquifer.

The top and side slopes of the disposal cell are covered with basalt riprap. Plant encroachment (biointrusion) is occurring, mostly on the southeastern part of the top of the disposal cell (GRJ PL-14 through GRJ PL-16). Encroaching plants consist primarily of cheat grass, kochia, Russian thistle, halogeton, and four-wing saltbush. Because four-wing saltbush is a deep-rooted shrub that could potentially perforate the radon barrier, the spread of this plant will continue to be monitored (GRJ PL-16). Work underway by the DOE's Long-Term Performance (LTP) and Cover Monitoring Project will determine if control of this plant is necessary.

The riprapped side slopes of the disposal cell are in excellent condition. There is very little plant encroachment (GRJ PL-17 through GRJ PL-21) and no evidence of subsidence, rock deterioration, or slope failure on the side slopes. An abundance of small animal burrows was noted around the large riprap boulders at the base of the disposal cell along the south, west, and northern edges. Burrowing outside the riprapped portions of the disposal cell will not expose buried tailings.

Diversion Structures and Drainage Channels

A large riprapped diversion channel is located near the eastern edge of the disposal cell (GRJ PL-22 and GRJ PL-23). This channel drains to the southeast and is designed to collect and convey stormwater from the disposal cell into a natural drainage that flows away from the site to the southwest. The diversion channel is in excellent condition.

Other drainage features at the site include northern and southern stormwater collection ditches (GRJ PL-24 through GRJ PL-27) and a stormwater retention pond (GRJ PL-28 and GRJ PL-29) along the northern edge of the disposal site (Figure GRJ-1). The northern stormwater collection ditch captures run-on from a large catchment area north and east of the disposal site. Water

captured in this ditch flows into a large natural drainage north and west of the disposal cell. The ditch is filling with weeds and sediment; it should be cleaned out.

Gully and rill erosion is occurring west of the perimeter fence where the northern stormwater collection ditch ends and water spills downslope into the natural drainage north and west of the disposal site (GRJ PL-30 and GRJ PL-31). The outflow below the mouth of this ditch may eventually need to be riprapped to prevent erosion occurring west of the site from migrating headward and onto the site.

The southern stormwater collection ditch collects onsite stormwater from the cover material stockpile areas (see below) and other places across the northern part of the site. This ditch flows west into the northern stormwater retention pond. A second ditch, rather short, flows south into the northern stormwater retention pond. Both ditches need maintenance. Both are choked with sediment and may need to be cleaned to restore their capacity.

After heavy storms, water levels in the northern stormwater retention pond have risen to within a few inches of the top of the bank around the pond. The capacity of the pond should be increased to prevent stormwater from overflowing and flooding or eroding areas downstream from the pond. The capacity of the pond will be increased by deepening the pond and using the dirt to raise the height of the bank around the pond.

Areas Between the Disposal Cell and the Site Boundary

A number of temporary buildings and structures are on site between the disposal cell and the site boundary. Among these are a laundry building, a vehicle decontamination station, a lined recirculation pond, several office and storage trailers, a scrap metal storage area, and several stockpiles of cover and spoils materials (GRJ PL-32 through GRJ PL-36). In all, there are 12 separate stockpiles of rock and earthen materials on the northern and eastern sides of the disposal cell (Figure GRJ-1). These features will be used by the LTRM Project to operate and eventually close the open cell.

Rill erosion is occurring along the eastern edge of the Mancos Shale stockpile and in the perimeter road that parallels the eastern perimeter fence. Stormwater accumulates in small ponds adjacent to several of the stockpiles and along the road east of the southeastern diversion channel. The area around the stockpiles will be regraded and revegetated if erosion becomes a problem.

On the north and east sides of the disposal site, between the disposal cell and the perimeter fence, various grades of cover and fill materials ranging from clay to large basalt boulders are stored in 12 discrete stockpiles (GRJ PL-37).

On the south and west sides of the disposal site, between the disposal cell and the perimeter fence, the ground is relatively flat and covered with native vegetation that consists primarily of perennial grasses and small shrubs. Unlike the areas north and east of the disposal cell, the area

south and west is mostly undisturbed. No erosion was observed south and west of the disposal cell.

Site Perimeter

The perimeter fence that surrounds the site consists of a combination of square wire mesh at the bottom and two strands of barbed wire along the top, both supported by steel t-posts. The fence is in excellent condition.

The fence appears to be on or nearly on the property line along the north and south sides of the site (Figure GRJ-1). The fence is perhaps 200 to 300 ft inside the property line on the west, and as much as 1,000 ft inside at the southeast corner of the site. On the east side, the fence extends beyond the site boundary to enclose part of an adjoining 40-acre temporary withdrawal area that is actually federal land administered by BLM. (The withdrawal area is not included in the interim LTSP. It was, therefore, not formally inspected.) The temporary withdrawal area is used by DOE, by means of a Right-of-Way Reservation issued by BLM, to stockpile cover materials for the progressive closure of the open cell.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mi was visually inspected. No development or disturbance that could affect the site was observed.

The land surrounding the site is range land administered by BLM. The land is covered by native grass and shrubs, and is used primarily for cattle grazing.

There used to be an overpass over U.S. Highway 50 along the old haul road between the railroad off-loading area and the disposal cell. The overpass and access ramps were removed in the spring of 1998. Although the access ramp area on the east side of the highway was recontoured, rill and gully erosion is occurring on 2 to 3 acres on the southern and western parts of the former ramp area (GRJ PL-38). This area, near the highway, will be regraded and revegetated to control the erosion before it increases.

3.0 Ground-Water Monitoring

Ground-water monitoring is required by the LTSP to demonstrate the performance of the disposal cell.

There is no shallow aquifer at this site in the usual sense. The disposal cell was constructed directed on relatively impermeable Mancos Shale. This unit crops out at the surface, or is covered by a thin veneer of unconsolidated soil and alluvial materials, and extends to a depth of approximately 700 ft. The upper-most aquifer at the site, the Dakota Sandstone, lies beneath this 700-ft section of the Mancos Shale. The Dakota is not a usable aquifer because the yield is low and the quality of the water is poor.

During construction of the disposal cell, widely separated paleochannels were discovered at the top of the Mancos Shale. These paleochannels are filled with the same unconsolidated materials that thinly blanket the Mancos Shale. DOE monitors ground water at this site, as a best management practice, to ensure that water in the paleochannels is not affected by seepage or leaching from the disposal cell. Because there is no continuous shallow aquifer at the site, the paleochannels are the most likely places for leachate to appear should seepage from the disposal cell ever occur.

Monitor Wells

The monitoring network comprises three wells: two, MW-731 and MW-732, are screened in or near paleochannels adjacent to the disposal cell; the third well, MW-733, is inside the disposal cell, at the deepest part of the disposal cell, adjacent to the southwest corner of the open cell. Monitor well locations are shown in Figure GRJ-1.

Frequency of Monitoring

The LTSP requires that the three wells be sampled twice each year for 5 years, beginning in 1998. After the initial 5-year period, the three wells will be sampled once each year (beginning in 2003), and the need to continue monitoring on an annual basis will be evaluated every 5 years. Although DOE was only required to sample twice in 1998, data are available from four sampling events. The wells will be sampled twice in 1999. (Monitor well MW-733 was not sampled in April 1998, because of construction activity in the open cell at that time.)

Analytes

Samples are analyzed for standard field parameters and eight specific analytes including polychlorinated biphenyls (PCBs):

molybdenum	sulfate
nitrate	total dissolved solids (TDS)
PCB	uranium
selenium	vanadium

Results of Monitoring in 1998

Results of sampling in 1998 for the eight analytes listed above are in Table GRJ-1. The Maximum Concentration Limit (MCL) for each analyte, if established, is also listed in the table.

Molybdenum. The concentration of molybdenum at all three wells for all sampling events was very low. In each case, the concentration was at or below the laboratory detection limit.

Nitrate. Nitrate exceeded its MCL at each well on all occasions. The data show a slight decreasing trend in all three wells over the course of 1998.

Polychlorinated Biphenyls (PCBs). PCBs are included among the analytes because of the permitted disposal of a very small amount of PCB-contaminated materials in the disposal cell in 1998. Sampling for PCBs will begin in 1999.

Selenium. Selenium varied over two orders of magnitude among the three wells and exceeded the MCL for selenium in all cases. Selenium concentrations were highest in the two paleochannel wells outside the disposal cell, MW-731 and MW-732. Selenium barely exceeded the MCL at MW-733, the well inside the open cell. Results were fairly consistent from sampling event to sampling event at each well. There are no significant trends in the data from any well, although the selenium concentration decreased slightly at MW-731 and increased slightly at MW-733.

Sulfate. Sulfate values for all wells are fairly high, exceeding by more than one order of magnitude the secondary drinking water standard of 250 mg/L. At each well, concentration varied over a fairly small range, and there were no significant trends in the data for any one well. (The low result for August-September sampling at MW-732 is unexplained.)

Total Dissolved Solids (TDS). The concentration of TDS is high in all wells. TDS in two of the wells, MW-731 and MW-733, exceeds the 10,000 mg/L cutoff used to define "limited-use" water. Concentration of TDS at MW-732 was about half the result for the other two wells. A gradually increasing trend is evident in the data for MW-732 and MW-733; a slight decreasing trend can be seen in the data for MW-731.

Uranium. Uranium was below its MCL at all wells except MW-731, when it was sampled in November 1998. Previous results for MW-731 were slightly below the MCL. The data for this well show a slight increase in uranium over the year. Uranium in the other two wells was about half the concentration at MW-731. The concentration of uranium at MW-732 decreased slightly during the year, while the data for MW-733 show no trend.

Vanadium. Vanadium was at or below the laboratory detection limit at monitor wells MW-731 and MW-732. At monitor well MW-733, vanadium values were around 0.02 mg/L. There are no consistent trends in the results for vanadium.

Summary. The monitoring data for 1998 can be summarized as follows:

- Concentration of molybdenum and vanadium was very low at all wells. It was generally at or just above the laboratory detection limit.
- Concentration of sulfate and TDS was high at all wells. Although MCLs are not established for these analytes, their concentration was high against other standards or criteria: Sulfate concentration exceeded the secondary drinking water standard, and TDS exceeded the criterion for limited-use ground water.
- Concentration of nitrate at all wells consistently exceeded the MCL.
- Concentration of selenium varied noticeably among the three wells. The concentration exceeded the MCL at two of the wells and was very close to the MCL at the third well.

- Concentration of uranium exceeded the MCL at one well on one occasion and was very near the MCL on the other occasions. Uranium in the other two wells was consistently below the MCL.
- No definitive trends are evident in the monitoring data from 1998. For a given analyte, some wells showed increases, some decreases, and some no trend at all. At a given well, one contaminant may demonstrate a decrease while another contaminant may show an increase over the same monitoring period. Trends in the data, if increases or decreases in analyte concentrations are occurring, may only become apparent after additional years of sampling.

Table GRJ–1. Summary of Ground-Water Sampling Analytical Results

Analyte	Maximum Concentration Limit	Date	Monitor Well MW-731	Monitor Well MW-732	Monitor Well MW-733
Molybdenum	0.1 mg/L	Feb. 1998	0.0039	0.0032	0.0040
		Apr. 1998	0.0034	0.0025	NA
		Aug.-Sept. 98	0.0038	0.0027	0.0042
		Nov. 1998	0.0042	0.0032	0.0037
Nitrate, as NO_3	10.0 mg/L	Feb. 1998	302	180	425
		Apr. 1998	242	165	NA
		Aug.-Sept. 98	239	175	375
		Nov. 1998	164	97.7	358
PCB	None	Not available for 1998	Beginning 1999	Beginning 1999	Beginning 1999
Selenium	0.01 mg/L	Feb. 1998	2.05	0.408	0.0107
		Apr. 1998	1.87	0.388	NA
		Aug.-Sept. 98	1.77	0.414	0.015
		Nov. 1998	1.56	0.258	0.0134
Sulfate	None	Feb. 1998	7530	3860	6580
		Apr. 1998	7090	3650	NA
		Aug.-Sept. 98	7260	963	6400
		Nov. 1998	6730	3970	6280
TDS	None	Feb. 1998	13700	6910	12000
		Apr. 1998	13100	7100	NA
		Aug.-Sept. 98	13000	7090	12700
		Nov. 1998	12600	7140	12400
Uranium	0.044 mg/L	Feb. 1998	0.0402	0.0189	0.0196
		Apr. 1998	0.0406	0.0184	NA
		Aug.-Sept. 98	0.0413	0.0181	0.02
		Nov. 1998	0.052	0.014	0.0204
Vanadium	None.	Feb. 1998	0.004	0.004	0.0227
		Apr. 1998	0.0022	0.001	NA
		Aug.-Sept. 98	0.0018	0.001	0.0293
		Nov. 1998	0.001	0.001	0.0269

NA = Not available.

4.0 Conclusions

The site is in good condition. The site is unique in that a portion of the disposal cell will remain open to receive additional residual radioactive materials until perhaps 2023. Inspectors identified several maintenance tasks but found no cause for a follow-up inspection.

5.0 Photographs

Table GRJ-2. Photographs taken at Grand Junction (Cheney), Colorado, Disposal Site

Photograph Location Number	Photograph Description/Remarks
GRJ PL-1	Highway ramp area adjacent to Highway 50, with gate.
GRJ PL-2	Entrance gate to disposal site.
GRJ PL-3	Site access gate to controlled area.
GRJ PL-4	Perimeter signs on barbed-wire fence.
GRJ PL-5	NW survey marker.
GRJ PL-6	SW survey marker.
GRJ PL-7	SE survey marker.
GRJ PL-8	NE survey marker.
GRJ PL-9	Monitor well 731, view NW.
GRJ PL-10	SW monitor well 732, view N.
GRJ PL-11	Monitor well 733.
GRJ PL-12	Unknown casing, with 14 in. diameter.
GRJ PL-13	Panorama open hole, view E.
GRJ PL-14	Weed cover on top of SE portion of disposal site, view NW.
GRJ PL-15	Distribution of four-wing saltbush, view E.
GRJ PL-16	Four-wing saltbush on top of SE portion of disposal site.
GRJ PL-17	W side slope, view N.
GRJ PL-18	W side slope, view S.
GRJ PL-19	S side slope, view E.
GRJ PL-20	View down axis of armored stormwater channel, (E slope) view S.
GRJ PL-21	N side slope, view W.
GRJ PL-22	Riprap-lined diversion channel.
GRJ PL-23	Southern terminus of diversion channel, view NW.
GRJ PL-24	Northern stormwater ditch, view W.

Table GRJ-2 (continued). Photographs taken at Grand Junction (Cheney), Colorado, Disposal Site

Photograph Location Number	Photograph Description/Remarks
GRJ PL-25	Northern stormwater ditch, view E.
GRJ PL-26	Northern stormwater ditch junction, view NE.
GRJ PL-27	Northern stormwater ditch junction, view NE.
GRJ PL-28	Stormwater retention pond, view SW.
GRJ PL-29	Stormwater retention ditch and pond, view S.
GRJ PL-30	Erosion channel at NW site boundary, view E.
GRJ PL-31	View of drainage channel erosion, view W.
GRJ PL-32	Trailers and offices, view ENE.
GRJ PL-33	SW office and entrance building.
GRJ PL-34	Trailers and offices, view S.
GRJ PL-35	Storage trailers.
GRJ PL-36	Old offices and storage trailer.
GRJ PL-37	Waste rock pile storage and stockpile area, view N.
GRJ PL-38	Toe of re-contoured highway ramp adjacent to Highway 50

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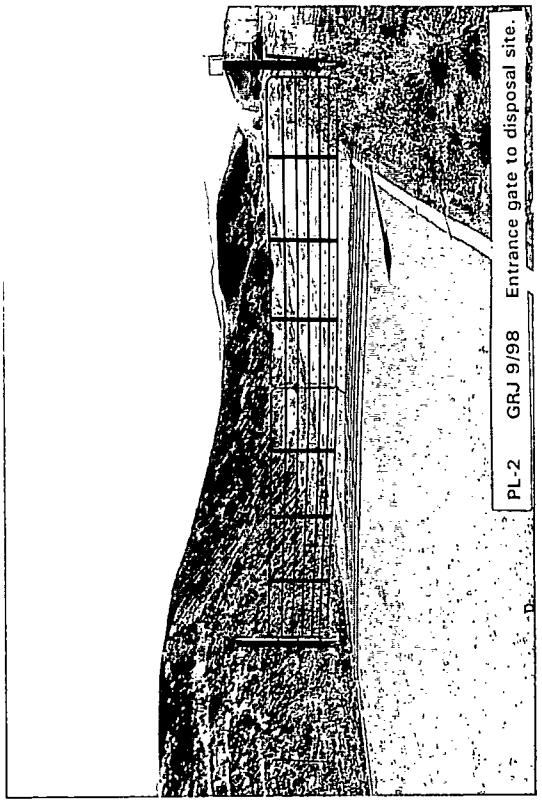
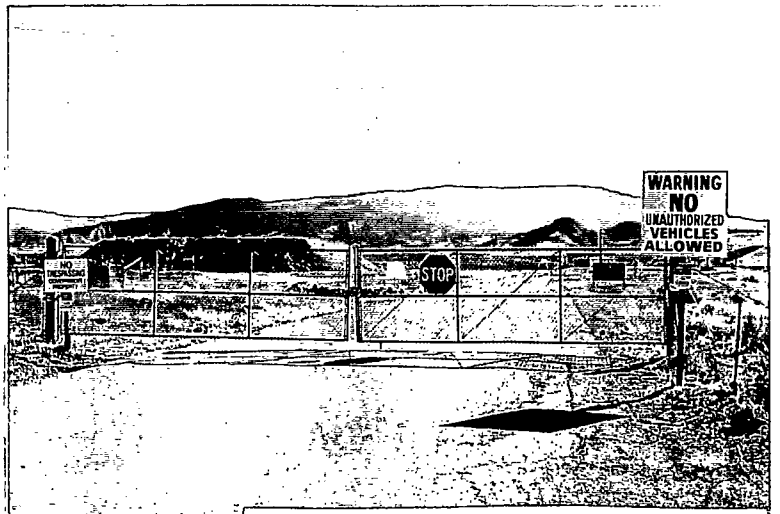
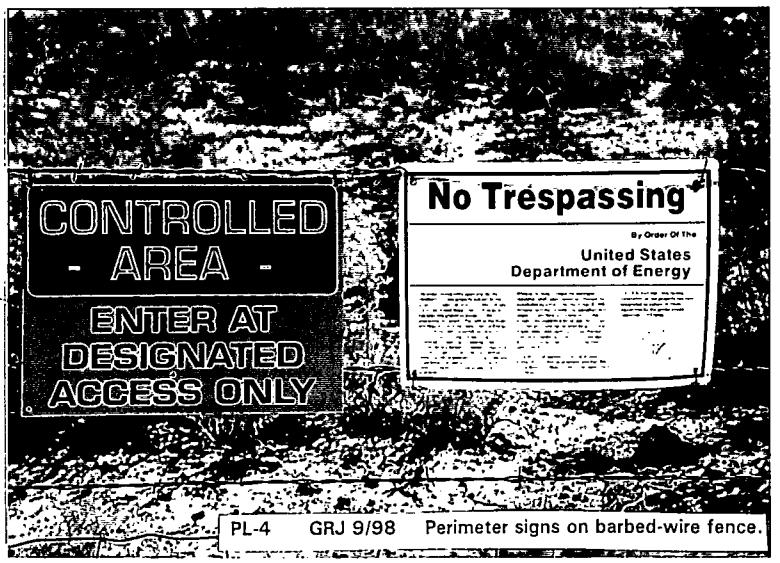


PL-2 GRJ 9/98 Entrance gate to disposal site.



PL-3 GRJ 9/98 Site access gate to controlled area.

PL-1 GRJ 9/98 Highway ramp area adjacent to Highway 50, with gate.



PL-4 GRJ 9/98 Perimeter signs on barbed-wire fence.

PL-5 GRJ 9/98 NW survey marker.

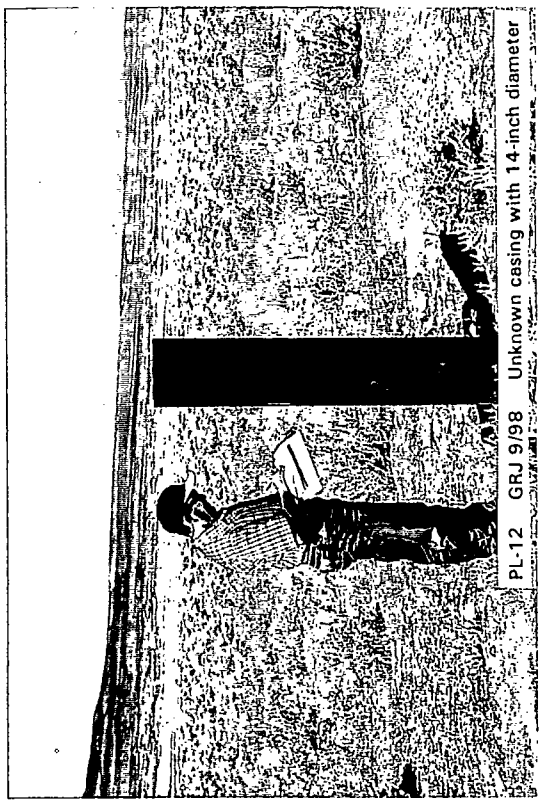
PL-7 GRJ 9/98 SE survey marker.

PL-8 GRJ 9/98 NE survey marker.

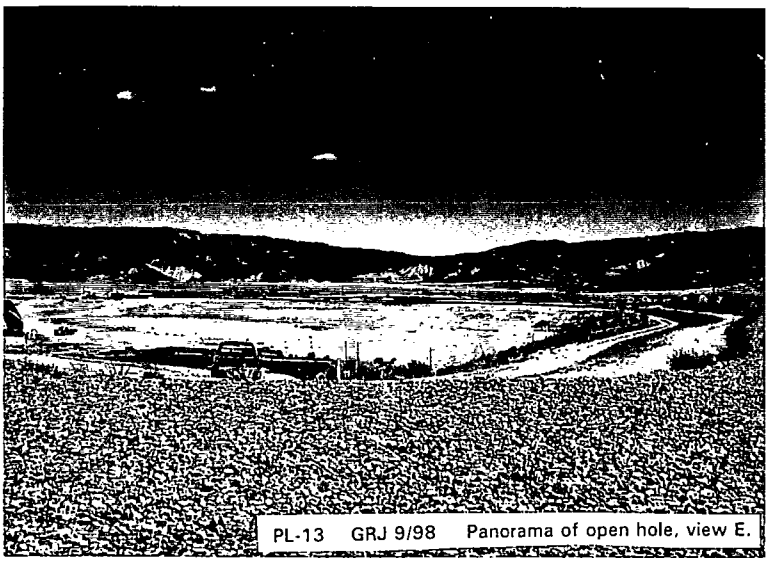
PL-6 GRJ 9/98 SW survey marker.

PL-9 GRJ 9/98 Monitor well 731, view NW.

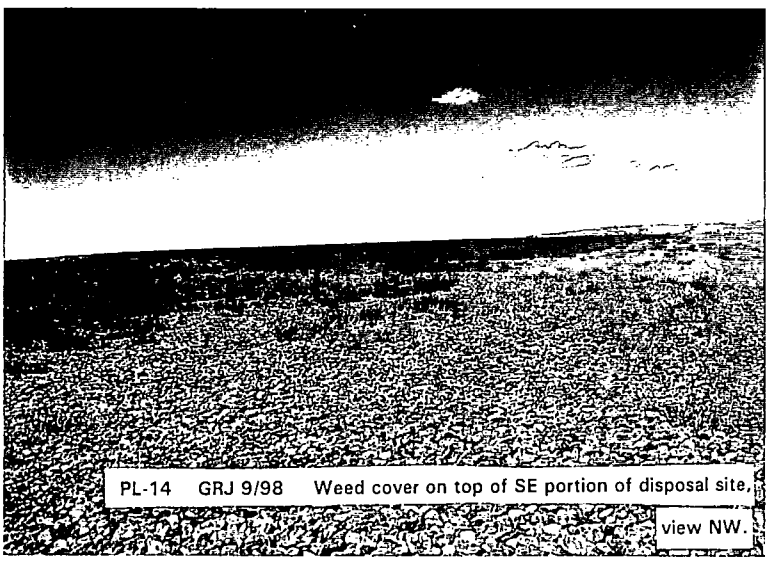
PL-10 GRJ 9/98 SW monitor well 732, view N.



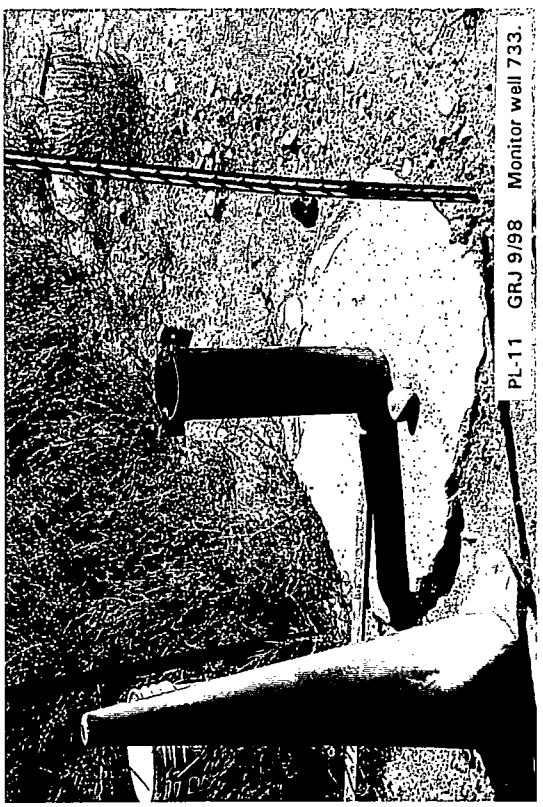
PL-12 GRJ 9/98 Unknown casing with 14-inch diameter



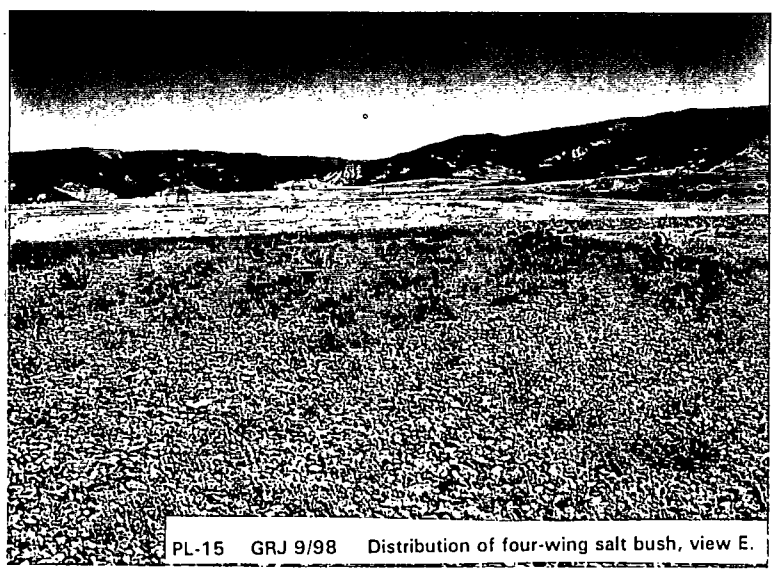
PL-13 GRJ 9/98 Panorama of open hole, view E.



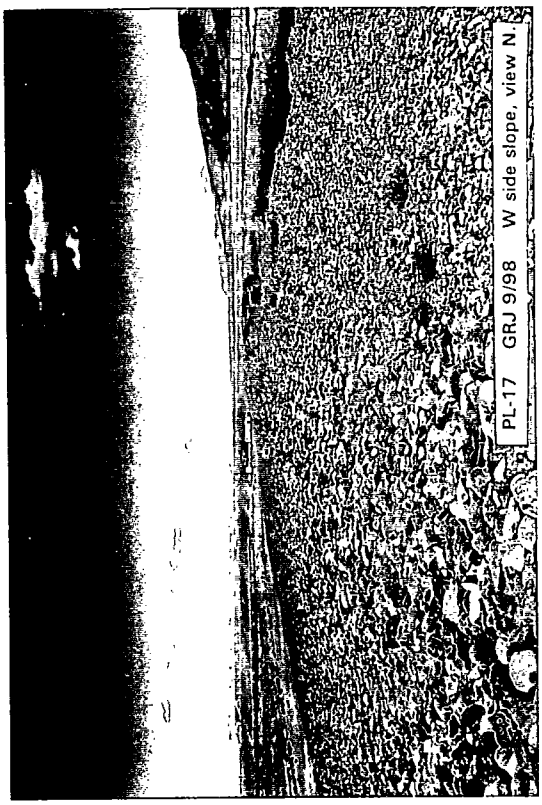
PL-14 GRJ 9/98 Weed cover on top of SE portion of disposal site, view NW.



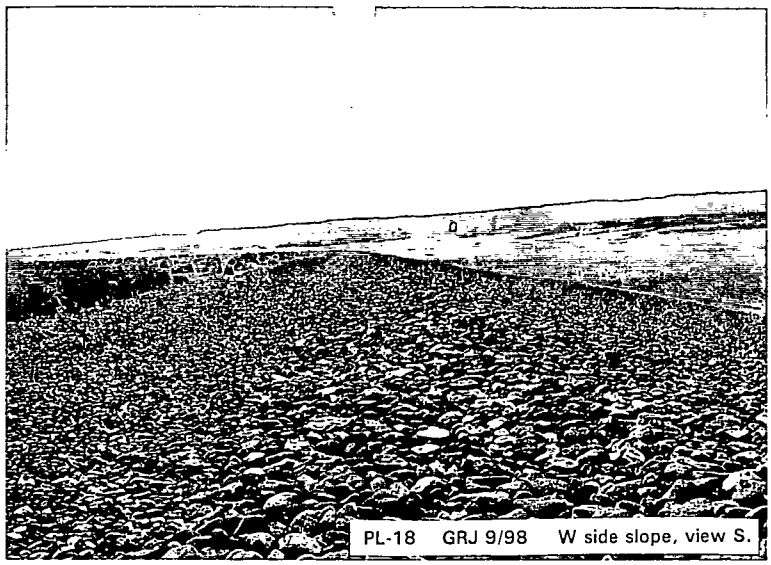
PL-11 GRJ 9/98 Monitor well 733.



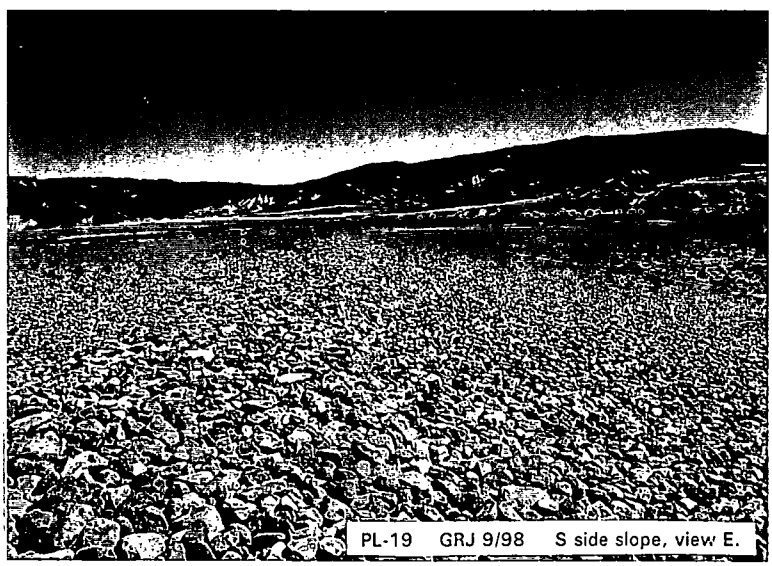
PL-15 GRJ 9/98 Distribution of four-wing salt bush, view E.



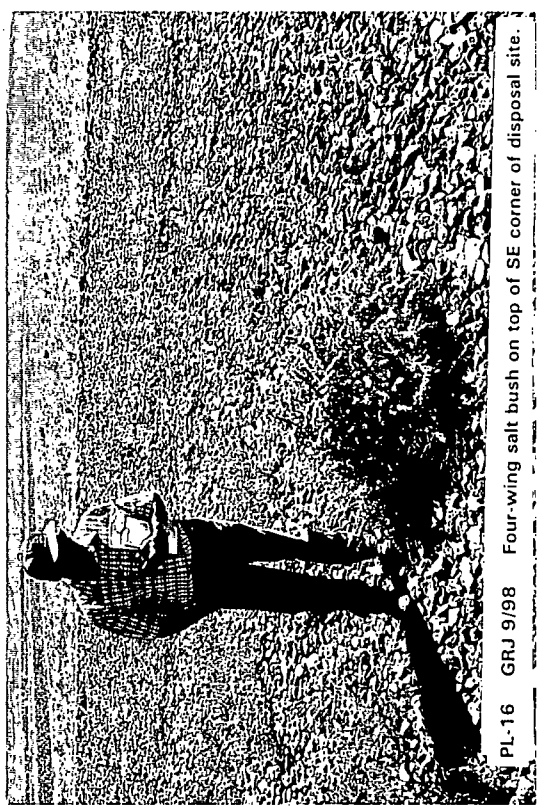
PL-17 GRJ 9/98 W side slope, view N.



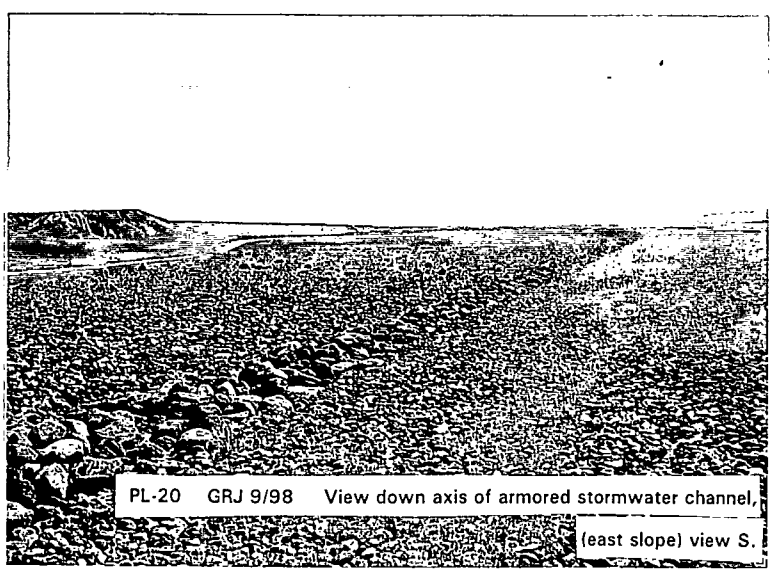
PL-18 GRJ 9/98 W side slope, view S.



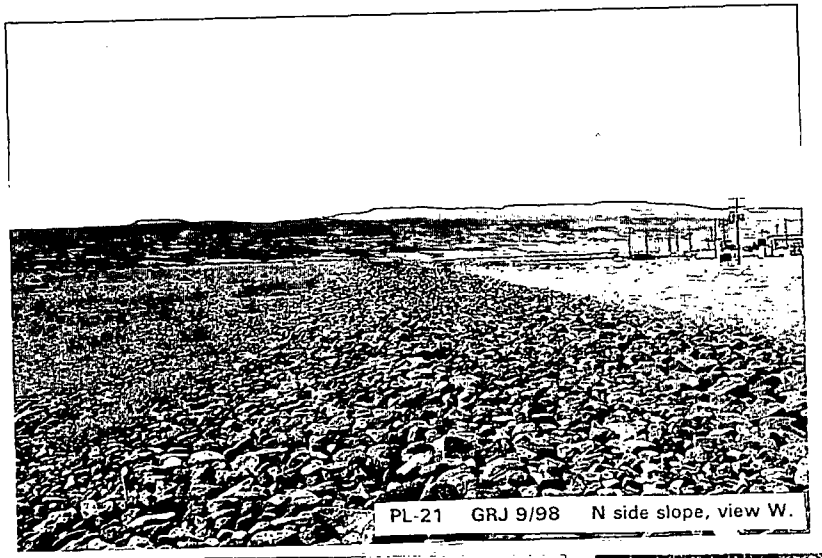
PL-19 GRJ 9/98 S side slope, view E.



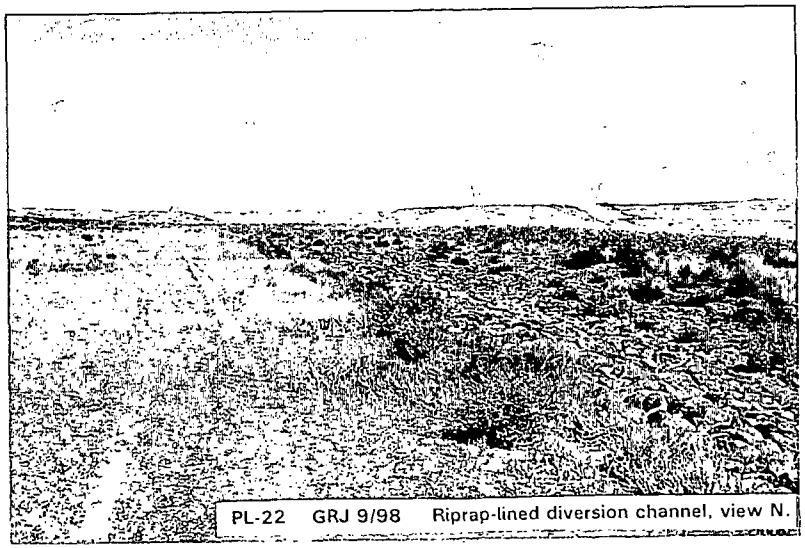
PL-16 GRJ 9/98 Four-wing salt bush on top of SE corner of disposal site.



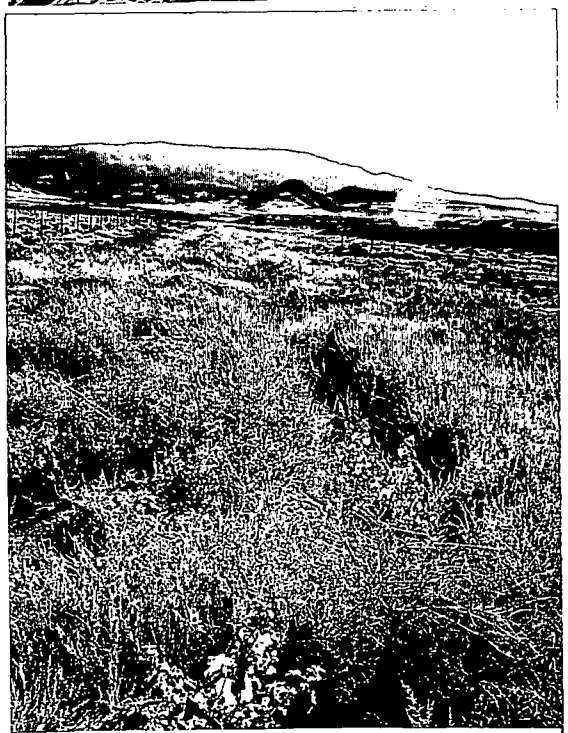
PL-20 GRJ 9/98 View down axis of armored stormwater channel, (east slope) view S.



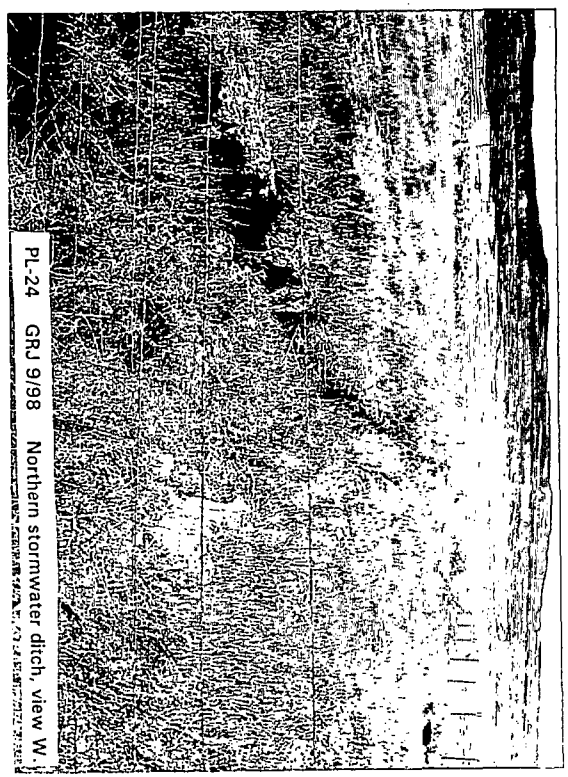
PL-21 GRJ 9/98 N side slope, view W.



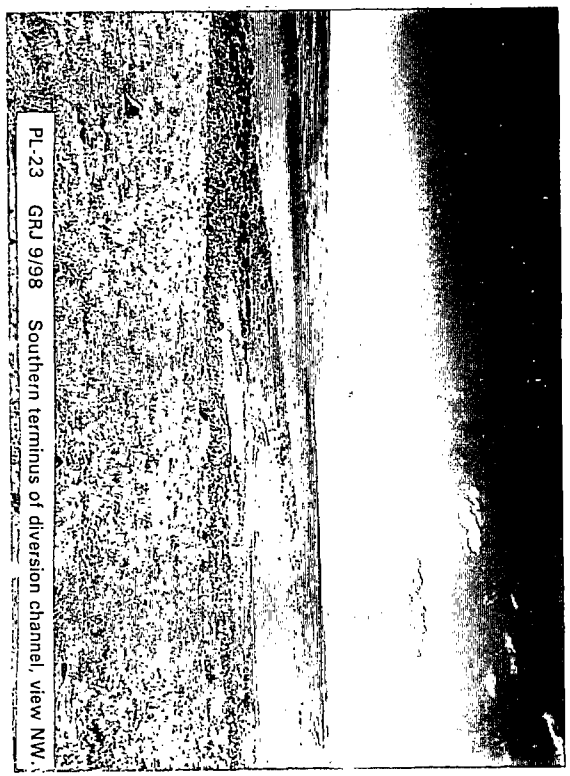
PL-22 GRJ 9/98 Riprap-lined diversion channel, view N.



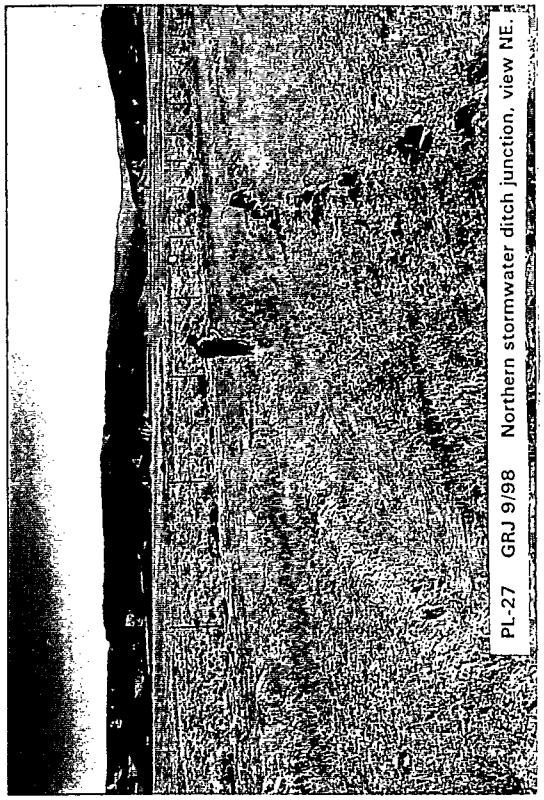
PL-25 GRJ 9/98 Northern stormwater ditch, view E.



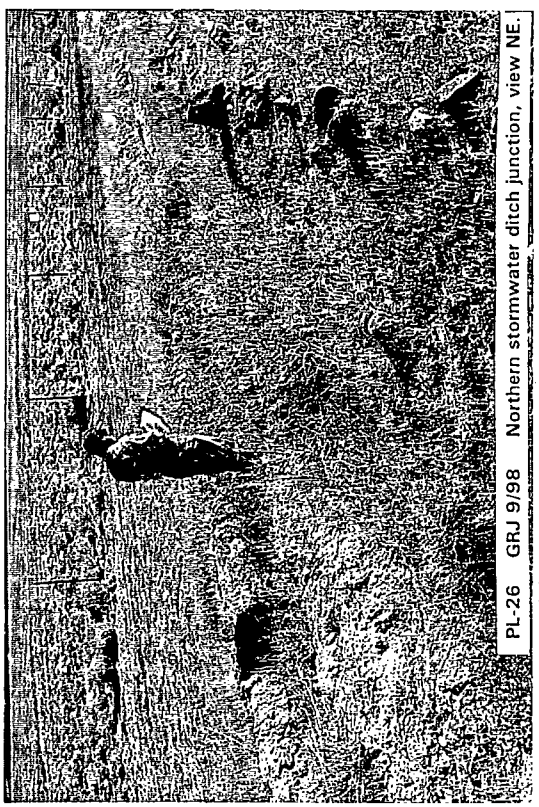
PL-24 GRJ 9/98 Northern stormwater ditch, view W.



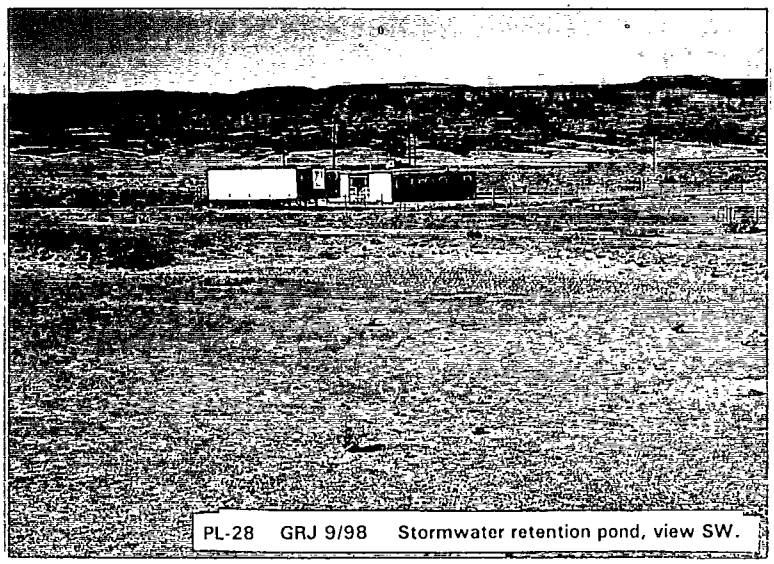
PL-23 GRJ 9/98 Southern terminus of diversion channel, view NW.



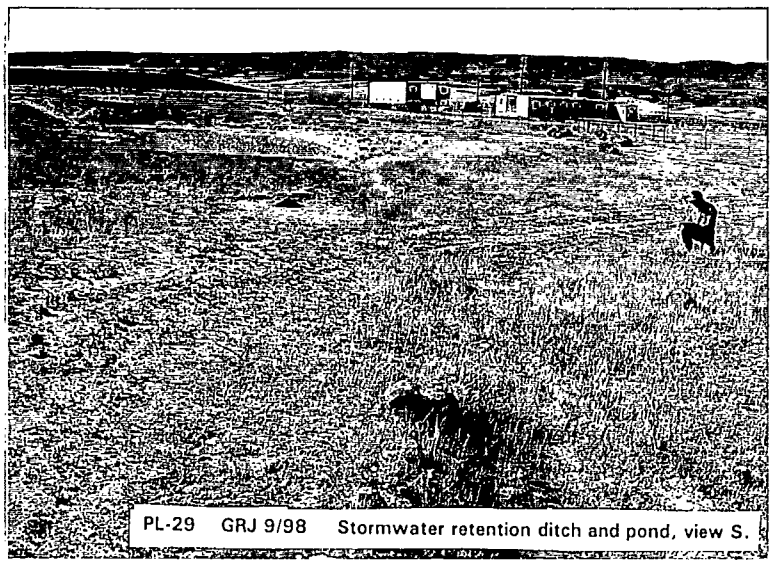
PL-27 GRJ 9/98 Northern stormwater ditch junction, view NE.



PL-26 GRJ 9/98 Northern stormwater ditch junction, view NE.

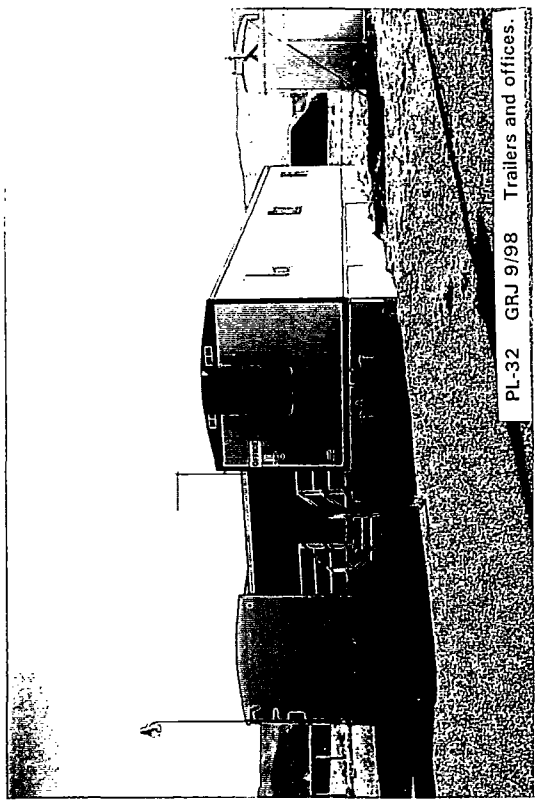


PL-28 GRJ 9/98 Stormwater retention pond, view SW.

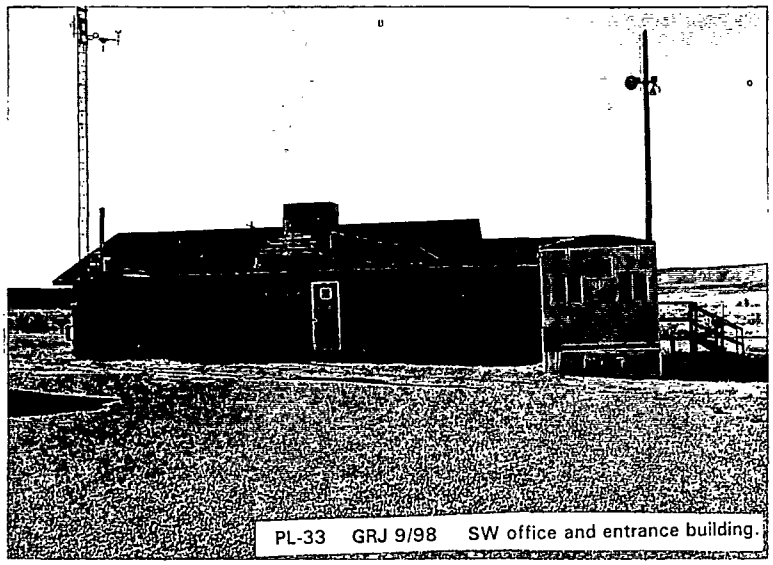


PL-29 GRJ 9/98 Stormwater retention ditch and pond, view S.

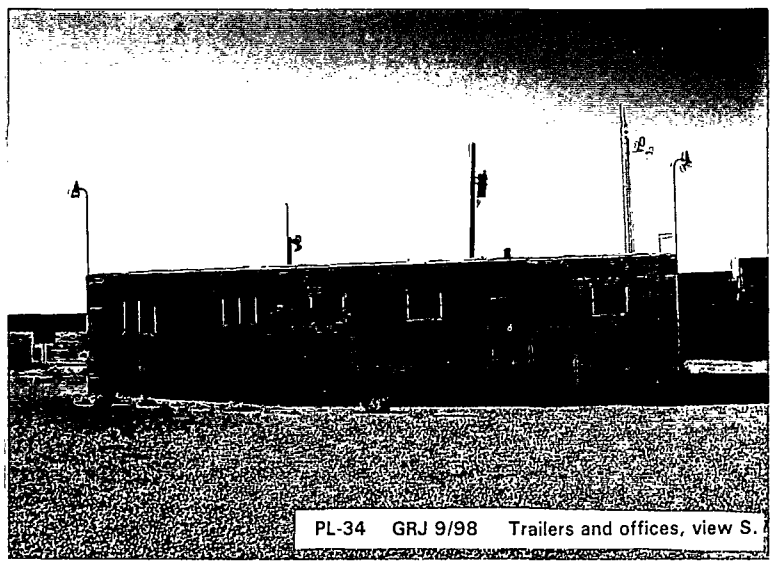
PL-30 GRJ 9/98 Erosion channel at NW site boundary, view E.



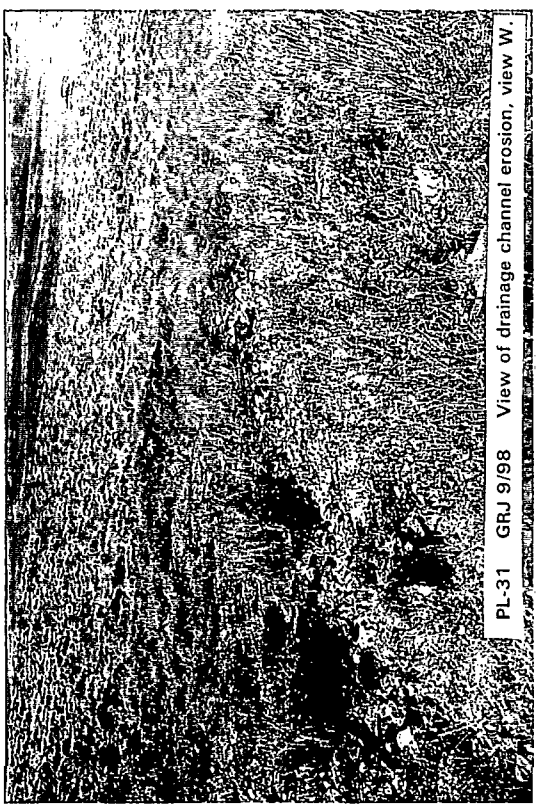
PL-32 GRJ 9/98 Trailers and offices.



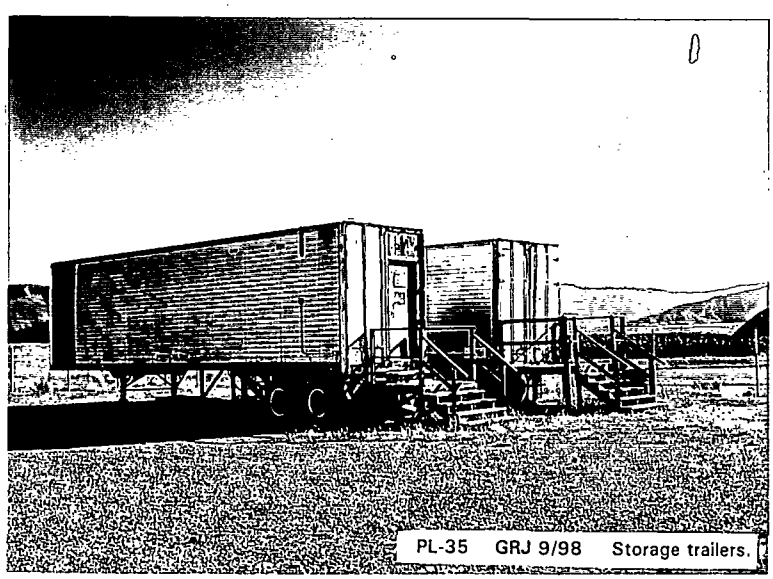
PL-33 GRJ 9/98 SW office and entrance building.



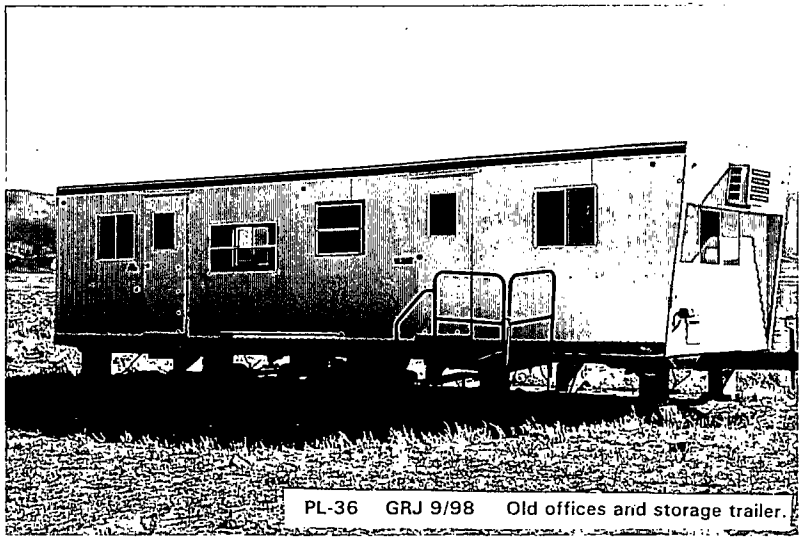
PL-34 GRJ 9/98 Trailers and offices, view S.



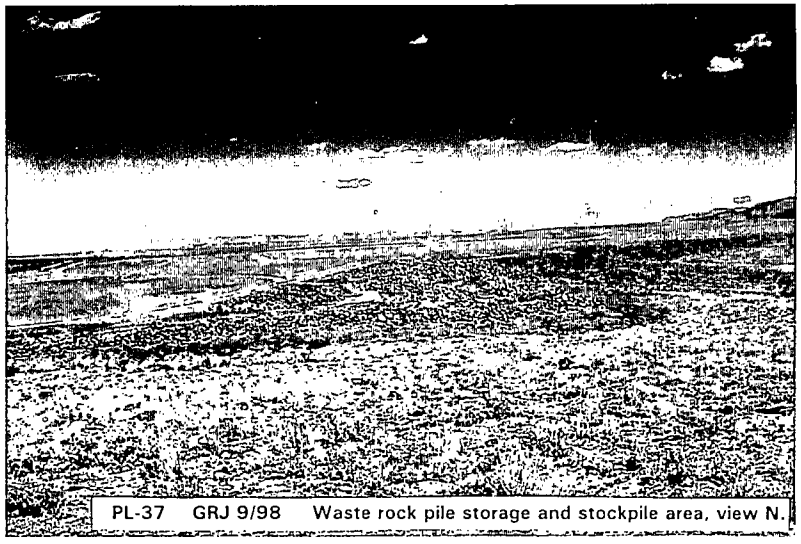
PL-31 GRJ 9/98 View of drainage channel erosion, view W.



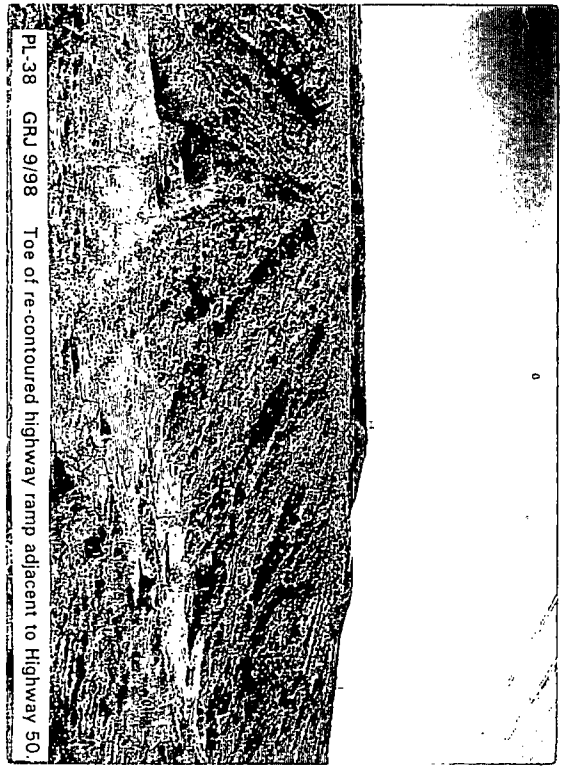
PL-35 GRJ 9/98 Storage trailers.



PL-36 GRJ 9/98 Old offices and storage trailer.



PL-37 GRJ 9/98 Waste rock pile storage and stockpile area, view N.



PL-38 GRJ 9/98 Toe of re-contoured highway ramp adjacent to Highway 50.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Green River, Utah, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC 99-06
Document Number S00184

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Summary

The Green River site, inspected on March 25, 1998, is in excellent condition. Three maintenance tasks were completed this year. Abandoned power poles were removed from the site. A gate west of the disposal site was rebuilt to improve site security. Four neutron access ports, no longer used, were decommissioned. A new task, installation of permanent boundary monuments and relocation of four perimeter signs along the new southeastern boundary of the site, will be completed in 1999. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Green River, Utah.

M.R. Widdop, Chief Inspector, and C.L. Jacobson, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on March 25, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Green River, Utah, Disposal Site*, July 1998. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-89, Rev. 2) for this site, and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance and follow-up inspections and monitoring.

Ground-water monitoring is required at this site. The results of ground-water monitoring are in Section 3.0 Ground-Water Monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) the disposal cell and surrounding area inside and including the security fence; (2) the site perimeter including the graded and reseeded area between the security fence and the site boundary, and (3) outlying areas. Each of these transects was inspected by walking a series of traverses. Part of the outlying area transect was inspected from a distance.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure GRN-1.

2.1 Specific Site Surveillance Features

The entrance gate at the county road was rebuilt in 1997 and is in excellent condition. The entrance sign (GRN PL-1) and 17 perimeter signs are mounted on steel posts along the site boundary. All are in excellent condition.

The security fence is set close to the disposal cell and is not along the site boundary. This leaves large areas of the site outside the security fence. There are two large gates in the security fence to allow water sampling vehicles access to monitor wells inside the fence. There is also a personnel gate along the northern part of the fence.

Permanent markers include two stone site markers, three survey monuments, and eight boundary monuments. Inspectors found all in excellent condition.

A decision by DOE just prior to site licensing extended the southeastern property line about 100 feet (ft) to the edge of the state's withdrawn area. The new boundary is marked at three points by lath and rebar (GRN PL-2, GRN PL-3, and GRN PL-4). Permanent boundary monuments will be installed at these three points. In addition, four perimeter signs, P14 through P17, will be moved outward to the new boundary line. This work is planned for 1999.

When the disposal cell was constructed, four neutron access ports were installed in the disposal cell to monitor moisture. The experiment was unsuccessful and the access ports were not used. All four access ports were decommissioned in March 1998. The casings around the access ports were cut off at the top of the radon barrier. The subsurface casings were filled with bentonite pellets and the steel caps were replaced. Riprap was carefully placed over the location of each of the former access ports.

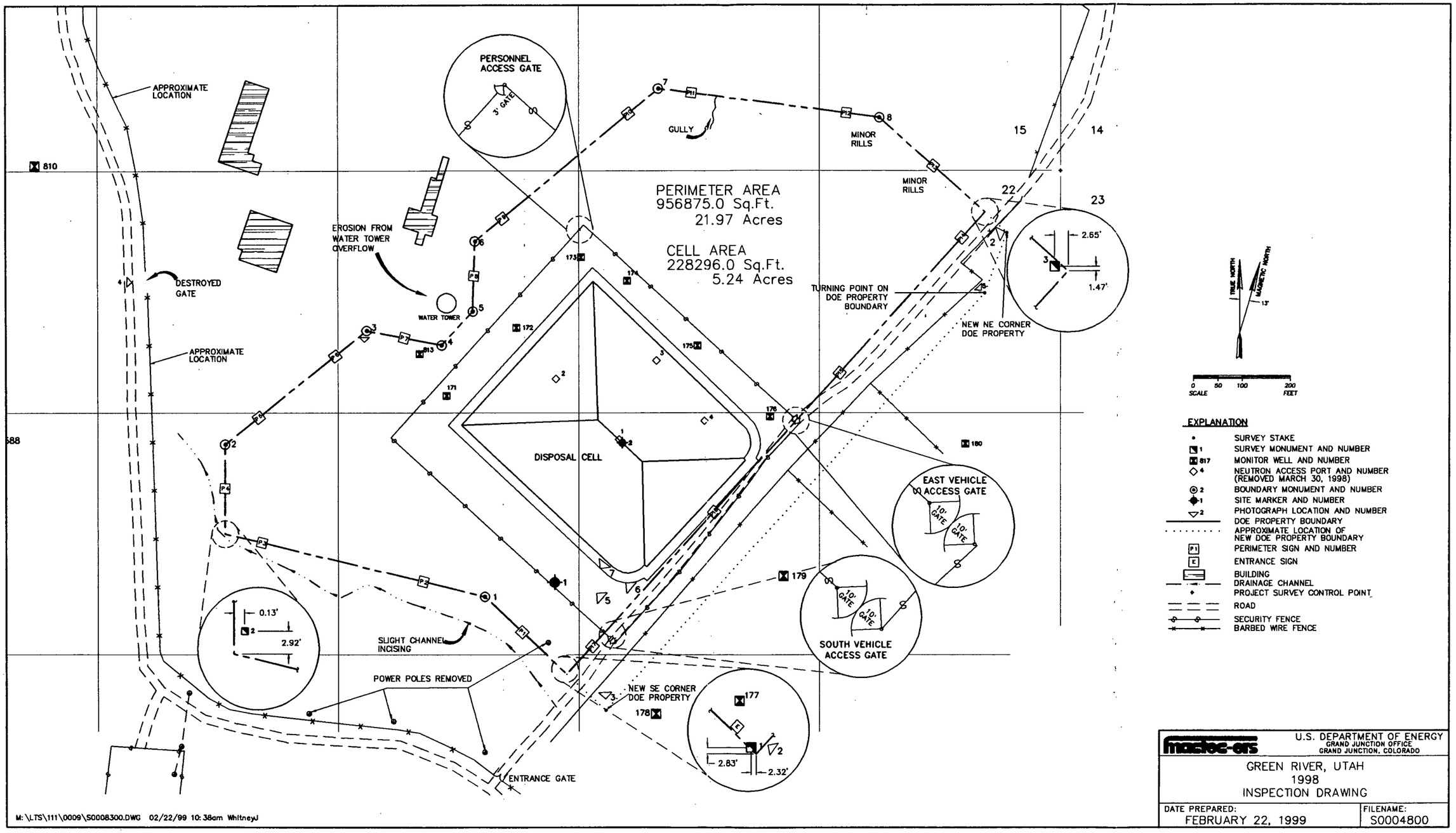
Ground-Water Monitor Wells

Four wells, MW-171, MW-172, MW-173, and MW-813, are downgradient or point-of-compliance (POC) wells. Data loggers and pressure transducers are installed in MW-171 and MW-173. See Section 3.0 Ground-Water Monitoring.

2.2 Transects

Disposal Cell and Area Inside the Security Fence

The side slopes and crest of the disposal cell are covered with riprap and are in excellent condition. Remnants of several widely separated annual weeds from the 1997 growing season were found on the side slopes. None of the weeds are deep-rooted. Natural vegetation is continuing to establish across the graded area inside the security fence (GRN PL-5).



macdoc-ers

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

GREEN RIVER, UTAH
1998
INSPECTION DRAWING

DATE PREPARED:	FILENAME:
FEBRUARY 22, 1999	S0004800

The diversion channel around the base of the disposal cell is also riprapped and in excellent condition. A minor soil subsidence, probably the result of small-scale piping, was noted at a few places adjacent to the diversion channel (GRN PL-6).

The accumulation of tumbleweeds in the diversion channel on the south and southwest sides of the disposal cell is minor and unchanged from previous years (GRN PL-7). Tumbleweed accumulation along the security fence is also minor and insignificant.

The new security fence is set well inside the site boundary. Installation of the security fence is so close to the disposal cell that it leaves large parts of the site open to trespass. The state's barbed-wire stock fence is flimsy and provides only minimal security. No evidence of trespass was seen during the 1998 inspection; but trespass has occurred in the past and unfenced parts of the site will continue to be monitored.

Site Perimeter

Vegetation continues to be sparse in the graded and reseeded areas northeast and southwest of the disposal cell. Graded areas were planted with Indian ricegrass, cheatgrass, and sand dropseed soon after construction was completed. Most of the grass did not survive even the first growing season, and minor erosion occurred. Vegetation in the graded areas today consists of small, native "desert" forbs. Vegetation is sparse, but this is the natural condition in the Green River area. Establishment of vegetation in graded areas is no longer considered a problem at this site, but it will continue to be monitored.

Rill and gully erosion is present on the hillside northeast of the disposal cell, just inside the site boundary, in the area generally between boundary monument BM-7 and survey monument SM-3. Erosion in this area does not appear to be increasing. The gully southeast of boundary monument BM-7 is the largest erosion feature on this hillside and is mostly filled with tumbleweeds. New vegetation is beginning to establish along the bottom of this gully. The presence of these plants indicates that erosion in this gully may be stabilizing. Erosion in this area will continue to be monitored.

Leaning power poles, including one just inside the southwest corner of the site were removed by the utility company sometime in 1997. In March 1998, DOE personnel removed aluminum conductors and a copper grounding rod associated with the power poles. Additional derelict poles remain, but they are several hundred feet away from the site and are no longer an issue.

Outlying Areas

The area extending outward from the site for a distance of 0.25 mile was observed for signs of erosion, development, or other disturbance that might affect site security or integrity. Minor rill erosion, noted during previous inspections, occurs at three places: (1) along the small natural gully southwest of the site, (2) near survey marker SM-2, and (3) northwest of the water tower. Erosion in these areas appears unchanged from previous years and will continue to be monitored.

The site access road bends westward around the southwest corner of the site and continues to the north. The state's barbed-wire fence also bends around this corner and continues to the north parallel to the road. About 750 ft north of this corner, a flimsy wire gate in the state's fence was down and damaged. This gate provides access to abandoned buildings on state land and to unfenced parts of the DOE's disposal site (GRN PL-8). In June 1998, DOE replaced the gate with a metal Powder River style gate.

3.0 Ground-Water Monitoring

DOE monitors ground water in the uppermost aquifer downgradient from the disposal cell to demonstrate the performance of the disposal cell (LTSP, pages 5-6 and 5-7).

Monitor Wells

Four wells constitute the monitoring network: MW-171, MW-172, MW-173, and MW-813. All are point-of-compliance (POC) wells on the northwest or downgradient side of the disposal cell. Location of these wells is shown on Figure GRN-1.

Frequency of Monitoring

The LTSP requires that ground water be sampled quarterly at the four POC wells for a period of three years beginning in 1999 and ending in 2001. After 3 years, the need to continue monitoring will be evaluated by DOE, NRC, and the State of Utah. DOE expects contaminant levels to decrease to levels that existed prior to the construction of the disposal cell. If, at the end of the 3-year period, contaminant levels are at or trending to pre-construction levels, monitoring will cease or the frequency of monitoring may be reduced. If contaminant level are not decreasing, options including additional remedial action will be considered.

Analytes

The purpose of ground-water monitoring is to demonstrate that the disposal cell is an effective containment system. Evaluation of the performance of the disposal cell, however, is complicated because ground water around and beneath the disposal cell is contaminated from the former milling operations. The chemistry of the preexisting contaminated ground water and the water that might seep from the disposal cell is similar. If the disposal cell is performing as designed, the concentration of three hazardous constituents (nitrate, sulfate, and uranium) should decrease over time. Accordingly, ground-water samples are analyzed for these three constituents, as well as standard water quality indicators and field parameters. The "proposed concentration limit," or standard, for each of the three hazardous constituents in each well is in Table GRN-1:

Table GRN-1. Proposed Concentration Limits for Four Point-of-Compliance Wells, Green River, Utah

Monitor Well	Nitrate (mg/L)	Uranium (mg/L)	Sulfate (mg/L)
MW-171	10.0 (= MCL)*	0.044 (= MCL)	3334
MW-172	102	0.067	4985
MW-173	10.0 (= MCL)	0.044 (= MCL)	4000
MW-813	10.0 (= MCL)	0.069	4440

*MCL = Maximum concentration limit at Title 40 *Code of Federal Regulations*, Part 192

Results of Ground-Water Monitoring in 1998

Although ground-water monitoring pursuant to the LTSP does not begin until 1999, results of monitoring in 1998 by the Uranium Mill Tailings Remedial Action (UMTRA) Ground Water (UGW) Project are reported here.

The four POC wells were sampled in March, July, and September 1998. Analytical results for nitrate, uranium, and sulfate are in Table GRN-2.

Table GRN-2. Summary of Ground-Water Sample Results

Analyte		Ground-Water Sample Location							
		MW-171		MW-172		MW-173		MW-813	
		Proposed Standard	Result	Proposed Standard	Results	Proposed Standard	Results	Proposed Standard	Results
Nitrate	3/98	10 mg/L	180	102 mg/L	1410	10 mg/L	166	10 mg/L	0.0140 U [a]
	7/98		186		1650		324		0.119
	9/98		181		1560		410		0.0637
Sulfate	3/98	3334 mg/L	4480	4985 mg/L	8510	4000 mg/L	4910	4440 mg/L	4270
	7/98		4060		7850		4560		3890
	9/98		4010		7350		4620		3400
Uranium	3/98	0.044 mg/L	0.0196	0.067 mg/L	0.0020	0.044 mg/L	0.0087	0.069 mg/L	0.0078
	7/98		0.0221		0.0045		0.0037		0.0089
	9/98		0.0206		0.0056		0.0032		0.0117

All results in mg/L.
(a) U = undetected at respective laboratory reporting limit.

Nitrate. Each sample in 1998 from MW-171, MW-172, and MW-173 exceeded the proposed concentration limit (standard) for nitrate (Figure GRN-2). The standard was not exceeded in any sample from MW-813.

At MW-171, MW-172, and MW-173, nitrate concentrations have risen in recent years. The standard was not significantly exceeded at MW-171 and MW-172 until about January 1995. All samples from these wells have exceeded the standard every year since then. Samples from

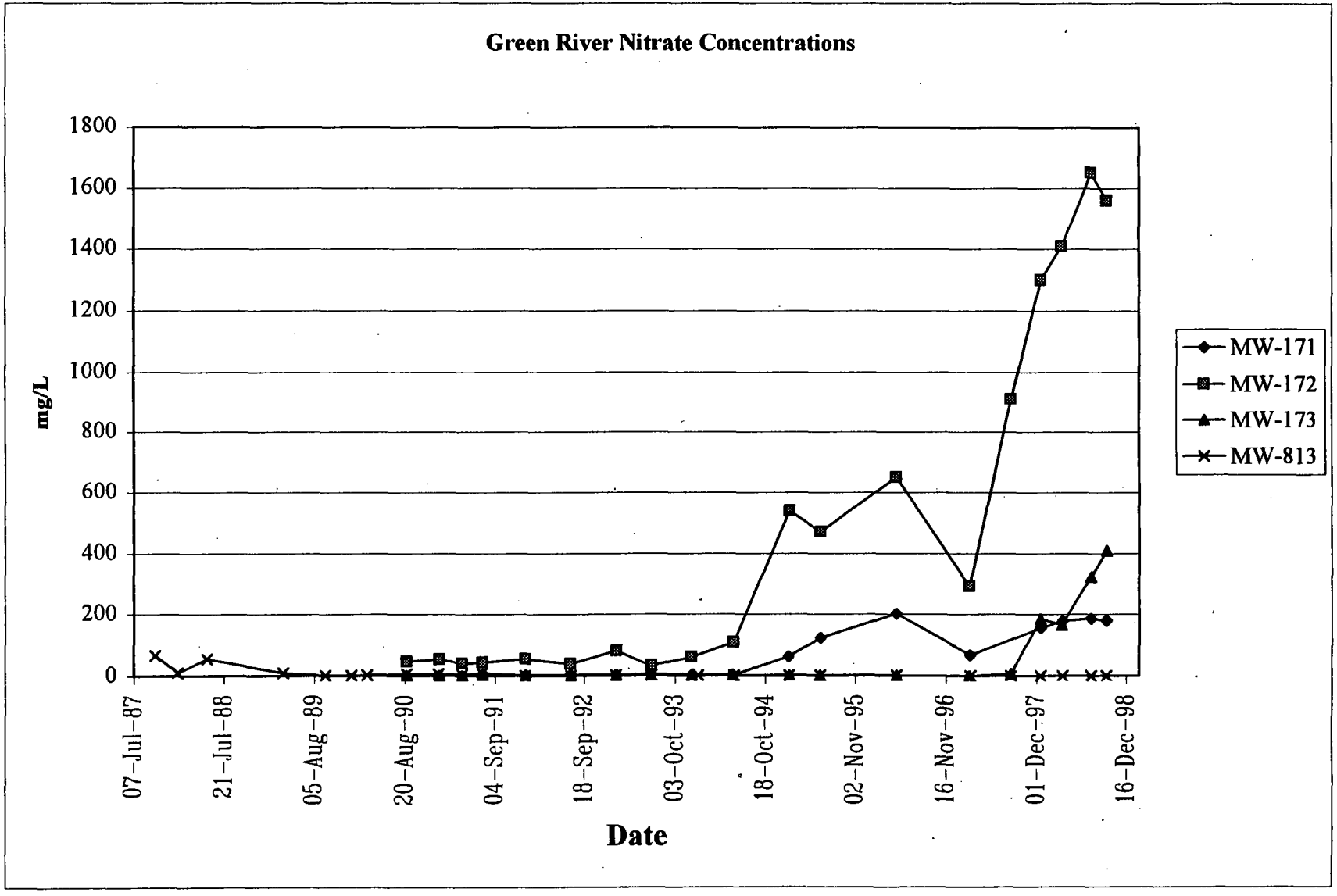


Figure GRN-2. Green River Nitrate Concentrations

MW-173 were below the standard until December 1997. Prior to that date, concentrations in MW-173 were near or below the detection limit. The most pronounced increase in nitrate occurs at MW-172, where concentration rose to about 1,600 milligrams per liter (mg/L) in 1998 from relatively uniform levels of 40 mg/L to 60 mg/L prior to December 1993.

The standard for nitrate was exceeded at MW-813 in the early period, 1987 to 1989; but concentrations have since decreased to low or nondetectable levels since then.

The disposal cell was constructed in 1988 and 1989. Prior to construction, from 1986 to 1988, nitrate in samples from MW-562 and MW-816 ranged between 45 mg/L and 173 mg/L. These two wells, both decommissioned, were formerly in the area now occupied by the disposal cell. Nitrate concentrations of 2 mg/L and 4,500 mg/L were detected in samples of tailings pore water collected from lysimeter 714 prior to surface remediation. (Lysimeter well 714 was located at the old tailings storage area north of the disposal site. Samples from this well were used to determine chemistry of the tailings pore water fluid.)

Uranium. The standard for uranium was not exceeded in any sample collected in 1998, nor has it ever been exceeded at a POC well since the disposal cell was constructed in 1989 (Figure GRN-3). Concentrations of uranium at MW-171 appear to have increased slightly throughout the post-construction monitoring period. The concentration of uranium in 1998 samples from MW-171 is about one-half the standard.

An overall decreasing trend for uranium is apparent for MW-172. At MW-173, concentrations have typically been below or slightly above the detection limit and no trend is apparent.

A five-fold decease in uranium concentration occurred at MW-813 from June 1994 through January 1995. Levels have since stabilized at about 0.01 mg/L.

Prior to construction of the disposal cell, uranium in samples from MW-562 and MW-816 ranged between 0.038 mg/L and 0.146 mg/l. Those levels are higher than present day concentrations at the four POC wells. Uranium concentrations of 221 mg/L and 675 mg/L were detected in samples of tailings pore water collected from lysimeter 714 prior to surface remediation.

Sulfate. Sulfate exceeded the standard in each sample collected in 1998 at MW-171, MW-172, and MW-173 (Figure GRN-4). The standard was not exceeded in any sample from MW-813 in 1998, nor since monitoring began at this well in 1987. Sulfate concentrations have consistently been about 3,800 mg/L at MW-813.

A trend toward increasing sulfate concentrations is evident at MW-171 since sampling at this well began in August 1990. Since then, the sulfate concentration has gradually doubled to reach 1998 levels. The standard was first exceeded in January 1995 and in each sample since then.

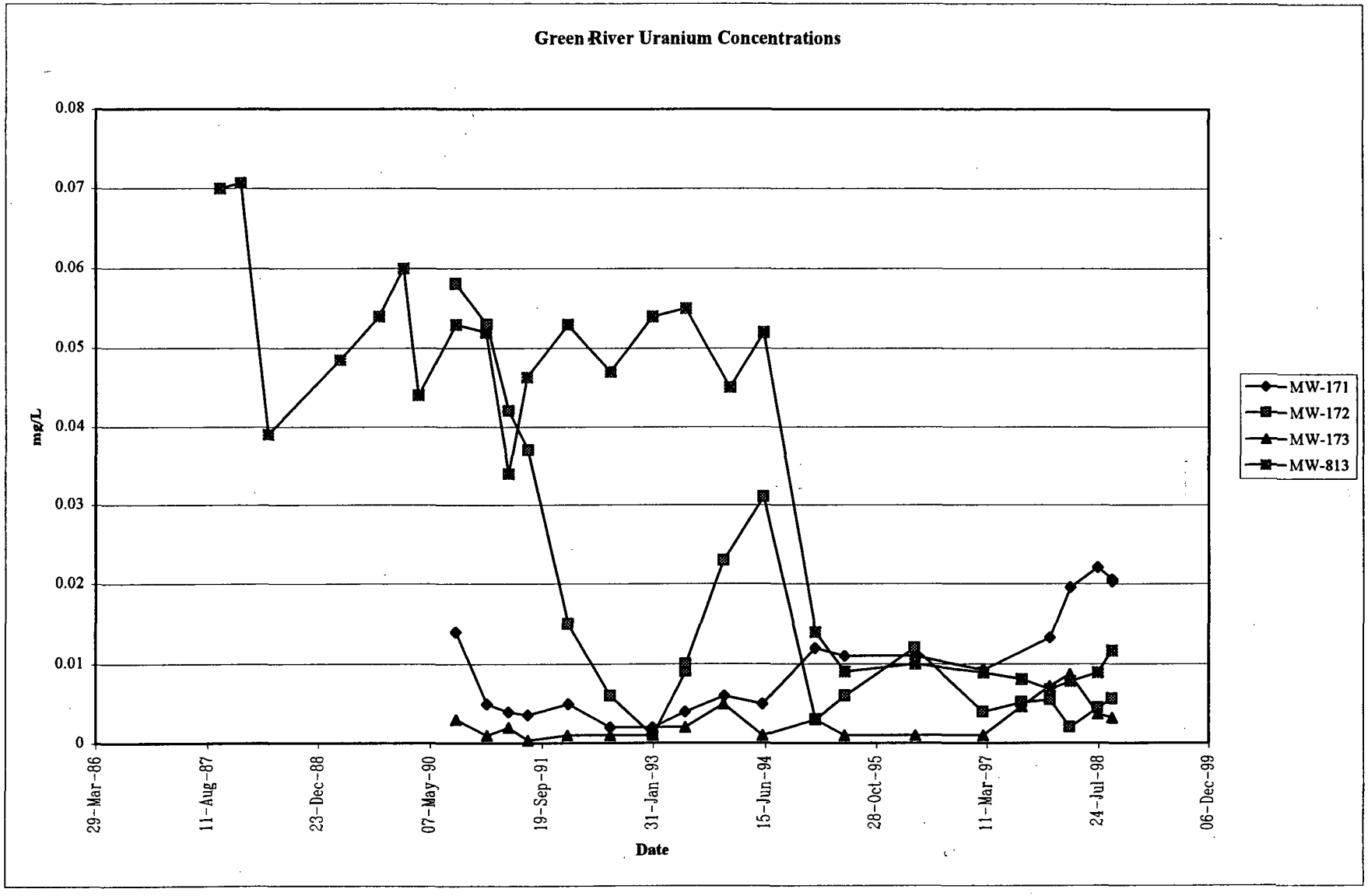


Figure GRN-3. Green River Uranium Concentrations

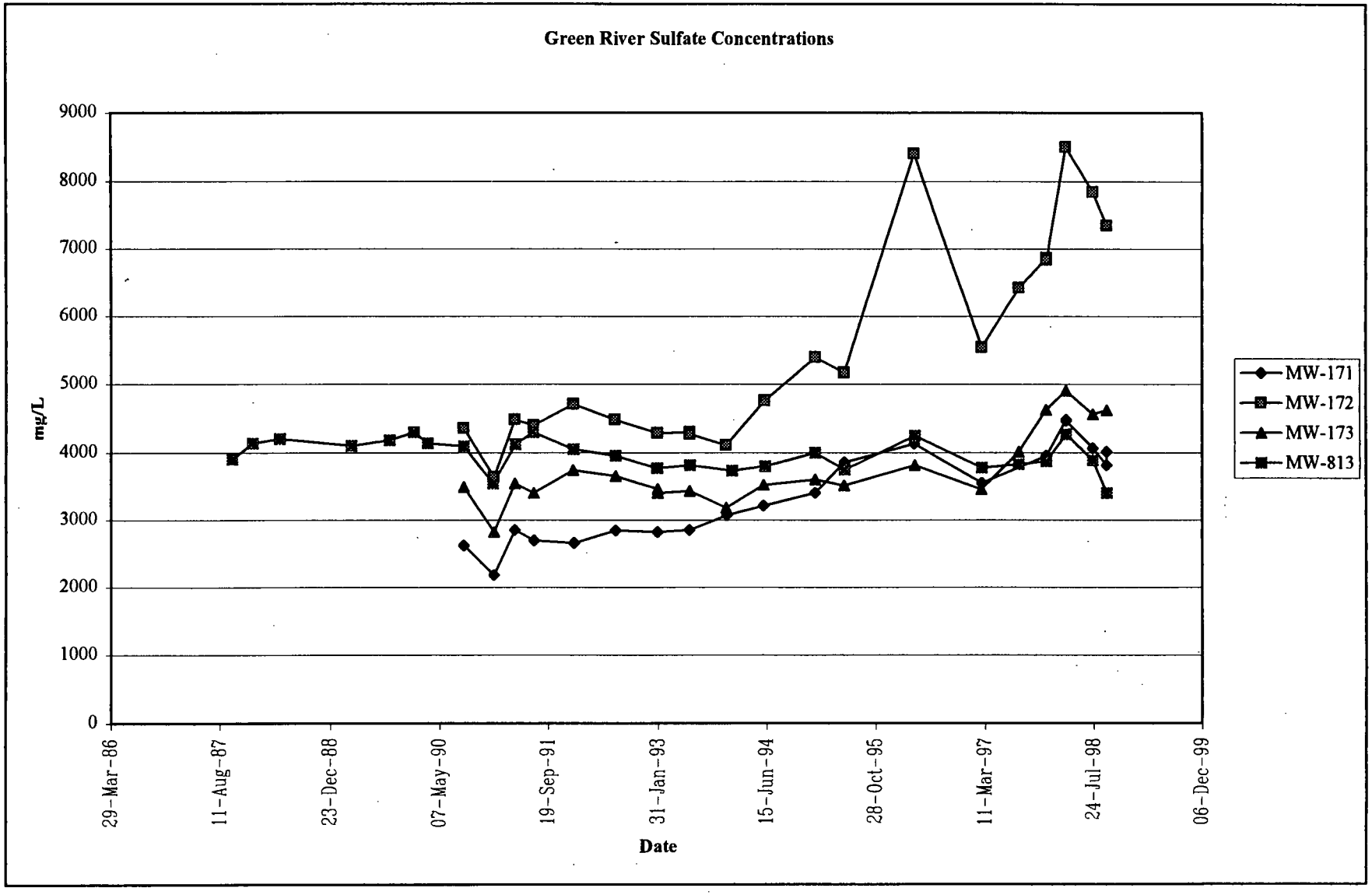


Figure GRN-4. Green River Sulfate Concentrations

At MW-172, the standard was first exceeded in January 1995 and in each sample thereafter. The increase in sulfate began in December 1993. Since then, the concentration has nearly doubled to current 1998 values.

Sulfate concentrations in samples from MW-173 ranged between about 3,500 mg/L and 4,500 mg/L between 1990 and 1998. In each sample from MW-173 since August 1997, sulfate has exceeded the standard. Since about mid-1994, sulfate fluctuations have been in phase among all four POC wells.

Prior to construction of the disposal cell, sulfate in samples from MW-562 and MW-816 ranged between 3,940 mg/L and 4,600 mg/L (1986 to 1988 data). Those levels are similar to or higher than present day concentrations at all wells except MW-172. Sulfate concentrations of 16,000 mg/L and 56,200 mg/L were detected in samples of tailings pore water collected from lysimeter 714 prior to surface remediation.

Ground-Water Level Monitoring. Water level hydrographs for the wells surrounding the disposal cell indicate relatively stable conditions. The observed water level fluctuations do not appear abnormal and generally occur in phase among the wells. There is no indication of a regional change in water levels or flow direction over the period of observation. The ground-water gradient in the vicinity of the disposal site is to the west or northwest. However, in the immediate vicinity of the disposal cell, a prevailing direction of flow is difficult to determine because the hydraulic head distribution does not provide a well-defined potentiometric surface. The head potentials indicate that a wide range of flow directions is possible, including a southerly component. It is probable that hydraulic heads and ground-water flow in the relatively complex hydrostratigraphic units at the site are fracture controlled.

Summary. The foregoing data and observations will form the basis for comparison with monitoring in the required 3-year period beginning in 1999. These data are summarized as follows:

- Nitrate exceeds the standard at three of the four POC wells. A pattern of increasing concentrations is apparent at these three wells.
- Nitrate concentrations prior to cell construction were much lower than recently observed at MW-172.
- Uranium concentrations are below the standard at each POC well. Uranium concentrations have decreased significantly at some wells. No major trend in uranium concentrations is apparent at the remaining wells. Uranium concentrations in ground-water prior to cell construction were greater than recent values at all four POC wells.
- Sulfate concentrations prior to cell construction were similar to, or greater than, present day levels in three of the POC wells. At MW-172, sulfate has exceeded the standard since 1995.
- Water level fluctuations appear normal and in phase among the wells. There is no indication of a regional change in water level or flow direction over the period of observation.

4.0 Conclusions

The site is in excellent condition. Only one maintenance task was identified. No cause for a follow-up inspection was identified.

5.0 Photographs

Table GRN-3. Photographs taken at Green River, Utah, Disposal Site

Photograph Location Number	Photograph Description/Remarks
GRN PL-1	Entrance sign (showing new area code sticker) and MW-177.
GRN PL-2	New NE corner of DOE property boundary.
GRN PL-3	Turning point along new DOE property boundary.
GRN PL-4	New SE corner of DOE property boundary.
GRN PL-5	Natural vegetation inside security fence.
GRN PL-6	Erosion at south corner of diversion channel.
GRN PL-7	Tumbleweed accumulation at south corner of diversion channel.
GRN PL-8	Destroyed wire gate in state's fence west of site.

[a]See Figure GRN-1 for photograph locations.

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PL-1 GRN 3/98 Entrance sign (showing new area code sticker) and MW-177.

PL-2 GRN 3/98 New NE corner of DOE property boundary.

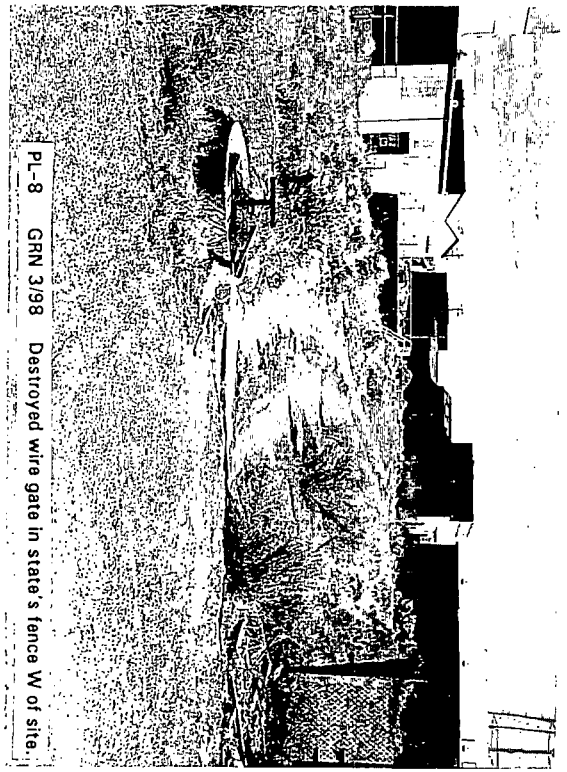
PL-3 GRN 3/98 Turning point along new DOE property boundary.

PL-4 GRN 3/98 New SE corner of DOE property boundary.

PL-5 GRN 3/98 Natural vegetation inside security fence.

PL-6 GRN 3/98 Erosion at S corner of diversion channel.

PL-7 GRN 3/98 Tumbleweed accumulation at S corner of diversion channel.



PL-8 GRN 3/98 Destroyed wire gate in state's fence W of site.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Gunnison, Colorado, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Document Number S00184

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Summary

The Gunnison site, inspected on July 16, 1998, is in excellent condition. Revegetation of graded and disturbed areas around the disposal cell is improved and is no longer a concern. Monitoring of riprap at key locations around the base of the disposal cell continued. Rock in these areas is in excellent condition. One minor maintenance task (fence repair) was completed during the inspection; no new maintenance tasks were identified. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Gunnison, Colorado.

C.L. Jacobson, Chief Inspector, and G.M. Smith, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on July 16, 1998. W. Naugle of the Colorado Department of Public Health and Environment participated in the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Gunnison Colorado, Disposal Site*, April 1997. U.S. DOE, Albuquerque, N.M., DOE/AL 62350-22, Rev. 2) for the site, and (2) procedures established by DOE to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is required by the LTSP for this site. Results of ground-water monitoring are presented in Section 3.0 Ground-Water Monitoring.

2.0 Results of the Annual Prelicensing Inspection

To ensure a thorough and efficient inspection, the site was divided into four areas referred to as transects: (1) the riprap-covered top of the disposal cell; (2) riprap-covered side slopes, apron, and diversion ditches; (3) area between the cell and the site boundary; and (4) outlying areas. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure GUN-1.

2.1 Specific Site Surveillance Features

Access Road, Entrance Gate, and Entrance and Perimeter Signs

The road to the site is an all-weather gravel road in good condition that is maintained by the U.S. Bureau of Land Management. The south entrance gate is a simple barbed-wire gate in the stock fence that surrounds the site. The gate is closed with (1) a wire loop over the top of the adjoining fence post, and (2) a chain padlocked to the adjoining post. The gate is in good condition.

The entrance sign, just east of the entrance gate, and all 44 perimeter signs, with the exception of signs P3 and P23, were in excellent condition. Signs P3 and P23 have been stolen and will be replaced.

Site Markers, Survey Monuments, and Boundary Monuments

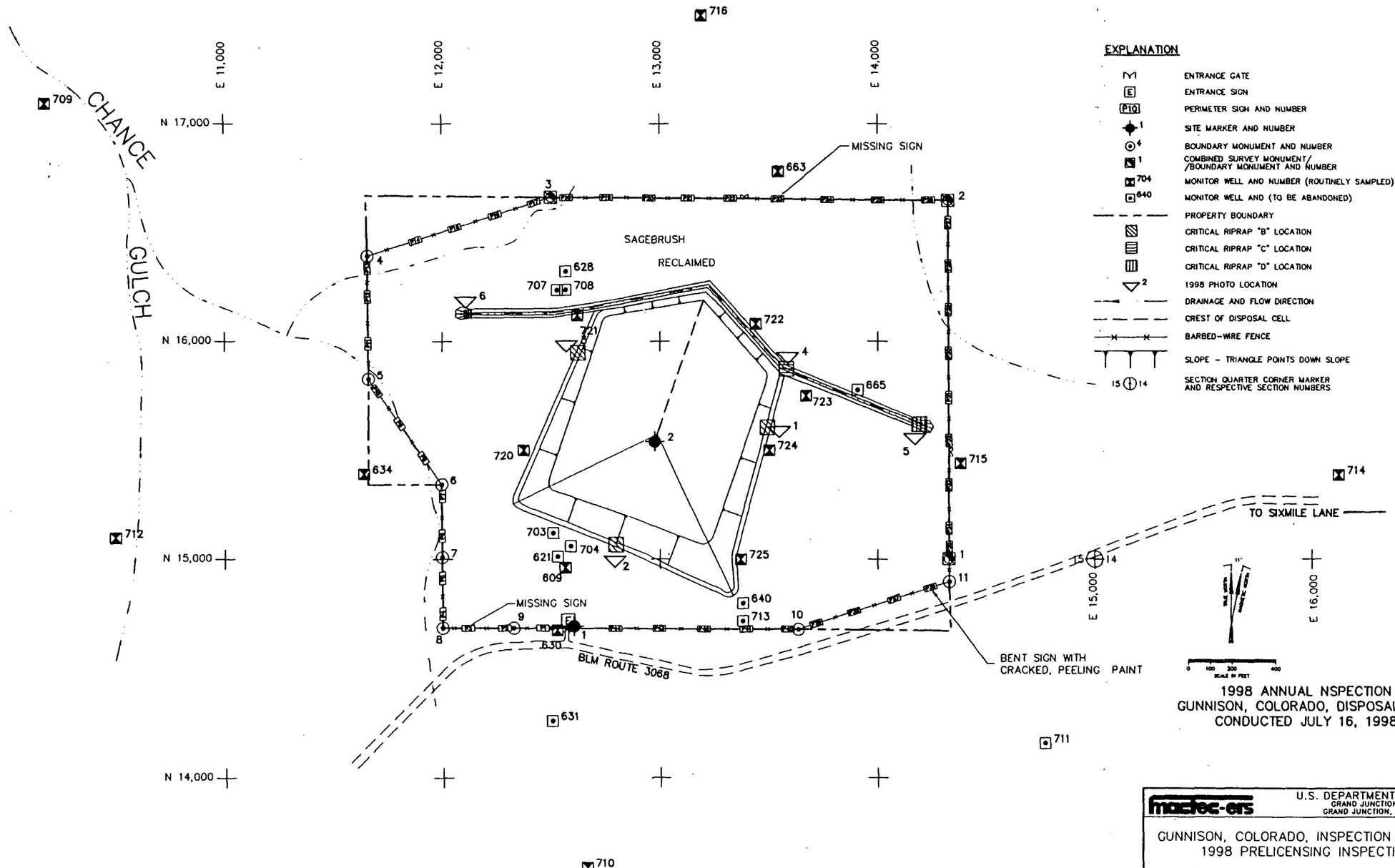
Both granite site markers, SMK-1 just inside the south entrance gate, and SMK-2 on the top of the disposal cell, are in excellent condition. Survey/boundary monuments, SM-1/BM-1, SM-2/BM-2, and SM-3/BM-3, and eight additional boundary monuments, BM-4 through BM-11, are also in excellent condition.

Monitor Wells

There are 16 wells in the ground-water monitoring network (Table GUN-1). Six of the wells are for compliance monitoring, two for background monitoring, and eight for water level measurements. All are in excellent condition.

Table GUN-1. Active Monitor Wells at Gunnison Disposal Cell Site

Compliance and Background Wells	Water Level Wells
MW-720, compliance	MW-630
MW-721, compliance	MW-634
MW-722, compliance	MW-663
MW-723, compliance	MW-709
MW-724, compliance	MW-710
MW-725, compliance	MW-712
MW-609, background	MW-714
MW-716, background	MW-715



EXPLANATION

- ENTRANCE GATE
- ENTRANCE SIGN
- PIQ — PERIMETER SIGN AND NUMBER
- 1 — SITE MARKER AND NUMBER
- 4 — BOUNDARY MONUMENT AND NUMBER
- 1 — COMBINED SURVEY MONUMENT/ /BOUNDARY MONUMENT AND NUMBER
- 704 — MONITOR WELL AND NUMBER (ROUTINELY SAMPLED)
- 640 — MONITOR WELL AND (TO BE ABANDONED)
- PROPERTY BOUNDARY
- CRITICAL RIPRAP "B" LOCATION
- CRITICAL RIPRAP "C" LOCATION
- CRITICAL RIPRAP "D" LOCATION
- 2 — 1998 PHOTO LOCATION
- DRAINAGE AND FLOW DIRECTION
- CREST OF DISPOSAL CELL
- BARBED-WIRE FENCE
- SLOPE – TRIANGLE POINTS DOWN SLOPE
- 15 14 — SECTION QUARTER CORNER MARKER AND RESPECTIVE SECTION NUMBERS

1998 ANNUAL NSPECTION
GUNNISON, COLORADO, DISPOSAL SITE
CONDUCTED JULY 16, 1998

macfec-ers

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

GUNNISON, COLORADO, INSPECTION DRAWING
1998 PRELICENSING INSPECTION

DATE PREPARED:	FILENAME:
JANUARY 11, 1999	S0012500

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Top of Disposal Cell

The top of the disposal cell is in excellent condition. There was no evidence of erosion, settling, slumping, or encroachment of vegetation.

Side Slopes, Apron, and Diversion Ditch

The riprapped side slopes, apron, and diversion ditches were also in excellent condition. There was no evidence of erosion, slumping, settling, or significant encroachment of vegetation in any of these features.

The riprap in six test squares was carefully inspected and photographed according to the procedure in the LTSP. Each test square, roughly 1 square meter, is in a "critical flow path" location in a diversion channel (Figure GUN-1). Corners of each square are marked with orange paint. Each square was photographed with the photographer facing north (approximately). The compass in each photograph indicates true north. Rock-by-rock comparison in this year's photographs (GUN PL-1 through GUN PL-6) with photographs taken in 1997 shows no deterioration of any rock.

Area Between the Disposal Cell and the Site Perimeter

Both disturbed (regraded) and undisturbed areas surround the disposal cell. Disturbed areas were graded to drain runoff away from the disposal cell and were then reseeded with crested wheatgrass, pennycress, and rabbitbrush. These plants along with annual weeds are the predominant species in the reseeded areas. Undisturbed areas are in their natural state, distinguished from reseeded areas primarily by the presence of sagebrush. The revegetation is considered successful although plants are more dense in some areas than in others. Success of the revegetation will continue to be monitored.

A four-strand wire fence runs along the site boundary and surrounds the site on all sides. The three upper strands are barbed wire, the lowest is smooth wire. In addition to the entrance gate, there are two auxiliary gates, one in the north fence, the other in the east fence. These two gates provide access to outlying monitor wells. Inspectors repaired a broken strand of barbed wire along the east fence. Overall, the fence and gates are in excellent condition.

Outlying Areas

The area outward from the disposal cell for a distance of 0.25 mile was visually inspected. No development or disturbance that could affect the site was observed.

The property northeast of the site is part of the Gunnison County Landfill. No landfill operations occur within 0.25 mile of the site.

Natural drainages lie west, northwest, and northeast of the site. Banks and slopes along these drainages are stabilized with natural vegetation. No erosion of significance was observed along these drainages.

3.0 Ground-Water Monitoring

DOE monitors ground water at this site to comply with ground-water protection standards in Title 40 *Code of Federal Regulations* Part 192.03 and to demonstrate the performance of the disposal cell.

Monitor Wells

The ground-water monitoring network consists of six downgradient (point-of-compliance [POC]) wells and two upgradient (background) wells. In addition, water levels are measured in eight outlying wells to detect changes in regional ground-water conditions should such occur (Table GUN-1). Location of monitor wells is shown in Figure GUN-1.

Frequency of Monitoring

Frequency of monitoring is given in the LTSP and in Table GUN-2.

Table GUN-2. Frequency of Ground-Water Monitoring

Year	Frequency	Time of Year
1997	2	Fall and early summer
1998	1	Early summer
1999	1	Early summer
2000	1	Early summer
2001	1	Early summer
Beyond	Every 5th year, i.e., 2006, 2011, etc.	Early summer

The site was licensed in September 1997. Monitor wells were sampled in June and October 1997 and June 1998.

Analytes

Samples will be analyzed for standard water quality indicators (major cations and anions); field parameters; and one hazardous constituent, uranium.

Results of Ground-Water Monitoring in 1997 and 1998

Ground-Water Sample Analytical Results. The concentration of uranium in ground-water samples collected in June and October 1997 and June 1998 are shown in Table GUN-4. Monitor wells MW-609 and MW-716 are upgradient or background wells. The remaining wells are downgradient or POC wells. The latter are used to monitor cell performance against background conditions established by the former. The compliance standard for uranium, as stated in the LTSP, is 0.013 milligrams per liter (mg/L).

Uranium was detected in one or more samples from each background and POC well sampled in 1997 and 1998, except MW-721, at which uranium was not detected in any sample (Table GUN-3). Uranium concentrations in the POC wells were statistically similar to those in the background wells, and the uranium concentration did not vary significantly at any given well during the period. The uranium concentration in samples from MW-720 are slightly higher than in samples from background wells. However, they are well within the historical range for the background wells. The uranium concentrations in all wells are very close to the laboratory detection limits of 0.001 mg/L and are much lower than the performance standard of 0.013 mg/L. Thus, there is no indication that uranium is leaching from the disposal cell or that ground-water quality has degraded because of the presence of the disposal cell.

Table GUN-3. Uranium Concentrations in Ground Water, June and October 1997 and June 1998

Monitor Well	Location	Uranium [mg/L]		
		June 1997	October 1997	June 1998
609	Background	0.0037	0.0037	0.0035
716	Background	0.0033	0.0032	0.0030
720	POC	0.0048	0.0048	0.0045
721	POC	0.001 U	0.001 U	0.001U
722	POC	0.0017	0.0018	0.0015
723	POC	0.0033	0.0032	0.0019
724	POC	0.0011	0.0012	0.001 U
725	POC	0.0030	0.0031	0.0021

Ground-Water Level Monitoring Results. Hydrographs for the wells listed in Table GUN-3 show very minor fluctuations in the elevation of the water table since cell closure in 1995. (These data are on file at the GJO.) Hydraulic head potentials and gradients between wells also have not changed, that is, ground-water flow directions have remained static.

The disposal cell is approximately centered in a topographic saddle that slopes down to the east and west, and rises to the north and south. The shape of the potentiometric surface generally replicates that of the surface topography, such that ground-water flow is toward the site from

north and south and away from the site on the west and east. The disposal cell is located near the mid-point of the north-south trending divide in the potentiometric surface, and immediately east of the saddle point. As a result, the ground water flows beneath the disposal cell and away from the disposal cell to the east (toward POC wells MW-722, MW-723, MW-724, and MW-725). The compliance monitoring network continues to be effective because hydrogeologic conditions at the site remain stable and as characterized before the monitoring network was established.

4.0 Conclusions

The site is in excellent condition. Only minor maintenance and no follow-up inspections are required.

5.0 Photographs

Table GUN-4. Photographs taken at Gunnison, Colorado, Disposal Site

Photograph Location Number	Photograph Description/Remarks
GUN PL-1	Critical riprap B test square, E edge of pile.
GUN PL-2	Critical riprap B test square, S edge of pile.
GUN PL-3	Critical riprap B test square, W edge of pile.
GUN PL-4	Critical riprap C test square, E diversion ditch.
GUN PL-5	Critical riprap D test square, E diversion ditch.
GUN PL-6	Critical riprap D test square, W diversion ditch.

PL-1 GUN 7/98 Critical riprap B test square, E edge of pile.

PL-2 GUN 7/98 Critical riprap B test square, S edge of pile.

PL-3 GUN 7/98 Critical riprap B test square, W edge of pile.

PL-4 GUN 7/98 Critical riprap C test square, E diversion ditch.

PL-5 GUN 7/98 Critical riprap D test square, E diversion ditch.

PL-6 GUN 7/98 Critical riprap D test square, W diversion ditch.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Lakeview, Oregon, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Summary

The Lakeview site, inspected on May 5 and 6, 1998, is in fair to good condition. Deep-rooted plants continue to establish on the top of the disposal cell. Study of the long-term effect of these plants on the radon barrier continues. Measurements indicate that weathering has decreased the size of the riprap, but that size remains above the design requirement. Measurements of the rock will continue. Electrical conductivity measurements and chemical analysis indicate that water in the energy dissipation area (EDA) and flowing from two trench drains is meteoric water and not seepage from the disposal cell. No maintenance is required, and no cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Lakeview, Oregon.

M.P. Plessinger, Chief Inspector, and G.M. Smith, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on May 5 and 6, 1998. R.W. Edge of DOE participated in the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Collins Ranch Disposal Site, Lakeview, Oregon*, August 1994. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-19F, Rev. 3) for this site, and (2) procedures established by the GJO to comply with Title 10 *Code of Federal Regulations* Part 40.27. K.R. Hooks, T.L. Johnson, W.H. Ford, and B.N. Jagannath, of the U.S. Nuclear Regulatory Commission (NRC), conducted an independent but concurrent inspection of the site on May 5.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is required by the LTSP for this site. The results of ground-water monitoring in 1998 are in Section 3.0 Ground-Water Monitoring.

2.0 Results of Annual Inspection

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) the top of the disposal cell; (2) side slopes of disposal cell, north drainage channel including the EDA, rock aprons, and trench drains; and (3) site perimeter and outlying areas. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each

transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure LKV-1.

2.1 Specific Site Surveillance Features

The road that leads to the site entrance is private. DOE has a permanent easement to use this road. Approximately 0.5 mile (mi) east of the site, the landowner has placed a cable across the road. By arrangement with the landowner, DOE has a padlock on the cable so DOE's access to the site is unimpeded.

The entrance gate is a simple barbed-wire gate in good condition. The purpose of the gate and the barbed-wire fence around the site is primarily to keep out cattle to prevent over grazing.

The entrance sign and 10 of 12 perimeter signs are in excellent condition. Two perimeter signs, P10 and P12, are damaged by bullet holes. Both signs remain fully legible.

The two site markers, three survey monuments, and three boundary monuments are all in excellent condition.

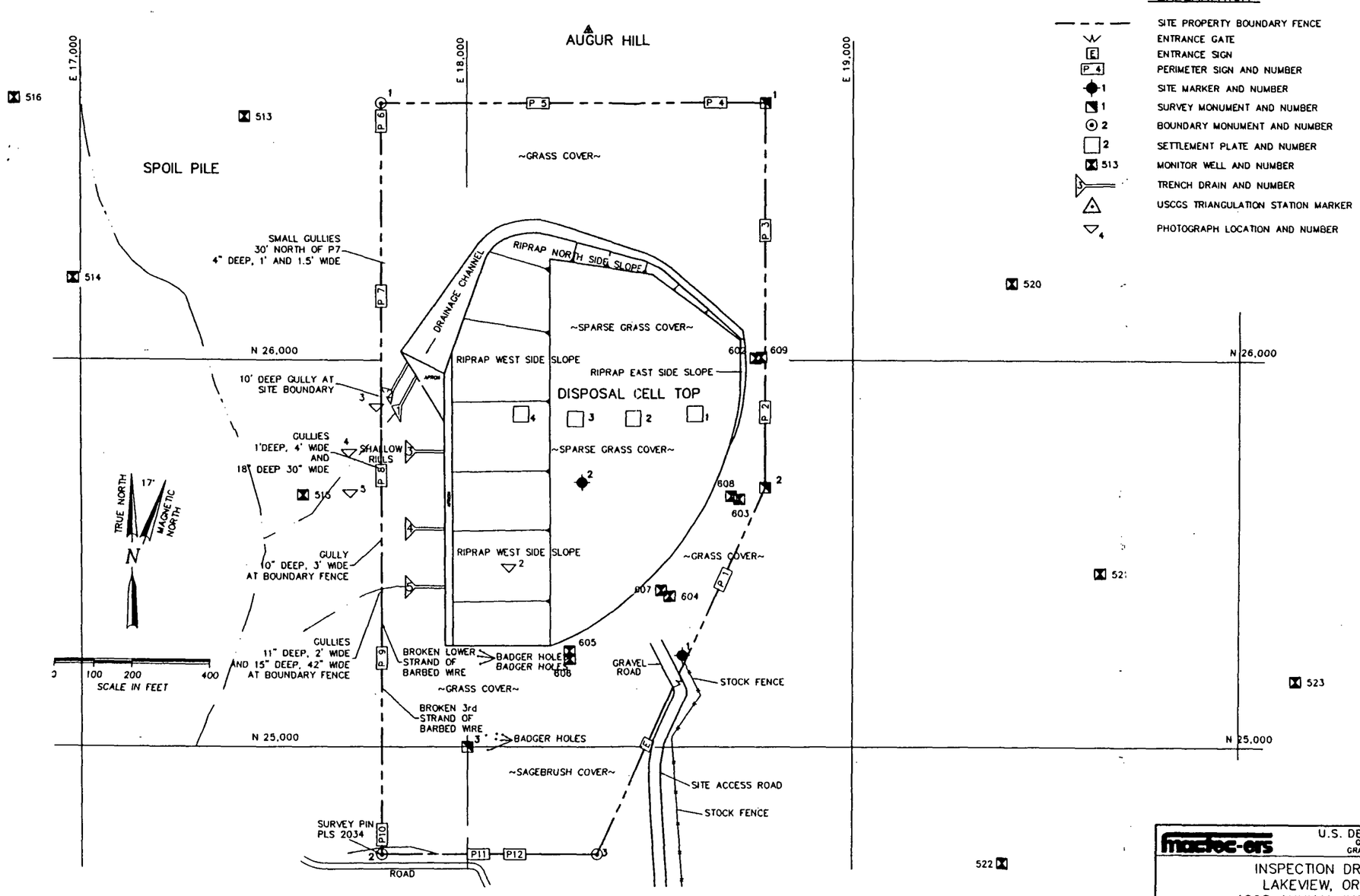
There are nine wells in DOE's ground-water monitoring network. An upgradient well, MW-515, is west of the disposal cell; eight downgradient wells are east of the cell. The eight downgradient wells are in four pairs: MW-602 and MW-609, MW-603 and MW-608, MW-604 and MW-607, and MW-605 and MW-606. All wells were inspected and are locked and in good condition.

2.2 Transects

Top of Disposal Cell

The engineering design for the cover that overlies the buried mill tailings has created conditions that favor the growth of deep-rooted plants. The cover consists of a very thin layer of rock and soil called the rock-soil matrix. This layer is only about 4 inches (in.) thick. This rock-soil matrix overlies an 18-in. layer of riprap that in turn rests on top of the radon barrier. The radon barrier is a 16-in. layer of compacted clay-rich soil. The relatively thin rock-soil matrix was apparently intended to support perennial grasses to enhance the aesthetic appearance of the disposal cell.

The first problem is that the low water-storage capacity of the rock-soil matrix limits the growth of shallow-rooted perennial grasses. The grass cover is sparse for lack of soil moisture and is likely to remain so for as long as current climatic conditions persist.



EXPLANATION

- SITE PROPERTY BOUNDARY FENCE
- ENTRANCE GATE
- E — ENTRANCE SIGN
- P 4 — PERIMETER SIGN AND NUMBER
- 1 — SITE MARKER AND NUMBER
- 1 — SURVEY MONUMENT AND NUMBER
- 2 — BOUNDARY MONUMENT AND NUMBER
- 2 — SETTLEMENT PLATE AND NUMBER
- 513 — MONITOR WELL AND NUMBER
- 3 — TRENCH DRAIN AND NUMBER
- USCGS TRIANGULATION STATION MARKER
- 4 — PHOTOGRAPH LOCATION AND NUMBER

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

INSPECTION DRAWING
LAKEVIEW, OREGON
1998 ANNUAL INSPECTION

DATE PREPARED:	FILENAME:
JANUARY 5, 1999	S0009500

The second and possibly more important problem is that root systems may allow meteoric water to move downward through the rock-soil matrix and underlying riprap layer into the radon barrier. This water movement could encourage the growth (biointrusion) of deep-rooted shrubs, such as rabbitbrush and sagebrush. Many mature deep-rooted shrubs are now growing on top of the disposal cell. The density of these plants is expected to increase until it approaches or exceeds the density of these plants in adjacent, undisturbed, native plant communities. These deep-rooted shrubs may increase the saturated hydraulic conductivity of the radon barrier. If water begins to move through the radon barrier, it may leach contaminants from the tailings into surrounding ground water and soils.

Air-Entry Permeameter Tests. Air-entry permeameter (AEP) tests were performed on the radon barrier in July 1997 and June 1998. AEP tests measure the saturated hydraulic conductivity of the radon barrier. Hydraulic conductivity is a property of porous media that influences the rate that moisture travels through a material; in this case, the radon barrier. The design specification for the hydraulic conductivity of the Lakeview radon barrier is 1×10^{-7} to 1×10^{-8} centimeters per second (cm/sec). The results of AEP tests in 1997 and 1998 indicate that the saturated hydraulic conductivity of the radon barrier has increased, where measurements were taken, to as much as 1×10^{-4} to 1×10^{-5} cm/sec. This result is two to three orders of magnitude above the design standard. The trend toward greater permeability is greatest where plant roots have penetrated the radon barrier.

Saturated hydraulic conductivity is not a direct measure of infiltration through the radon barrier; but when there is an increase in this parameter, there is potential for water to infiltrate and move through the disposal cell.

At semiarid sites like Lakeview, saturated conditions may occur only seasonally and last for short periods of time. The general case will most likely be an unsaturated condition. The hydraulic conductivity of soil is at a maximum under saturated conditions and decreases rapidly with decreasing moisture content (unsaturated conditions). DOE will conduct further tests to evaluate the soil-water balance of the Lakeview radon barrier in 1999.

Radon Monitoring. To see if roots may be allowing significant levels of radon to escape through the radon barrier into the atmosphere, DOE will monitor radon at the site for 1 year. Six pairs of track etch cups were placed around the site boundary, three pairs were placed on the disposal cell directly above the cover, and three pairs were located offsite in the direction of the prevailing wind to collect background data. The track etch cups were changed every 90 days. The first set of track etch cups were set out in early May and taken down in early August. The second set was set out in early August and removed in early October.

Results for the first 6 months of the 1-year radon monitoring project show no significant levels of radon associated with the site. The Environmental Protection Agency (EPA) standard for release of radon to the atmosphere is 20 picocuries per second (pCi/sec), area averaged. The highest reading from the track etch cups is one reading of 1.2 pCi/sec at the southwest corner of the site. This reading is an order of magnitude below the 20 pCi/sec standard. All other readings were less than 1.0 pCi/sec, or two orders of magnitude below the EPA standard. Values from the three

pairs of cups directly on top of the disposal cell ranged between 0.1 and 0.4 pCi/sec, identical to the readings from the three off-site, background pairs of cups. These data suggest that radon levels at the site are essentially the same as background. Monitoring results for the last 6 months of the 1-year project will be in the 2000 annual report. Data are maintained in the permanent site file at GJO.

Side Slopes of Disposal Cell and Adjacent Drainage Channel, Rock Aprons, and Trench Drains

Riprap. Deterioration or crumbling of riprap, due to weathering of poor quality rock, on the west and north side slopes of the disposal cell, and in the EDA at the lower end of the north drainage channel, was first noted by inspectors in 1995. The crumbling of the rock is a result of two factors: (1) use of rock that was altered or weathered before it left the two rock quarries, and (2) continued weathering of the rock as it lay in place on the disposal cell.

In 1997, DOE established a field procedure to measure the continuing, gradual decrease in size of rock. This procedure was incorporated in the LTSP in March 1998. The procedure was used to establish baseline conditions in 1997. The procedure was used again during this year's annual inspection to measure changes that might have occurred since 1997 (LKV PL-1). NRC observed this year's measurements.

Design specifications call for the diameter of the riprap on the side slope of the disposal cell to range between 2.7 and 3.9 in. More specifically, the specification is that 50 percent of the rock by weight (D_{50}) be larger than 2.7 in. Rock of larger size was placed on the disposal cell in order to meet the D_{50} requirement conservatively. Results from 1998's measurements indicated a D_{50} of 2.75 in. Rock of this size is sufficient to protect the disposal cell from erosion in the unlikely event of a most-severe-case storm, the probable maximum precipitation event that was used to calculate the design D_{50}. DOE will again measure the size and weight of the riprap in 1999.

Durability of Large Rock in the EDA. Water sometimes stands in the large depression at the bottom of the north drainage channel, an area referred to as the EDA. Water stands at this location because the trench drains that extend southwest from the EDA are 2 to 3 ft higher in elevation than the bottom of the EDA. Water in the EDA is not a concern unless it causes weathering of the large riprap boulders to accelerate by increasing the frequency of freezing and thawing or the growth of secondary mineralization.

To monitor the long-term durability of the large-diameter riprap in the EDA, selected rocks were numbered (numbers painted on) and ten photograph stations were established in 1997. A steel t-post marks each photograph station. In 1997 and 1998, inspectors photographed the numbered rocks from the established photograph stations.

Comparison of the 1997 and 1998 photographs showed no changes in the rock. Some of the rocks in the EDA are cracked, but the crumbling, splitting, and spalling disintegration observed in the small-diameter riprap on the side slope of the disposal cell has not occurred. Photographs will be maintained in the permanent file at GJO.

Source of Water in the EDA and Trench Drains. To address NRC's concern that water standing in the EDA and flowing from the two trench drains might be coming from the disposal cell, as seepage, inspectors measured the electrical conductivity of the water; ground-water sampling personnel later sampled the water for chemical analysis.

Conductivity values were, in all cases, very low. They ranged from 2×10^{-1} to 3×10^{-1} micro-mhos/cm. Such low conductivity is characteristic of meteoric water that is essentially free of total dissolved solids. (Conductivity values for tailings pore fluids at uranium mill tailings sites typically are in the 1×10^{3} to 1×10^{4} micro-mhos/cm range—four to five orders of magnitude above the readings from water in the EDA and trench drains at Lakeview.)

Furthermore, DOE has noticed over the years that the trench drains and the EDA are dry except after snowmelt or heavy rains.

There was sufficient water in the EDA and trench drains in August 1998 for DOE to take samples. Analysis of these samples for the three hazardous constituents in the tailings pore fluid, arsenic, cadmium, and uranium were all below detection limits. DOE is satisfied, therefore, that water in the EDA and trench drains is runoff and not seepage. (See Section 3.0 Ground-Water Monitoring for discussion of hazardous constituents in tailings pore fluid.)

Biointrusion. Grass encroachment into the riprap is increasing on the north side slope of the disposal cell. Grass encroachment is also increasing in the upper or eastern part of the north drainage channel. A few grass plants are growing in the EDA at the lower end of the north drainage channel. As long as plant encroachment remains sparse in the drainage channel, it will not affect the performance of the channel during a large storm.

Site Perimeter and Outlying Areas

This transect includes (1) the graded and seeded area between the disposal cell and the site boundary, (2) the fence along the perimeter of the site, and (3) the undisturbed native shrub-and-grass community that extends out from the site for a distance of 0.25 mi.

Minor gullies have formed in the graded and seeded area west of the five trench drains. Some of these gullies continue onto private property west of the site. There is a 10-in. deep gully at the site boundary below the outflow from trench drain, TD-2 (LKV PL-2). Water was flowing from all five trench drains on the date of the inspection (LKV PL-3). Two gullies have formed west of TD-3 (LKV PL-4), one gully west of TD-4, and two gullies west of TD-5. These gullies have not damaged the trench drains but may damage property on the west. DOE will continue to monitor these gullies during future inspections.

Intermittent standing water in a depression just south of monitor wells MW-602 and MW-609 has been nearly eliminated by a shallow ditch excavated by inspectors in 1997. Although a small amount of water still collects in this area from time to time, it does not appear significant and no further repair is necessary.

Several strands of barbed wire in the boundary fence were loose or broken. The top and second strands of wire were loose and entangled in many places, probably caused by deer jumping the fence. Inspectors separated the strands. Along the west boundary of the site, the bottom strand of wire is broken north of perimeter sign P9, and the third strand is broken south of P9. The fence appears sufficient to keep cattle out; but a rancher reported a calf inside and separated from the cow earlier in the spring. Inspectors gave the rancher a key to the lock on the entrance gate to make it easier to rescue livestock that get inside. In the future, inspectors should anticipate the need for minor fence repairs during the inspection.

3.0 Ground-Water Monitoring

DOE monitors ground water at this site, as a best management practice, to demonstrate the initial performance of the disposal cell. During remediation, tailings were moved from the former mill to the Lakeview, or Collins Ranch, disposal site, a "clean" site where ground water in underlying geologic formations was not contaminated except by naturally occurring minerals. The initial performance of the disposal cell will be considered demonstrated and acceptable if, after a short period of ground-water monitoring, the results demonstrate that contaminants are not leaching from the disposal cell into local ground water.

Monitor Wells

There are nine wells in the monitoring network: one upgradient well, MW-515, and four pairs of downgradient wells, MW-602 through MW-609. All wells are screened in the uppermost aquifer. In each pair of downgradient wells, one is screened at a depth of approximately 100 ft; the second is screened at approximately 150 ft. The shallower of the two wells in each downgradient pair is usually dry and cannot be sampled. Well locations are shown in Figure LKV-1.

Frequency of Monitoring

Wells in the monitoring network are sampled once every 5 years. The Lakeview site was included under NRC's general license in 1994. Therefore, the first time that DOE would sample again would be in 1999. However, at NRC's request, DOE sampled in August 1998. (The four shallow downgradient wells, MW-602 through MW-605, were dry and could not be sampled.) DOE will sample again in 1999. If additional monitoring is required after 1999, it will be on the regular 5-year interval, i.e., 2004. In addition to sampling every fifth year, the ground-water section of the LTSP is to be evaluated on the same 5-year basis to determine the need to continue monitoring.

Analytes

Three hazardous constituents (analytes), arsenic, cadmium, and uranium, exceeded EPA Maximum Concentration Limits (MCLs) in samples from the tailings pore fluid. Therefore,

these three constituents are the target analytes, and DOE analyzes ground-water samples for these three analytes plus standard water quality indicators and field parameters.

Results of Ground-Water Monitoring

Ground-Water Sample Analytical Results. Analytical results for arsenic, cadmium, and uranium in ground-water samples collected in 1998 are shown in Table LKV-1. The MCLs for these analytes are also included in the table.

Table LKV-1. Summary of Ground-Water Sample Results

Analyte	MCL	Ground-Water Sample Location				
		MW-515 (upgradient)	MW-606 (POC)	MW-607 (POC)	MW-608 (POC)	MW-609 (POC)
Arsenic	0.05	0.0091	0.0145	0.0072	0.0045	0.001 U
Cadmium	0.01	0.001 U [a]	0.001 U	0.001 U	0.001 U	0.001 U
Uranium	0.044	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

All results in mg/L.
(a) U = undetected at respective laboratory reporting limit.

Cadmium and uranium were below the laboratory detection limit in all samples collected in 1998. Cadmium has never been above the detection limit in any downgradient monitor well since the disposal cell was completed in 1988 (Figure LKV-2). Similarly, uranium concentrations have remained at or below the detection limit in all downgradient monitor wells over the same period (Figure LKV-3).

Arsenic was detected in the 1998 samples from the upgradient well and in three of the downgradient wells (Figure LKV-4). The highest concentration of arsenic, 0.0145 milligrams per liter (mg/L) at MW-606, is approximately 1.6 times greater than the concentration of arsenic, 0.0091 mg/L, in the upgradient well. Arsenic in the remaining downgradient wells was equal to or less than that in the upgradient well.

Prior to construction of the disposal cell, the concentration of naturally occurring arsenic in local monitoring wells was as high as 110 mg/L. The natural abundance of arsenic in the area around the disposal cell, particularly at the deeper monitoring interval, is caused by the hydrothermal activity that has occurred—and that is still occurring—in the area.

Arsenic in DOE's monitor wells is a natural, background condition. The concentration of arsenic in DOE wells has remained stable or essentially constant since the disposal cell was completed and DOE monitoring began (Figure LKV-4).

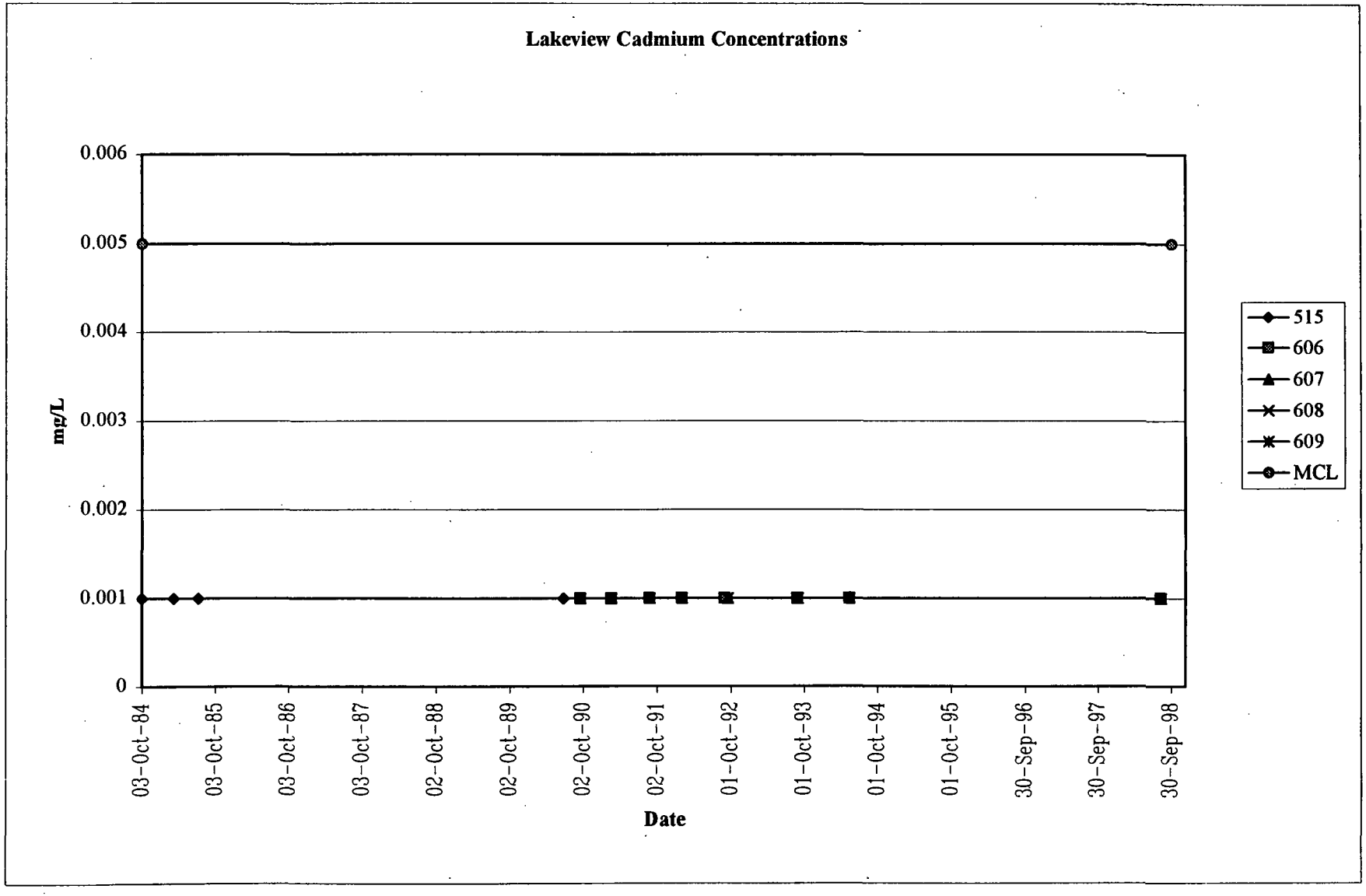

Figure LKV-2. Lakeview, Oregon, Disposal Site Cadmium Concentrations

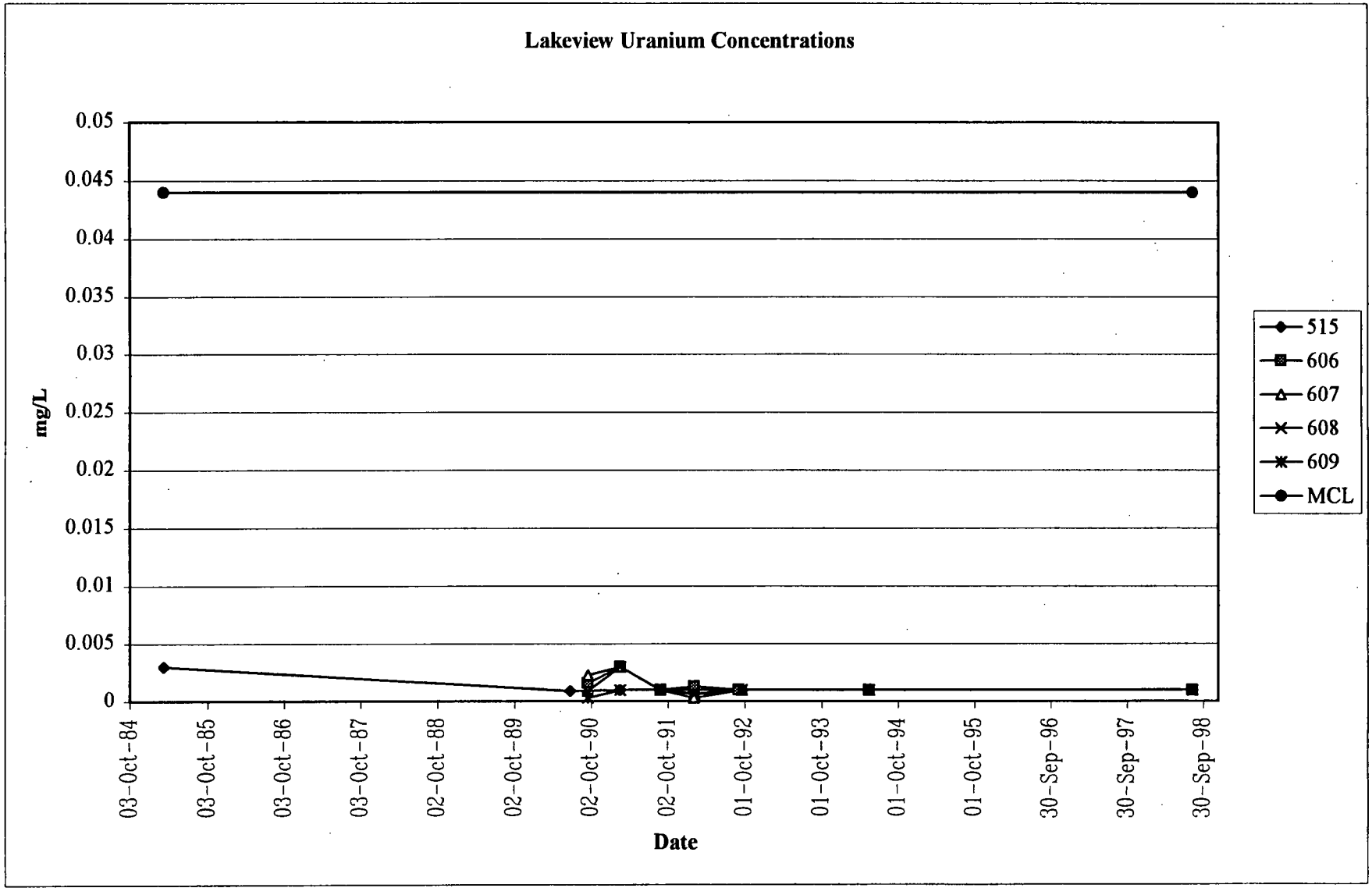

Figure LKV-3. Lakeview, Oregon, Disposal Site Uranium Concentrations

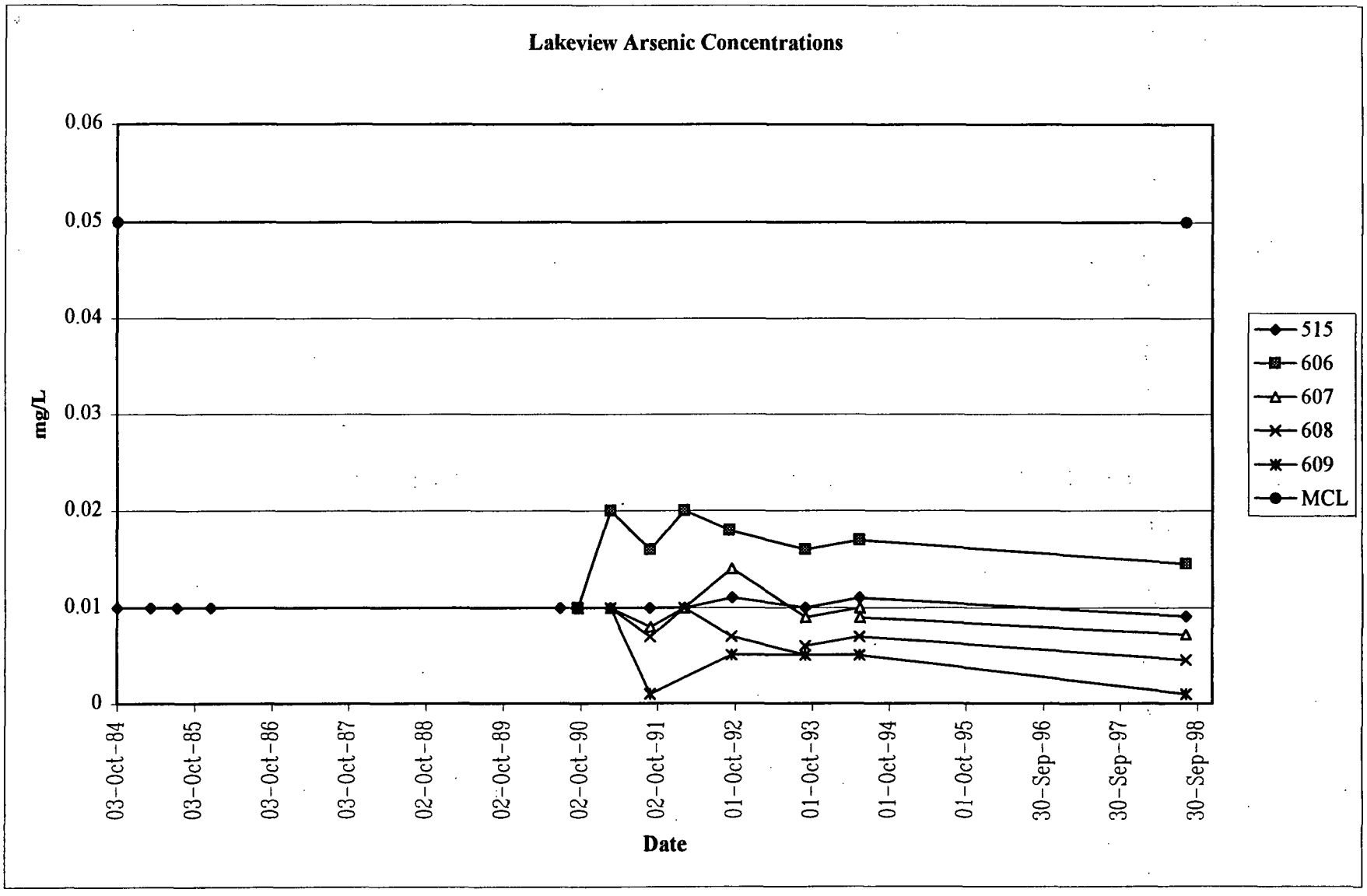

Figure LKV-4. Lakeview, Oregon, Disposal Site Arsenic Concentrations

Ground-Water Level Monitoring. Ground-water levels in August 1998 were high compared to measurements in previous years. For example, the elevation of the water table was 2 to 10 ft higher in August 1998 than in September 1992. The gradient, or direction of ground-water flow, continued to be to the southeast in August 1998. Therefore the downgradient monitor wells are in the correct location downgradient from the cell.

Summary. The results of ground-water monitoring show that—10 years after the disposal cell was completed—the concentrations of all three target analytes are (1) far below the MCL for each analyte and (2) the same as background. The initial performance of the disposal cell is, therefore, adequately and sufficiently demonstrated. The disposal cell is performing as an efficient containment system: Hazardous constituents are not leaching from the enclosed tailings.

4.0 Conclusions

The Lakeview disposal site is in fair to good condition. Progressive deterioration of riprap on the side slope will continue to be monitored. Rock in the EDA will be inspected and rephotographed annually to detect changes that may occur. The long-term effects of root intrusion on the radon barrier will continue to be evaluated by the LTP project. Results of ground-water monitoring adequately fulfill the obligation, stated in the LTSP, to demonstrate the initial performance of the disposal cell.

5.0 Photographs

Table LKV-2. Photographs taken at Lakeview, Oregon, Disposal Site

Photograph Location Number	Photograph Description/Remarks
LKV PL-1	Riprap size monitoring at sample point No. 2.
LKV PL-2	Head cut erosion west of Trench Drain No. 2 at site boundary.
LKV PL-3	Water flowing from Trench Drain No. 1.
LKV PL-4	Gullies west of Trench Drain No. 3.

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PL-1 LKV 5/98 Riprap size monitoring at sample point No. 2.

PL-2 LKV 5/98 Head cut erosion west of Trench Drain No. 2 at site boundary.

PL-3 LKV 5/98 Water flowing from Trench Drain No. 1.

PL-4 LKV 5/98 Gullies west of Trench Drain No. 3.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Lowman, Idaho, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC 99-06
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2.2 Transects LOW-5

3.0 Ground-Water Monitoring LOW-6

4.0 Conclusions LOW-8

Figures

Figure LOW-1. Lowman, Idaho, 1998 Inspection Drawing LOW-3

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Summary

The Lowman site, inspected on July 9, 1998, is in good condition. An erosion control project, completed in October 1998, corrected erosion problems in areas north and west of the disposal site. No additional maintenance tasks are required. Encroachment of vegetation in the riprap is increasing and will be evaluated. DOE will visit the site in the spring of 1999 to ensure that erosion control structures have survived the winter, and to intervene if they have not.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Lowman, Idaho.

C.L. Jacobson, Chief Inspector, and M.P. Plessinger, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on July 9, 1998. R.W. Edge of DOE participated in the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Lowman, Idaho, Disposal Site*, April 1994. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-36, Rev. 1) for this site and (2) procedures established by GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is required by the LTSP at this site. Results of ground-water monitoring are presented in Section 3.0 Ground-Water Monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) the top and side slopes of the disposal cell; (2) on-site areas immediately adjacent to the disposal cell, including the site boundary; and (3) areas adjacent to the site property. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure LOW-1.

2.1 Specific Site Surveillance Features

Site Access

The access road leaves Idaho State Highway 21 and extends 500 to 600 feet (ft) northeast to the site boundary. The road is graded, hard-packed and in good condition. A locked, two-panel gate spans the road approximately 150 ft from the highway. The hinges on the southeast gate post were out of alignment, and this condition impaired the swing of the gate. During the erosion control project in October, the existing gate was replaced with a Powder River style gate that is now fully functional.

Perimeter and Entrance Signs

Entrance sign E1, adjacent to the entrance gate, and entrance sign E2, at the site boundary near site marker SMK-1, are both in good condition. There are bullet holes in E2 but the sign is still readable.

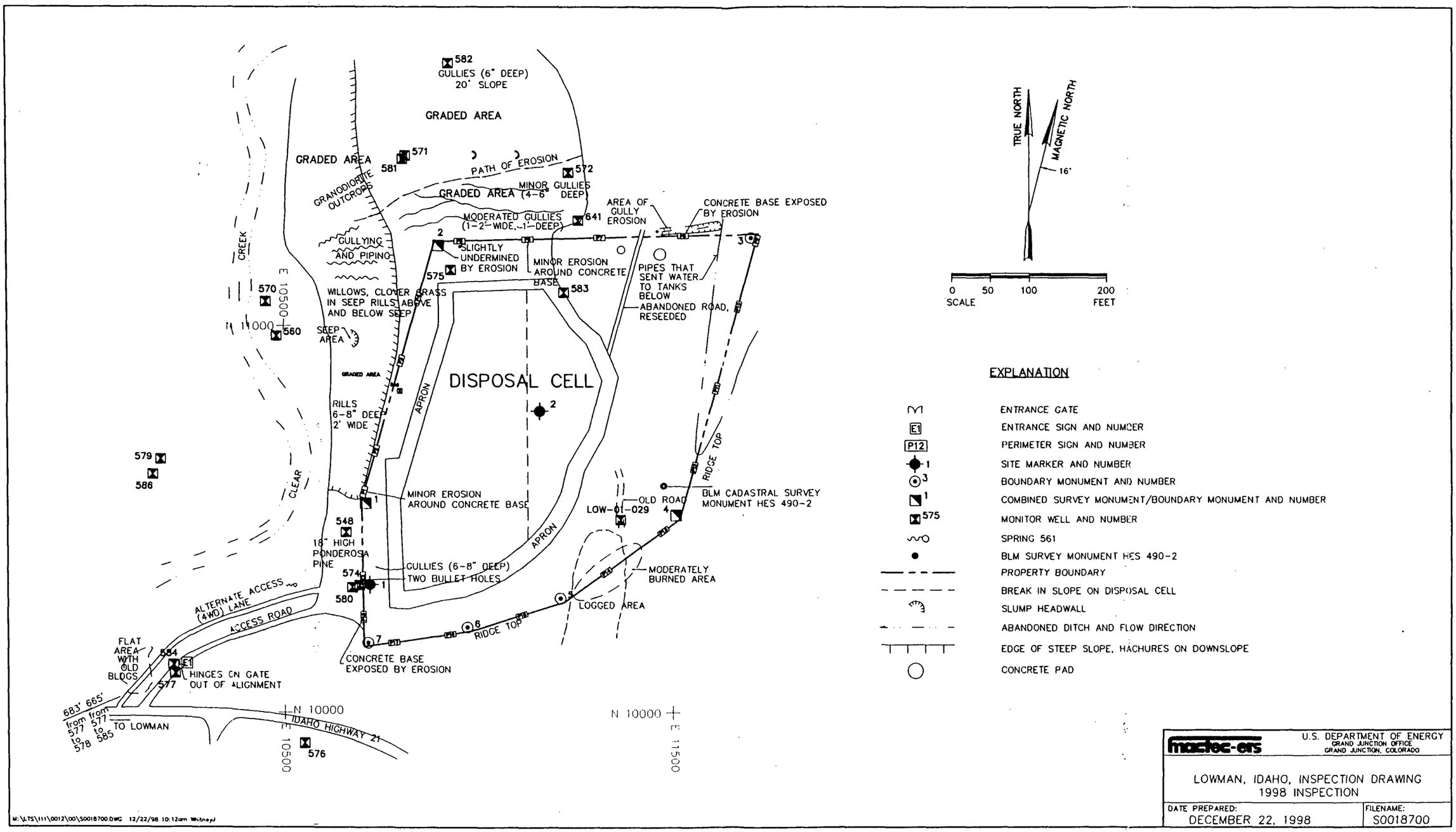
Eighteen perimeter signs mark the site boundary. All signs are legible and in good condition. Erosion has exposed 15 to 19 inches (in.) of concrete at the base of sign post P8, and 3 to 5 in. of concrete is exposed at the base of post P18. Erosion around these signs did not increase over the past year. Minor erosion around sign posts P1 and P6 was also noted. These perimeter signs are along the north and west boundaries of the site where the surface was regraded during the erosion control project completed in October. Success of the erosion control project will be evaluated in 1999.

Site Markers

The two site markers SMK-1, just inside the site boundary near the end of the access road, and SMK-2, on top of the disposal cell, are both in excellent condition.

Survey Monuments and Boundary Monuments

Seven monuments mark the boundary of the site. Three are combined survey–boundary monuments, SM-1/BM-1, SM-2/BM-2, SM-4/BM-4; and four are boundary monuments with less precise elevation control, BM-3, BM-5, BM-6, and BM-7. All seven monuments were in good condition except SM-2/BM-2, which was in an area of minor erosion. SM-2/BM-2 is at the northwest corner of the site where the surface was regraded during the erosion control project completed in October.



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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

LOWMAN, IDAHO, INSPECTION DRAWING
1998 INSPECTION

DATE PREPARED:	FILENAME:
DECEMBER 22, 1998	S0018700

Ground-Water Monitor Wells

There are six monitor wells at this site. All are inside the boundary except one, MW-580, that lies just outside the boundary near site marker SMK-1. A perennial spring or seep, referred to as Spring 561, lies between the site and Clear Creek near the southwest corner of the site. This spring is included in the monitoring network. All wells have cap-and-pin locking systems and are in excellent condition. (See Section 3.0 Ground-Water Monitoring.)

Erosion Control Project

The attempt, in 1991, to revegetate areas that were graded or disturbed during remedial action failed. As early as 1992, inspectors noted erosion starting to develop in revegetated areas north and west of the disposal site. In September and October 1998, DOE completed an erosion control project in these areas to reclaim the land damaged by erosion and to prevent erosion from migrating toward the disposal cell.

During the erosion control project, the slope north of the disposal site was regraded and three terraces were constructed to intercept runoff and divert it off site to the north and into Clear Creek. The poor quality soils in this area, and in selected areas west of the site, were carefully amended and reseeded. The success of the erosion control project will be fully assessed in the 1999 annual inspection report. Inspectors, or perhaps personnel from the U.S. Forest Service, will visit the site in the early spring of 1999 to check on the success of the erosion control project and to address problems that may have resulted from spring runoff.

2.2 Transects

Top and Side Slopes

The top and side slopes of the disposal cell are armored with basalt riprap. An apron of large diameter riprap, 25 to 35 ft wide, surrounds the disposal cell on all sides to protect the disposal cell from erosion. The riprap is in excellent condition.

The eastern third of the disposal cell is referred to as the top slope. It slopes gently to the west at a grade of about 10 percent. The western two-thirds of the disposal cell is referred to as the side slope. It slopes to the west at a grade of about 20 percent. Inspectors observed no cracks, depressions, slumps, or other indication of slope instability on or around the disposal cell.

Encroachment of vegetation (biointrusion) on the top and side slopes of the disposal cell is increasing. Ponderosa pine is the most noticeable species. Some of these trees are now 4 ft tall. Other species include redosier dogwood, whortleberry, Norway cinquefoil, common mullein, and thistle. The long-term effect of these plants on the integrity of the disposal cell will be evaluated.

Areas Immediately Adjacent to the Cell

A steep-sloped ridge rises above the disposal cell east and south of the site. The ridge and its slopes are covered with pine and thick grass. No evidence of erosion or slope instability has ever been seen on these slopes. Small scale logging occurred on the ridge sometime in the early 1990s, and this issue raised concern that erosion might develop. The logging was selective and did not involve clear cutting.

Several small depressions, some 1 to 2 ft wide and about as deep, continue to be noted by inspectors along the steep slopes and ridge top above the disposal cell. None of these depressions appear new; nor do they seem to be increasing in size or number.

A small hole of unknown origin was discovered in 1996 approximately 15 ft west of the western riprap apron. In 1996, this hole was about 7 in. in diameter and 30 in. deep. When measured in 1997, the hole was 34 in. in diameter and 11 in. deep. The hole now appears to have collapsed upon itself, and is no longer a concern.

Regions Adjacent to the Site Property

The area outward from the disposal site for a distance of 0.25 mile was visually inspected for evidence of construction, development, logging, or changes in land use that might affect the site. None was observed. Erosion in areas immediately north and west of the site is discussed above under Erosion Control Project.

3.0 Ground-Water Monitoring

Ground-water monitoring is required by the LTSP to demonstrate the initial performance of the disposal cell. The Lowman site is unique among uranium mill tailings sites in that the mill processed heavy mineral sands by a mechanical separation process to produce a columbite-euxenite and monazite sand concentrate. The concentrate was shipped elsewhere for chemical processing to produce columbium and tantalum oxides, uranium oxide, titanium and thorium compounds. Only residual, radioactive sand, consisting of refractory oxides and silicates with very low leachability characteristics, remained on site for remediation. No chemical process was used at the mill, so there are no process-related chemicals in underlying soils or local ground water. Ground water at the site is not contaminated. The purpose of post-remediation ground-water monitoring by the DOE is to demonstrate the initial performance of the disposal cell; or, in other words, to demonstrate that no contamination has occurred or is occurring as a result of the design, location, or construction of the disposal cell.

Monitor Well Network

The Long-Term Surveillance Plan (LTSP) designates seven sampling locations at the Lowman site (see Monitor Wells above). Sampling locations consist of six wells and one spring.

MW-583	Upgradient, north of the disposal cell
MW-641	Upgradient, north of the disposal cell
MW-548	Downgradient, west of the disposal cell
MW-549	Downgradient, west of the disposal cell
MW-575	Downgradient, northwest of the disposal cell
MW-580	Downgradient, southwest of the disposal cell
Spring 561	Spring or seep, downgradient, southwest of the disposal cell

Location of wells and spring are shown on Figure LOW-1.

Sampling Frequency

The six wells and one spring are sampled annually to demonstrate the initial performance of the disposal cell and to evaluate the need to continue monitoring. GJO sampled the site in 1997 and 1998. The results of sampling on these two occasions are presented below.

Analytes

The LTSP states that DOE will demonstrate the initial performance of the disposal cell by demonstrating compliance with U.S. Environmental Protection Agency ground-water protection standards. The compliance analyte at the Lowman site will be antimony at a concentration limit of 0.007 milligrams per liter (mg/L) (LTSP, Section 5.1.3.). In addition to antimony, samples are also analyzed for standard water quality indicators and field parameters.

Results of Ground-Water Monitoring

GJO sampled the six wells and one spring in 1997 and 1998. In all samples, the concentration of antimony was below the detection limit. (The instrument detection limit for antimony and similar metals is about 1.0 micrograms per liter [µg/L].)

Because of the low leachability characteristics of the radioactive sands in the disposal cell, and because of the design, location, and construction of the disposal cell, contamination of ground water is not expected. The analytical results show that indeed contamination is not occurring and has not occurred since remedial action was completed in 1991. The initial performance of the disposal cell is therefore adequately and sufficiently demonstrated.

4.0 Conclusions

The site is in good condition. Erosion in areas north and west of the disposal cell was corrected during an erosion control project completed in October. No additional maintenance is required at this time. Inspectors identified plant encroachment as an increasing problem that may require intervention. There will be a follow-up inspection in early spring to check on the success of the erosion control project.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Mexican Hat, Utah, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
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Summary

The Mexican Hat site, inspected on September 16, 1998, was in excellent condition. Minor problems with the security fence and three perimeter signs were noted. One boundary monument is exposed to erosion and eventually may have to be replaced. The seeps that are part of the ground-water monitoring network were inspected and sampled in May 1998. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Mexican Hat, Utah.

M.R. Widdop, Chief Inspector, and W.J. Waugh, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on September 16, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Mexican Hat, Utah*, February 1996. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-207, Rev. 1) for this site, and (2) procedures established by DOE-GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is requiredby the LTSP for this site. Results of ground-water monitoring are in Section 3.0 Ground-Water Monitoring.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into four areas referred to as transects: (1) the top of the disposal cell; (2) the side slopes of the disposal cell and surrounding diversion ditches; (3) the site perimeter; and (4) outlying areas. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown in Figure HAT-1.

2.1 Specific Site Surveillance Features

The site is surrounded by a high-quality barbed-wire fence. The entrance gate is chain link. The prefabricated chain-link panels on each side of the entrance gate have been replaced with barbed-wire fencing. Gate and fencing are generally in excellent condition. However, the perimeter fence requires several repairs.

A steel t-post near perimeter sign P-29 is broken off at ground level, and the wires at this location are loose (HAT PL-1). Inspectors noted missing clamps on angle braces near perimeter sign P-40 (HAT PL-2). The bottom strand was loose near boundary monument BM-5. Fence repairs will be completed in 1999.

There are 43 perimeter signs and 1 entrance sign at the site. All but three perimeter signs are in excellent condition. Perimeter signs P-14, P-15, and P-16, are defaced by graffiti scratched into the yellow paint. The signs remain fully legible and functional. The graffiti can not be seen from a distance. Inspectors also noted that the black paint is thin or faded on some of the other perimeter signs. These signs eventually may have to be replaced.

The 2 site markers, 4 survey monuments, 12 boundary monuments, and 6 settlement plate casings were inspected and found to be in good condition.

2.2 Transects

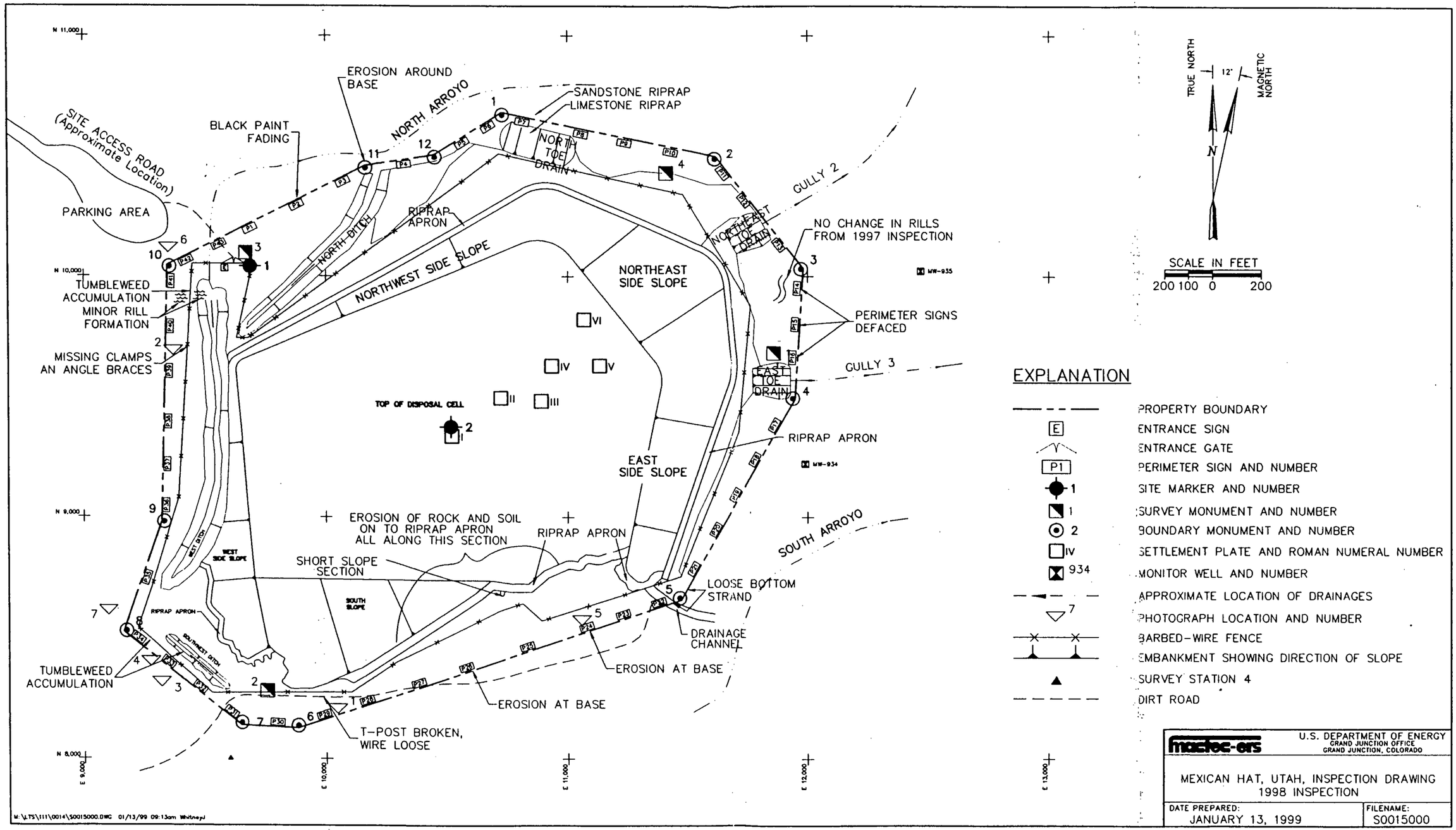
Top of Disposal Cell

The top of the disposal cell is in excellent condition. The inspectors saw no evidence of differential settling, cracking, erosion, plant growth, or burrowing.

Side Slopes and Diversion Ditches

The riprapped side slopes on the disposal cell and surrounding diversion ditches are also in excellent condition. There is no plant encroachment on the side slopes or in the riprapped diversion ditches. There is minor accumulation of tumbleweeds in the southwest diversion ditch (HAT PL-3), but the accumulation is too small to interfere with the ditch.

Sloughing of rock and soil from the cliffs above the south apron of the disposal cell continues, but the scree slope along the base of the cliffs is not significantly larger than before. The scree slope is approximately 18-to-24-in. high against the base of the vertical face of native rock. Some larger pieces of sandstone (up to 12-in. in diameter) have rolled down the cliff face and out onto the riprap apron, as noted during previous inspections (HAT PL-4). Mass wasting from the cliffs above the south apron is a slow process that is expected to continue. It is not a result of large-scale erosion in the cliffs above. Nor is this small accumulation of scree at the base of the cliffs a threat to the long-term performance of the disposal cell.


EROSION AROUND BASE
NORTH ARROYO
SANDSTONE RIPRAP
LIMESTONE RIPRAP
BLACK PAINT FADING
SITE ACCESS ROAD (Approximate Location)
PARKING AREA
NORTH TOE DRAIN
GULLY 2
NORTHEAST TOE DRAIN
NO CHANGE IN RILLS FROM 1997 INSPECTION
RIPRAP APRON
NORTH DITCH
NORTHWEST SIDE SLOPE
NORTHEAST SIDE SLOPE
TUMBLEWEED ACCUMULATION
MINOR RILL FORMATION
MISSING CLAMPS AN ANGLE BRACES
PERIMETER SIGNS DEFACED
GULLY 3
EAST TOE DRAIN
TOP OF DISPOSAL CELL
RIPRAP APRON
EAST SIDE SLOPE
EROSION OF ROCK AND SOIL ON TO RIPRAP APRON ALL ALONG THIS SECTION
RIPRAP APRON
SOUTH ARROYO
SHORT SLOPE SECTION
WEST SIDE SLOPE
SOUTH SLOPE
LOOSE BOTTOM STRAND
DRAINAGE CHANNEL
EROSION AT BASE
EROSION AT BASE
TUMBLEWEED ACCUMULATION
T-POST BROKEN, WIRE LOOSE
RIPRAP APRON
SOUTHWEST DITCH
WEST DITCH
MW-935
MW-934
N 11,000
N 10,000
N 9,000
N 8,000
E 9,000
E 10,000
E 11,000
E 12,000
E 13,000
TRUE NORTH
MAGNETIC NORTH
12°
N
SCALE IN FEET
200 100 0 200
EXPLANATION
PROPERTY BOUNDARY
ENTRANCE SIGN
ENTRANCE GATE
PERIMETER SIGN AND NUMBER
SITE MARKER AND NUMBER
SURVEY MONUMENT AND NUMBER
BOUNDARY MONUMENT AND NUMBER
SETTLEMENT PLATE AND ROMAN NUMERAL NUMBER
MONITOR WELL AND NUMBER
APPROXIMATE LOCATION OF DRAINAGES
PHOTOGRAPH LOCATION AND NUMBER
BARBED-WIRE FENCE
EMBANKMENT SHOWING DIRECTION OF SLOPE
SURVEY STATION 4
DIRT ROAD
U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO
MEXICAN HAT, UTAH, INSPECTION DRAWING
1998 INSPECTION
DATE PREPARED:
JANUARY 13, 1999
FILENAME:
S0015000

Site Perimeter

Boundary monument BM-11 is on a steep slope and erosion has occurred beneath the concrete "boot" or pedestal that anchors the monument. This monument moves slightly when touched. Several perimeter signs and boundary monuments are also on steep slopes and exposed to erosion. The eroded base of perimeter sign P-24 is shown in HAT PL-5. Monuments and signs in unstable locations will be monitored during future inspections.

Minor rill formation, previously noted, occurs between the fence and perimeter signs P-14 and P-15 . The rills appear unchanged over the past year, and plants are beginning to grow in some of the rills. This situation suggests that erosion may have stopped or is at least decreasing. Rills are also present between the fence and the west drainage ditch near perimeter sign P-40 (HAT PL-6). Both areas will continue to be monitored. Other slopes around the disposal cell appear stable, with apparently stable rock exposures at the surface of the slopes and only minor accumulations of loose material or scree at the bottom of the slopes.

Tumbleweeds catch in the fence, as for example, near boundary monuments BM-10 and BM-8 (HAT PL-6 and HAT PL-7, respectively). The accumulation this year is less than in the past.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development or disturbance that could affect the site was observed. Nothing notable seems to have changed since the site was constructed in 1994.

The ground-water monitoring network at this site consists exclusively of seeps along the two washes north and east of the disposal cell. The seeps were not inspected during this inspection because they were inspected when sampled in November 1997 and in May and November 1998. In November 1997, 10 of the 11 seeps produced sufficient water to be sampled. Seep 254 was dry and could not be sampled. In May 1998, 9 of the seeps produced sufficient water to be sampled. In November 1998, 7 of the seeps produced sufficient water to be sampled. Seep 251 provided sufficient water for a partial sample, but Seeps 248, 249, and 254 were essentially dry. Seep locations are shown in Figure HAT-2.

3.0 Ground-Water Monitoring

DOE monitors ground water at several seeps downgradient from the site in response to a request from the Navajo Nation. The seeps are along North Arroyo, north of the site, and Gypsum Creek, east of the site.

Ground water in the underlying Halgaito Shale is limited in areal extent and the low hydraulic conductivity of the shale results in low water yields so that monitor wells are not practical. Water in naturally occurring seeps is believed to be representative of ground water in the underlying Halgaito Shale. The Halgaito Shale would be the uppermost aquifer if it produced enough water to be an aquifer.

Eleven seeps are sampled when there is sufficient water. Only a few of the seeps flow perennially. Flow in the others is dependent on recent precipitation. Some seeps may be dry or yield too little water to be sampled after periods of dry weather.

Of the 11 seeps, 3 are in North Arroyo and 8 along Gypsum Creek. Two of the seeps, Seep 256 and Seep 261, are sufficiently far upstream from the disposal site to be considered representative of upgradient (background) ground water. Seep locations are shown in Figure HAT-2.

Frequency of Monitoring

The LTSP specifies that DOE will monitor the seeps periodically. The period is unspecified. In fiscal year 1998, DOE sampled the seeps twice, in November 1997 and again in May 1998. DOE will sample the seeps quarterly in 1999. (Results of sampling in November 1998 will be included in the 1999 annual report.)

Analytes

The LTSP does not specify analytes. DOE currently analyzes samples for standard water-quality indicators, field parameters, and the following list of hazardous constituents for which there is a corresponding U.S. Environmental Protection Agency maximum concentration limit (MCL):

arsenic	lead	radium-226 and radium-228
cadmium	molybdenum	selenium
chromium	nitrate	gross alpha
gross alpha		

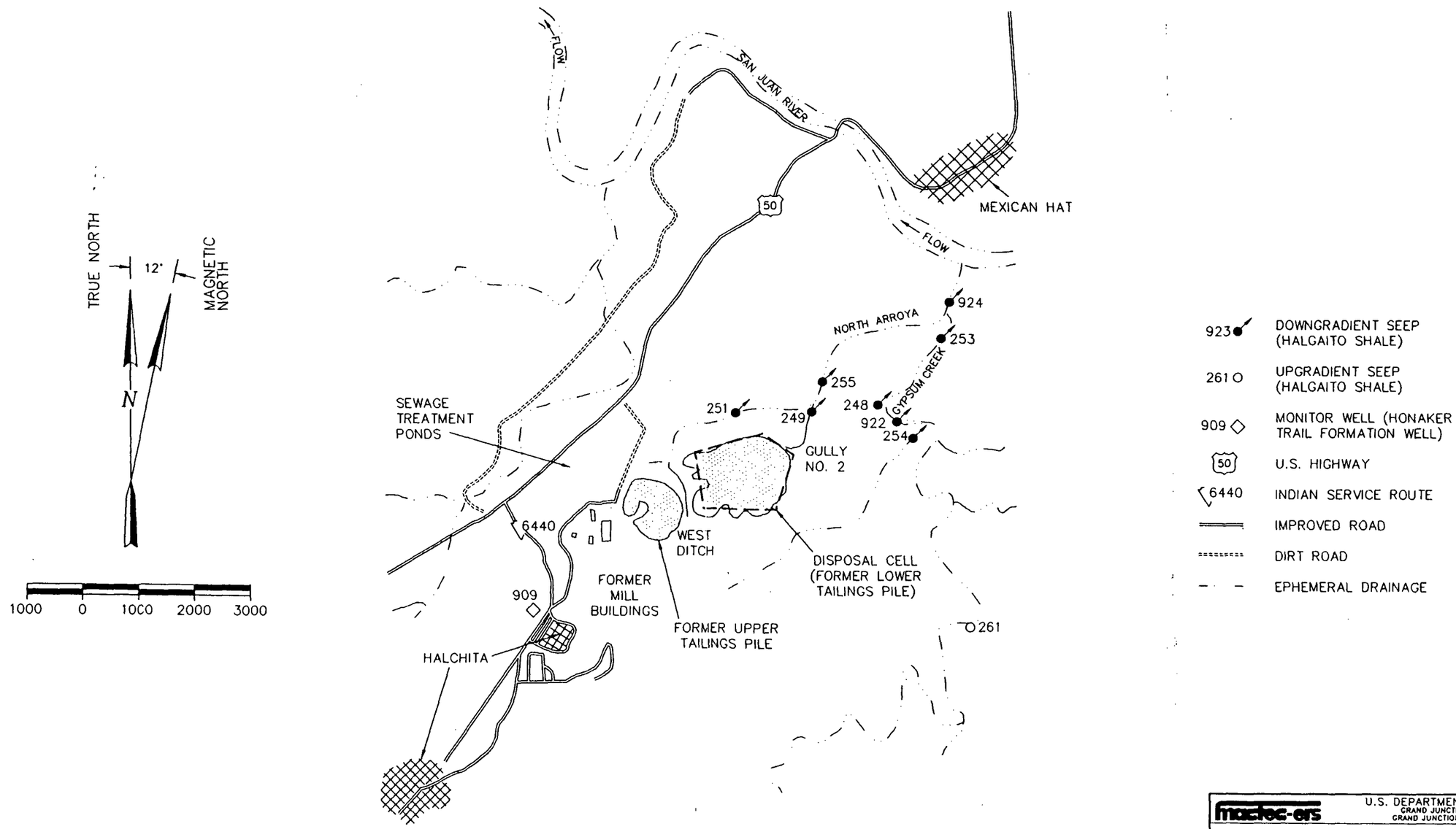
Results of Ground-Water Monitoring in 1997 and 1998

Ground water in the seeps was sampled in November 1997 and May and November 1998. (Results of sampling in November 1998 will not be available for inclusion in this report. The November 1998 results will be included in the 1999 annual report). Results of sampling in November 1997 and May 1998 are presented in Table HAT-1. The MCL for each hazardous constituent is also included in the table.

The following constituents were detected above the respective MCL in one or more samples collected in November 1997 and May 1998:

gross alpha	nitrate	uranium
molybdenum	selenium	

The gross alpha standard (15 picocuries per liter [pCi/L]) excludes contributions from uranium and radon-222 decay. However, the gross alpha results in Table HAT-1 include contributions from those two sources. If uranium activity (1 microgram [μg] uranium ≈ 0.68 pCi uranium-234 + uranium-238) is subtracted from the gross alpha values in the table, it is evident that most or all of the alpha activity is attributable to uranium in the seep samples.



NOTE: WELL AND SEEP LOCATIONS ARE APPROXIMATE

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

SEEP LOCATIONS AT MEXICAN HAT, UTAH, DISPOSAL SITE

DATE PREPARED:	FILENAME:
JANUARY 11, 1999	S0018900

Table HAT-1. Summary of Seep Sample Analytical Results

Analyte	MCL	Seep Sample Location (November 1997 and May 1998)									
		256 (upgradient)	261 (upgradient)	248	249	251	253	255	922	923	924
Arsenic	0.05	0.0038 0.001 U [a]	0.001 U 0.001 U	0.001 U 0.001 U	0.0026 0.0016	0.0027 0.0018	0.0018 0.0021	0.0019 0.003	0.0017 0.0015	0.0015 ND [c]	0.0019 0.002
Cadmium	0.01	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U ND	0.001 U 0.001 U
Chromium	0.05	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U 0.002 U	0.005 U ND	0.005 U 0.002 U
Gross alpha	15 [b]	48.9 U 26.7 U	38.7 U 43.2 U	381 355.7	430 421.3	242.4 209.3	329.7 188.9	317.5 631.4	196.8 182.8	52.7 ND	351.7 278.4
Lead	0.05	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U 0.001 U	0.001 U ND	0.001 U 0.001 U
Molybdenum	0.10	0.0031 0.0088	0.0085 0.0080	0.0414 0.0445	0.0412 0.0460	0.268 0.228	0.0423 0.0874	0.0476 0.0976	0.0305 0.0275	0.047 ND	0.0755 0.0933
Nitrate as NO_3	44	0.138 0.0773 U	0.474 0.108 U	212 249	468 427	395 419	112 106	425 911	132 159	1.52 ND	103 103
Radium-226 + 228	5	3.95 0.25	0.08 0.08	0.09 0.6 U	0.19 0.23	0.9 U 0.27	0.10 0.25	0.11 0.7 U	0.14 0.13	0.06 ND	0.16 0.32
Selenium	0.01	0.001 U 0.0021	0.008 0.001 U	0.235 0.287	0.0243 0.0288	0.0081 0.005	0.0366 0.0444	0.0209 0.0459	0.033 0.0349	0.0254 ND	0.0394 0.0463
Uranium	0.044	0.0202 0.0232	0.231 0.0148	0.580 0.676	0.788 0.792	0.460 0.449	0.466 0.370	0.643 1.37	0.337 0.366	0.0327 ND	0.403 0.393

All results in mg/L except Ra-226 + 228 and gross alpha in pCi/L.
(a) U = undetected at respective laboratory reporting limit.
(b) Excludes contributions from uranium and radon-222 decay. Ground-water sample results include uranium and radon-222 decay.
(c) ND = no data: location 923 dry in May 1998.

Upgradient seeps, Seeps 256 and 261, contained detectable quantities of arsenic, molybdenum, nitrate, radium-226 + radium-228, selenium, and uranium. However, the concentrations were generally very low, near the laboratory detection limit for each constituent, and were lower to much lower than the (1) the respective MCL value for each constituent and (2) downgradient results for the same analytes.

The MCL for gross alpha activity, nitrate, selenium, and uranium, was exceeded at each downgradient seep with the exception of the Seep 923, where only gross alpha and selenium were above the MCL. Most of the remaining analyte concentrations at that location were comparable to upgradient or background values, indicating that Seep 923 may be near the eastern margin of downgradient contamination from former milling operations and the disposal cell.

The MCL for molybdenum was exceeded only at Seep 251. In general, except for Seep 923, contaminant concentrations are relatively uniform among downgradient seeps, and do not show a tendency to decrease with downgradient distance (northeast) of the disposal cell.

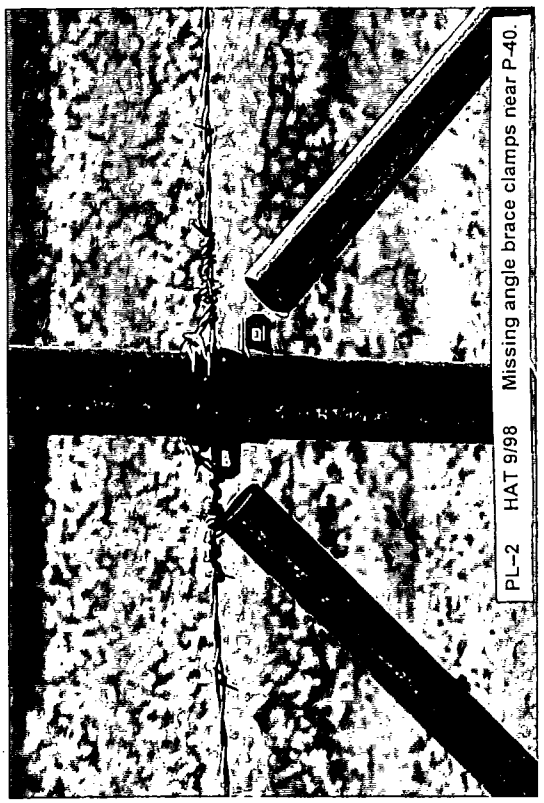
4.0 Conclusions

The Mexican Hat site is in excellent condition. Inspectors identified minor maintenance problems with the security fence and several features that require continued monitoring. No cause for a follow-up inspection was identified.

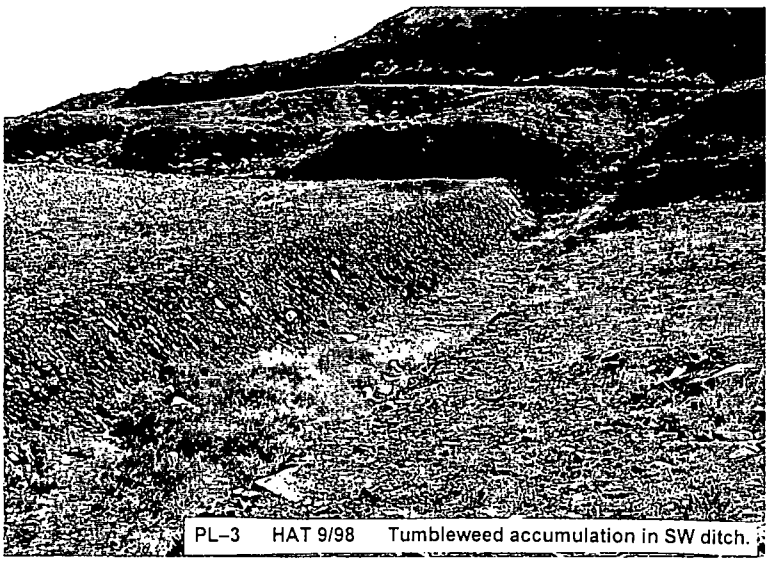
5.0 Photographs

Table HAT-2. Photographs taken at Mexican Hat, Utah, Disposal Site

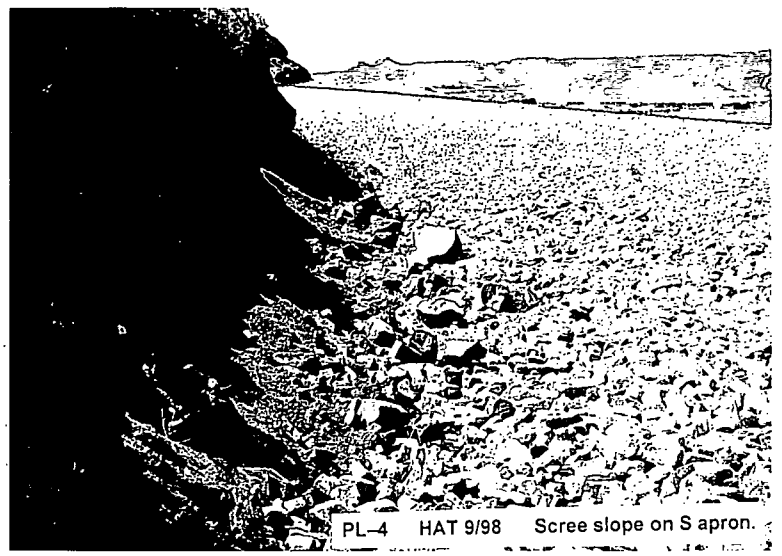
Photograph Location Number	Photograph Description/Remarks
HAT PL-1	Broken t-post and loose strand near perimeter sign P-29.
HAT PL-2	Missing angle brace clamps near perimeter sign P-40.
HAT PL-3	Tumbleweed accumulation in southwest ditch.
HAT PL-4	Scree slope on south apron.
HAT PL-5	Erosion at base of perimeter sign P-24.
HAT PL-6	Rill formation and tumbleweed accumulation near perimeter sign P-40.
HAT PL-7	Tumbleweed accumulation near boundary monument 8.



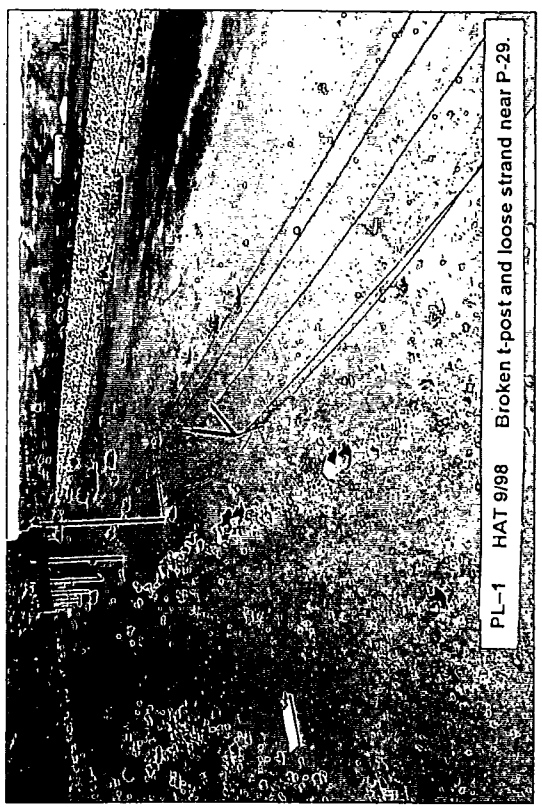
PL–2 HAT 9/98 Missing angle brace clamps near P-40.



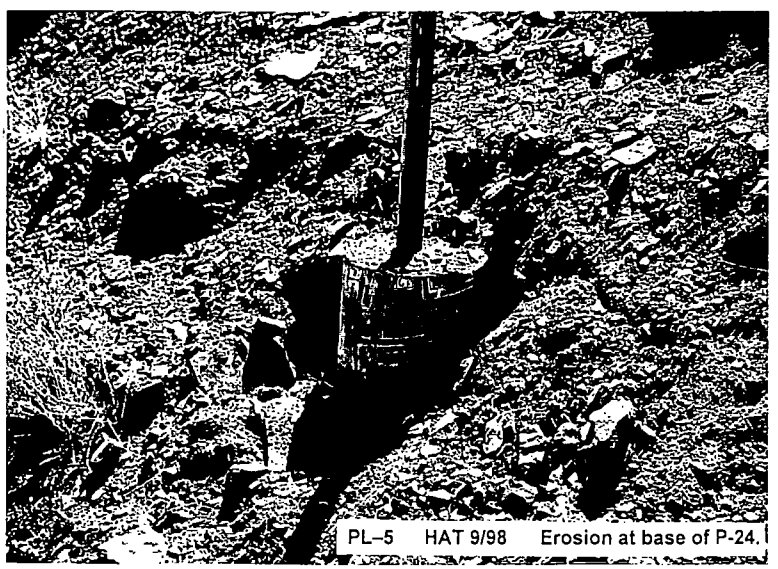
PL–3 HAT 9/98 Tumbleweed accumulation in SW ditch.



PL–4 HAT 9/98 Scree slope on S apron.



PL–1 HAT 9/98 Broken t-post and loose strand near P-29.



PL–5 HAT 9/98 Erosion at base of P-24.

PL–7 HAT 9/98 Tumbleweed accumulation near BM-8.

PL–6 HAT 9/98 Rill formation and tumbleweed accumulation near P-40.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Rifle, Colorado, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC 99-06
Document Number S00184

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Summary

The Rifle disposal site, inspected on August 6, 1998, is in excellent condition. Monitoring of water levels in standpipes and success of revegetation continues. Water level in standpipe MW-3 has risen to about 6,014 ft. This triggers an action level that requires DOE to evaluate the problem by continued quarterly monitoring and review of the contingency plan in preparation for implementation of the plan if it becomes necessary. Inspectors identified no maintenance requirements and found no cause for a follow-up inspection.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Rifle, Colorado.

M.P. Plessinger, Chief Inspector, and M.J. Gardner, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on August 6, 1998. J. Hams of the Colorado Department of Public Health and Environment participated in the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Estes Gulch Disposal Site Near Rifle, Colorado*, March 1997. U.S. DOE, Albuquerque, N.M., DOE/AL-62350-235, Rev. 0) for this site, and (2) procedures established by the GJO to comply with the requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is not required by the LTSP at this site. However, GJO records water levels in two standpipes in the disposal cell in response to a request from the state. An update on water levels in these two standpipes is included in this report.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into four areas referred to as transects: (1) the riprapped top of the disposal cell and interceptor trench; (2) the riprapped toe drain and toe drain outlet; (3) reclaimed areas surrounding the disposal cell; and (4) outlying areas. Each of these transects was inspected by walking a series of traverses. Part of the outlying areas transect was observed from a distance.

Within each transect, inspectors examined specific site surveillance features, such as survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might compromise site integrity or affect the

long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure RFL-1.

2.1 Specific Site Surveillance Features

Access Road, Entrance Sign, Perimeter Signs

Access to the Rifle disposal site is from an improved, all-weather gravel road that leads to the site from Colorado State Highway 13. The entrance gate consists of a pair of tubular metal gates hung on galvanized steel posts. A chain and padlock secures the two gates to each other.

A conventional barbed-wire stock fence partly surrounds the site. The fence extends from the entrance gate to steep gullies that bound the site on the east and west.

In the spring of 1998, a rancher notified GJO and the Bureau of Land Management that his cattle were going around the fence to graze on revegetated areas of the site. GJO contracted with the rancher to extend the east end of the fence to the north for 600 feet (ft) into the riprapped outflow channel to prevent cattle from gaining access from the east.

During the annual site inspection, inspectors extended the fence on the west end down into the gulch for about 75 ft to discourage cattle from going around the fence at the west end as well (RFL PL-1A and RFL PL-1B). The success of these fence modifications needs to be evaluated next spring when cattle are again on the adjoining grazing leases. (At some time, controlled grazing might actually benefit the revegetated areas, but not until the vegetation is well established.)

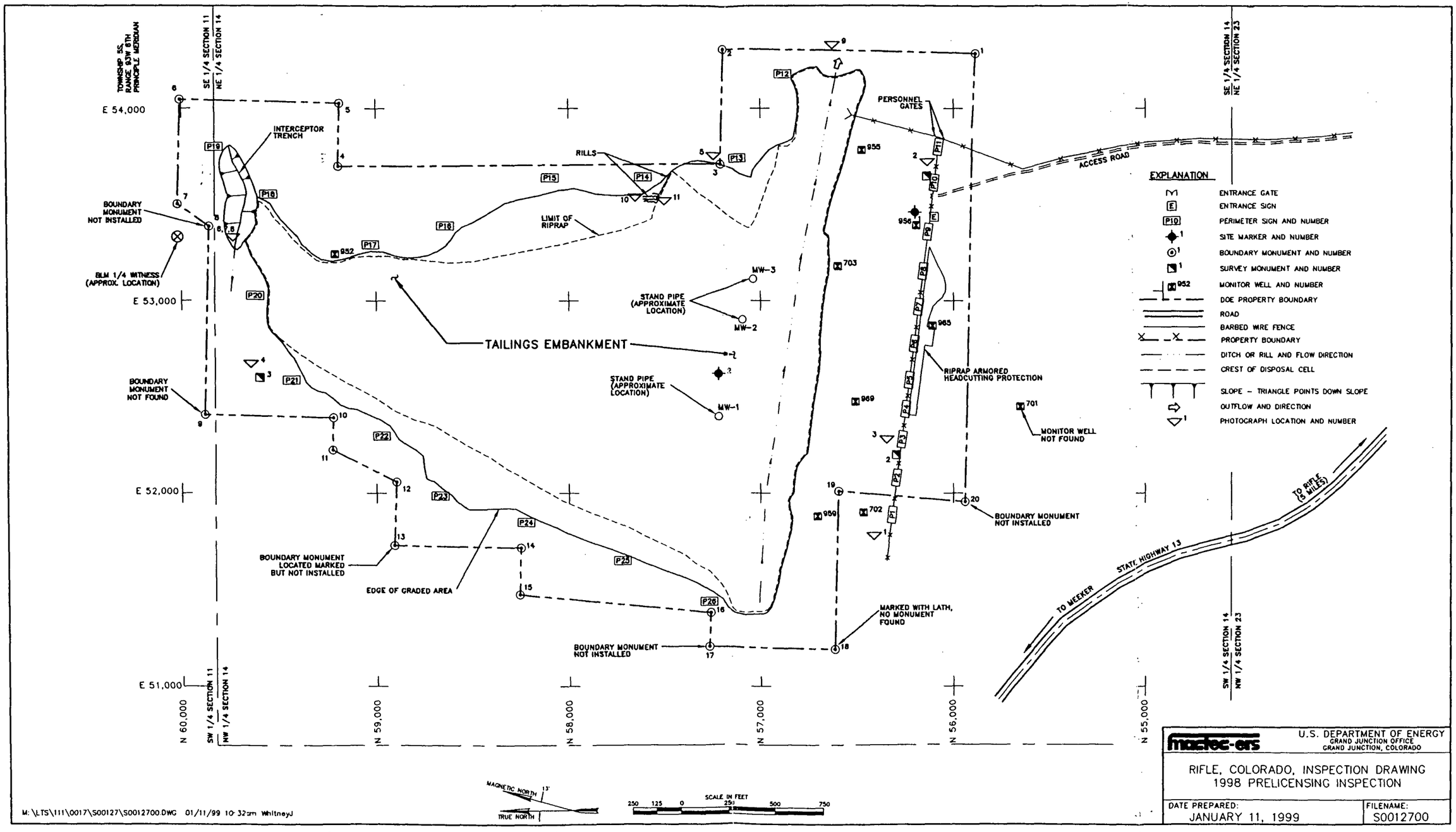
The entrance sign is just left (west) of the entrance gate. Along the southern edge of the site, perimeter signs are attached to the fence. Elsewhere the signs are mounted on galvanized steel posts set along the edge of the riprap that covers the disposal cell.

The access road, gate, fence, entrance sign, and all perimeter signs are in good condition. Inspectors found one perimeter sign, P11, on the ground, probably loosened by cattle rubbing against the sign. Inspectors reattached the sign.

Site Markers, Survey and Boundary Monuments

There are two granite site markers at the site: SMK-1 is just inside and to the left of the entrance gate, and SMK-2 is in the southern half of the disposal cell near the center of the break in slope between the top slope and south side slope. Both markers are in excellent condition.

The site has three survey monuments and an uncertain number of boundary monuments. Thethree survey monuments, SM-1, SM-2, and SM-3, are in excellent condition (RFL PL-2, RFL PL-3, and RFL PL-4). At the time of the 1997 inspection, inspectors were unable to locatethe three survey monuments. Inspectors located and inspected all three survey monuments in 1998.



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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

RIFLE, COLORADO, INSPECTION DRAWING
1998 PRELICENSING INSPECTION

DATE PREPARED:	FILENAME:
JANUARY 11, 1999	S0012700

The site boundary has 20 corners because of steep gullies on both the east and west sides of the site. Only 15 boundary monuments were installed because steep terrain prevented installation of the remaining 5 monuments. Inspectors located 14 of the 15 monuments. At the presumed location of boundary monument BM-18, there was a piece of lath in the ground but no monument. In 1997, inspectors were unable to locate BM-3. Inspectors located and photographed BM-3 this year (RFL PL-5). All 14 boundary monuments that were located are in excellent condition.

Standpipes

Three standpipes, MW-1, MW-2, and MW-3, are installed in the disposal cell (Figure RFL-1). Their purpose is to monitor water levels within the disposal cell. Standpipe MW-1 is dry and provides no data. A data logger in MW-2 has not functioned properly, so there is no useful historic data from this standpipe. A new data-logger was installed in MW-2 in December 1998. Data from MW-3 are shown in Figure RFL-2. (Noise or oscillations in the data are attributed to changes in barometric pressure.) DOE regards the regression line superimposed on the data in Figure RFL-2 to represent mean water level. Data loggers are downloaded quarterly.

The south or downslope end of the disposal cell, beneath the cover, consists of a berm or earthen dam. A liner extends part way up on the inside of the berm to an elevation of 6,018 ft. If water in the disposal cell should rise above this elevation, it might overflow the liner and saturate the berm. DOE has agreed to monitor water level in the disposal cell against this possibility.

The LTSP (Appendix, page 2-1) identifies action levels when water in the standpipes reaches elevations of 6,014 ft and 6,016 ft. At 6,014 ft, DOE will begin to evaluate the problem and anticipate a possible need to intervene. At 6,016 ft, DOE must intervene by implementation of the contingency plan in the LTSP. The contingency plan requires DOE to pump the standpipe wells to lower the water level to 6,014 ft.

In the last three months of 1998, the water level in MW-3 rose 2 to 2.5 in. above the 6,014 ft elevation (Figure RFL-2). This is a continuation of a rising trend over the last year and a half, beginning with the first data collected in August 1987. Water above the 6,014 ft datum triggers the first action level. During the evaluation required at this action level, DOE will (1) continue to monitor the standpipes by downloading the data loggers on a quarterly basis, and (2) will review the contingency plan for possible implementation. If the rising trend in water level does not flatten or decrease, DOE will prepare to implement the contingency plan.

2.2 Transects

Top of Disposal Cell and Interceptor Trench

The top of the disposal cell and the south face (of side slope) of the disposal cell are armored with riprap. The rock is in excellent condition. A few tufts of bunch grass and sweet clover are growing in the riprap on top of the disposal cell. Plant encroachment is not considered a problem at this time.

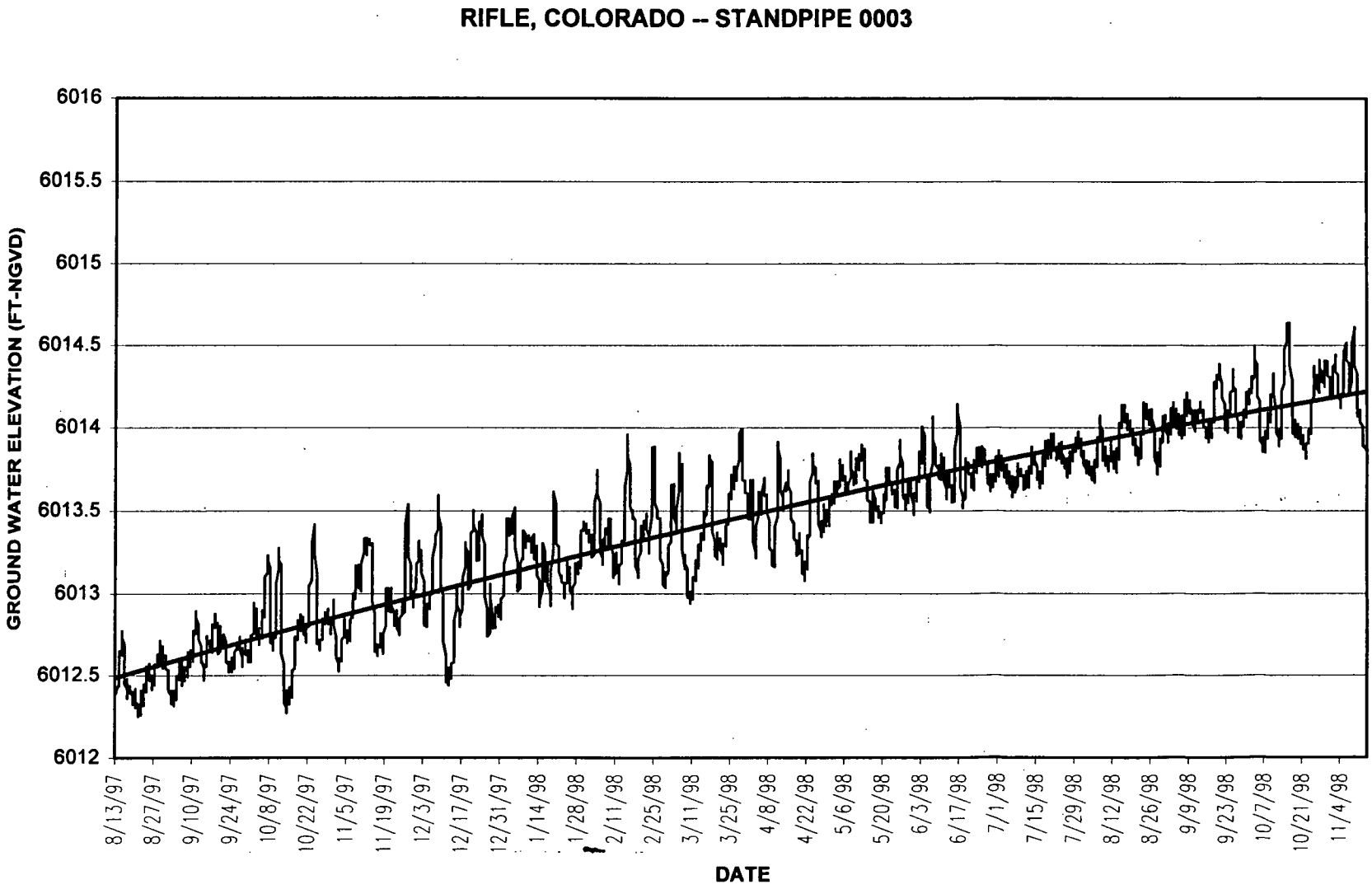


Figure RFL-2. Data from Standpipe MW-3

An unlined interceptor trench at the uphill end or apex of the disposal cell protects the disposal cell from erosion and stormwater run on (Figure RFL-1). The trench diverts water into the natural drainage (gulch) on the west. Erosion is occurring in the bottom of the interceptor trench, but this aspect was anticipated in the design (RFL PL-6, RFL PL-7, and RFL PL-8). The interceptor trench is expected eventually to erode to bedrock.

Toe Drain and Toe Drain Outlet

The toe drain and toe drain outlet lie at the bottom of the south face (or side slope) of the disposal cell. Both are armored with riprap and are in excellent condition. Erosion beyond the mouth of the toe drain outlet is occurring, but this too was anticipated in the design (RFL PL-9). The outlet is designed to "self-armor" as erosion removes finer materials and allows larger riprap to drop into the developing channel. The toe drain outlet has eroded back to a bedrock fall or knickpoint. The bedrock is expected to prevent further headcutting.

Reclaimed Areas

After the disposal cell was completed, disturbed areas immediately surrounding the disposal cell and to the south of the disposal cell were reseeded to reestablish local, native vegetation. Vegetation in areas south of the disposal cell is in excellent condition. Vegetation in areas on the east and west flanks of the disposal cell has not yet achieved the same level of success. As mentioned above, cattle grazed the revegetated areas last spring. Grazing did not damage the vegetation and may have improved it. The progress of the revegetation will continue to be monitored.

Minor rill erosion was noted in the graded and reseeded area on the east side of the disposal cell (RFL PL-10 and RFL PL-11). The erosion is expected to decrease once the new vegetation becomes more fully established. The area will continue to be monitored for erosion.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development or disturbance that could threaten the long-term stability of the disposal cell was observed.

Just beyond the south edge of the disposal cell, a gully is armored with riprap to prevent headcutting from moving toward the disposal cell. Inspectors made approximate measurements of the size and location of this feature (Figure RFL-1).

3.0 Ground-Water Monitoring

Ground-water monitoring in addition to monitoring water levels in the standpipes is not required at this site because (1) the multiple component cover over the tailings will prevent infiltration and leaching of hazardous constituents; (2) ground water in the underlying Wasatch Formation is

of limited use; and (3) the disposal cell is geologically isolated from the uppermost useable aquifer by 3,800 ft of low-permeability sedimentary rocks (siltstones).

4.0 Conclusions

The Rifle site is in excellent condition. No maintenance is required. Water levels in standpipes and success of revegetation will continue to be monitored. No cause for a follow-up inspection was identified.

5.0 Photographs

Table RFL-1. Photographs taken at Rifle, Colorado, Disposal Site

Photograph Location Number	Photograph Description/Remarks
RFL PL-1A	Fence extension at West end of fence.
RFL PL-1B	Second view of fence extension at West end of fence.
RFL PL-2	Survey monument 1.
RFL PL-3	Survey monument 2.
RFL PL-4	Survey monument 3.
RFL PL-5	Boundary monument 3.
RFL PL-6	Erosion at outlet of apex diversion channel.
RFL PL-7	Second view of erosion at outlet of apex diversion channel.
RFL PL-8	View from bottom toward top of apex diversion channel.
RFL PL-9	Erosion at toe drain outlet.
RFL PL-10	Rills on East side of tailings embankment.
RFL PL-11	Second view of rills on East side of tailings embankment.

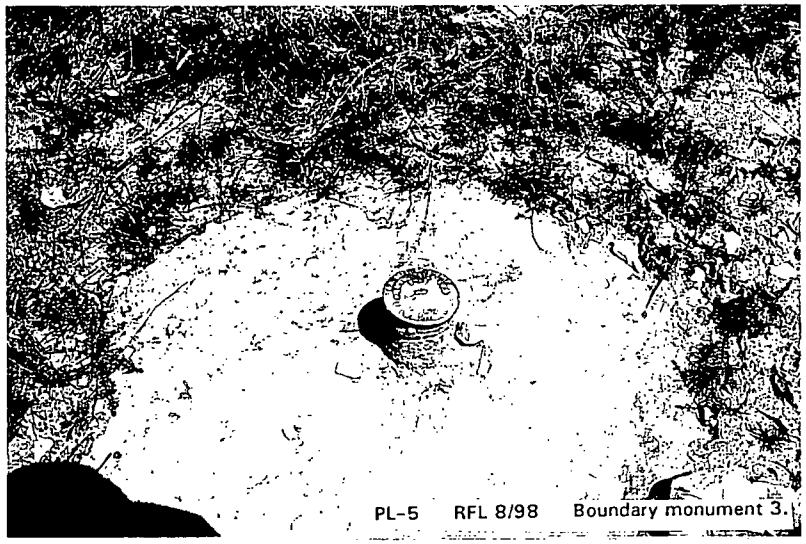
PL-1A RFL 8/98 Fence extension at W end of fence.

PL-1B RFL 8/98 Second view of fence extension at W end of fence.

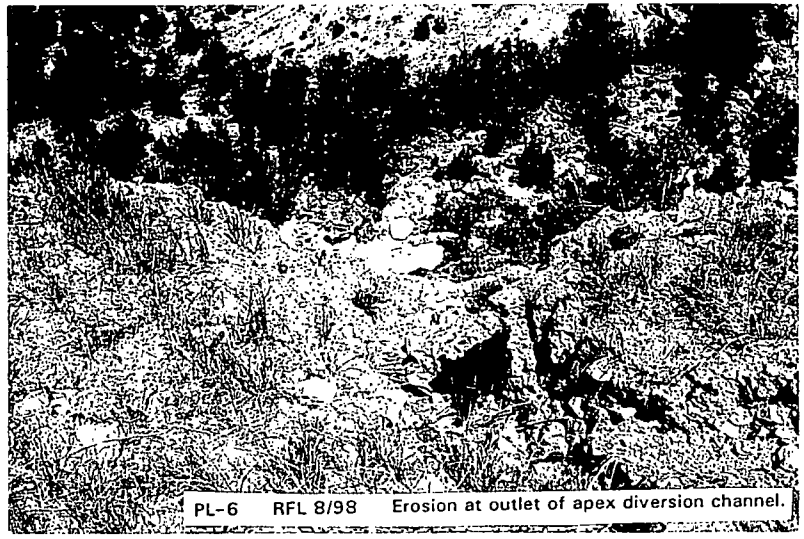
PL-2 RFL 8/98 Survey monument 1.

PL-3 RFL 8/98 Survey monument 2.

PL-4 RFL 8/98 Survey monument 3.



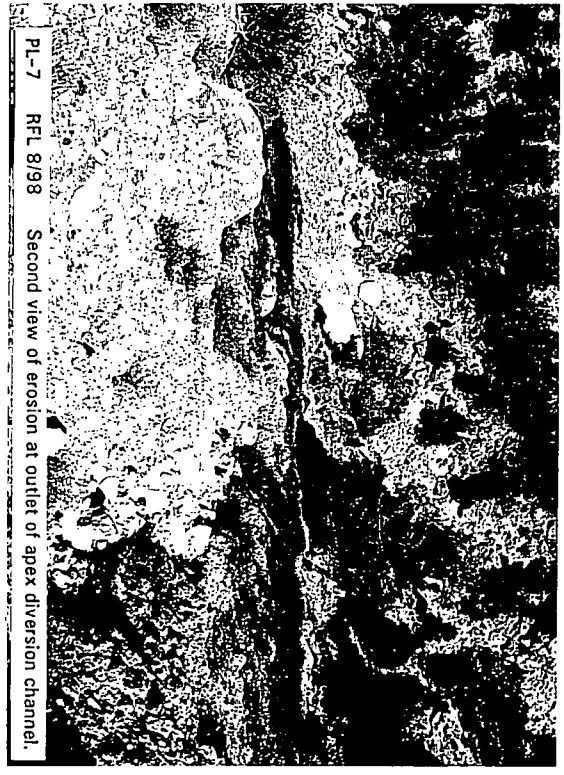
PL-5 RFL 8/98 Boundary monument 3.



PL-6 RFL 8/98 Erosion at outlet of apex diversion channel.

PL-9 RFL 8/98 Erosion at toe drain outlet.

PL-8 RFL 8/98 View from bottom toward top of apex diversion channel.



PL-7 RFL 8/98 Second view of erosion at outlet of apex diversion channel.

PL-10 RFL 8/98 Rills on E side of tailings embankment.

PL-11 RFL 8/98 Second view of rills on E side of tailings embankment.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Salt Lake City, Utah, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC 99-06
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Figure SLC-1. Salt Lake City, Utah, 1998 Inspection Drawing SLC-3

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Summary

The Salt Lake City (South Clive) site, inspected on June 17, 1998, is in good condition. Two personnel gates have been installed in the security fence. This restores DOE access to areas between the security fence and Envirocare's fence along the site boundary. No maintenance is required, and no cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Salt Lake City (South Clive), Utah.

M.P. Plessinger, Chief Inspector, and G.M. Smith, Assistant Inspector, both of MACTEC–ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on June 17, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the South Clive, Utah*, September 1997. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-228, Rev. 2) for this site, and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into four areas referred to as transects: (1) the riprapped top of the disposal cell; (2) the riprapped side slopes of the disposal cell together with the toe drain, maintenance road, and perimeter diversion channel; and (3) the site perimeter. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on Figure SLC-1.

2.1 Specific Site Surveillance Features

Access Road, Entrance Gate, and Entrance and Perimeter Signs

Access to the Salt Lake City disposal site is via paved and graded roads. The last 0.25 mile of graded road crosses Envirocare property along a permanent easement. Roads are in good condition.

The entrance gate is chain link with three strands of barbed wire at the top. The gate is in excellent condition. The gate is secured by a padlock and chain.

The entrance sign and all perimeter signs were in excellent condition.

Site Markers, Survey Monuments, and Boundary Monuments

There are two granite site markers: SMK-1, just inside the south entrance gate, and SMK-2, on top of the disposal cell. Both markers were in excellent condition.

Four boundary monuments, BM-1, BM-2, BM-3, and BM-4, were in place and in good condition.

2.2 Transects

Top of Disposal Cell

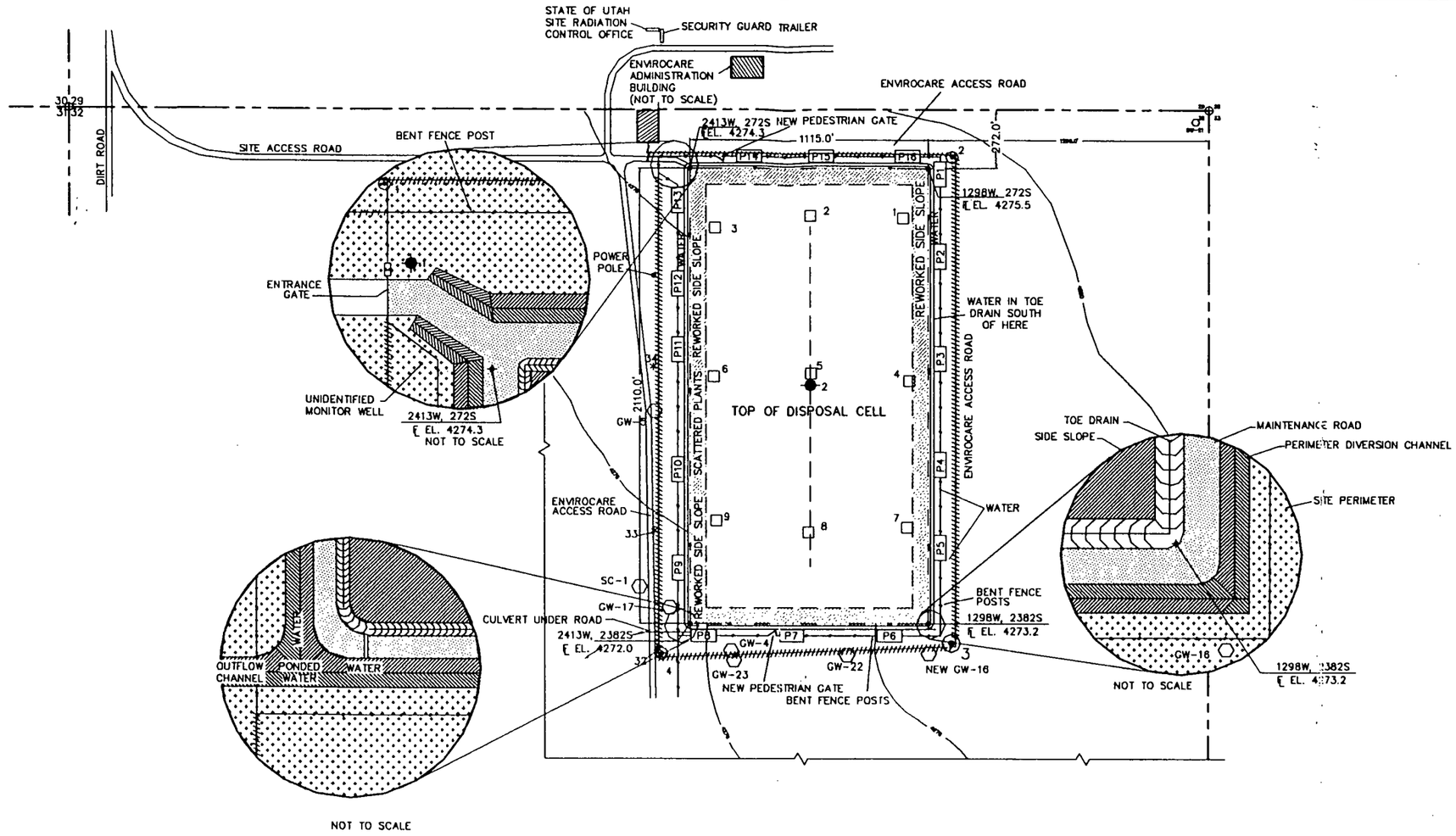
The top of the disposal cell is in excellent condition. No evidence of erosion, settling, slumping, or encroachment of vegetation was seen.

Side Slopes, Toe Drain, Maintenance Road, and Perimeter Diversion Channel

Inspectors walked the maintenance road around the base of the disposal cell to inspect the side slopes and features in the area between the edge of the disposal cell and the security fence. Again, no evidence of erosion, settling, slumping, or encroachment of vegetation was seen.

Inspectors noted that runoff continues to collect periodically in low spots in the toe drains and the perimeter diversion channels. The site is on a nearly flat playa or ancient lake bed. There is very little natural grade. Water occasionally collects in the low spots but, apparently, only for very brief periods of time. The evaporation rate for the area far exceeds precipitation. Occasional, brief ponding of water in the toe drains and diversion channels does not affect the disposal cell.

Sometime in 1996 or 1997, Envirocare installed a 2-inch pipe at the southwest corner of the site to function as a drain. The purpose of the pipe was to drain a low lying area southwest of the disposal cell. Inspectors noted that the pipe has been removed.



EXPLANATION

- SECTION LINE
- ENTRANCE SIGN
- SECURITY FENCE
- ENVIROCARE FENCE
- ENVIROCARE ENVIRONMENTAL STATION AND NUMBER
- PEDESTRIAN ACCESS GATE
- PERIMETER SIGN AND NUMBER
- SITE MARKER AND NUMBER
- BOUNDARY MONUMENT AND NUMBER
- SETTLEMENT PLATE AND NUMBER
- MONITOR WELL AND NUMBER
- SECTION CORNER MARKER AND RESPECTIVE SECTION NUMBERS
- DRAINAGE DIRECTION OF TOE DRAIN
- CREST OF DISPOSAL CELL
- FLOW LINE

TRANSECTS

- TOP OF DISPOSAL CELL
- SIDE-SLOPE APRON
- SIDE SLOPE
- TOE DRAIN
- MAINTENANCE ROAD
- PERIMETER DIVERSION CHANNEL
- SITE PERIMETER

TRUE NORTH
MAGNETIC NORTH

0 150 300 600
APPROXIMATE SCALE IN FEET - SEE NOTE 3

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

INSPECTION DRAWING
SOUTH CLIVE, UTAH
1998 ANNUAL INSPECTION

DATE PREPARED: JANUARY 6, 1999

FILENAME: S0009300

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Site Perimeter

The site perimeter transect extends from the outer edge of the perimeter diversion channels to about 5 feet (ft) outside the site boundary. This transect includes the security fence, Envirocare's fence, the enclosed area between the two fences, and the outflow channel. No problems were noted in this transect.

The DOE's security fence is set inside the property line by distances that vary between 13 and 114 ft. Large areas of the site between the DOE fence and the Envirocare fence used to be inaccessible to inspectors. To correct this situation, two personnel gates were installed in the DOE's fence in March 1998. Two connecting fences were also removed. As a result, inspectors now have access to all formerly inaccessible areas between the two fences.

3.0 Ground-Water Monitoring

Ground-water monitoring is not required by the LTSP for this site because of widespread natural contamination of ground water in the area.

4.0 Conclusions

The Salt Lake City site was in good condition at the time of inspection. Inspectors identified no maintenance tasks and found no cause for follow-up inspections.

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Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Shiprock, New Mexico, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
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Figure SHP-1. Shiprock, New Mexico, 1998 Inspection Drawing SHP-3

Tables

Table SHP-1. Photographs taken at Shiprock, New Mexico, Disposal Site SHP-7

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Summary

The site, inspected on June 17, 1998, is in good condition. Encroachment of vegetation, primarily tumbleweeds, continues on the disposal cell. On several occasions, DOE has sprayed the plants with herbicides. The last application was in the fall of 1997. The herbicide was a pre-emergent that may last longer than one growing season. The weeds are expected to return, however, because the riprap is a favorable environment for these weeds and there is a steady supply of seeds from offsite. Removal of tumbleweed from along the security fence is the only maintenance task identified during this year's inspection. Inspectors identified no requirement for a follow-up inspection at this site.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Shiprock, New Mexico.

M.J. Gardner, Chief Inspector, and W.J. Waugh, Assistant Inspector, both of MACTEC–ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on June 17, 1998. The inspection was conducted in accordance with (1) the LTSP (*Long-Term Surveillance Plan for the Shiprock Disposal Site, Shiprock, New Mexico*, September 1994. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-60F, Rev. 1) for this site and (2) procedures established by the GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) the riprapped top of the disposal cell, side slopes, diversion channels, and outflow channel; (2) the terrace north and northeast of the disposal cell, and (3) outlying areas. Each of these transects was inspected by walking a series of traverses. Parts of the outlying areas transect were inspected from a distance.

Within each transect, inspectors examined specific site surveillance features, such as survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure SHP-1.

2.1 Specific Site Surveillance Features

Entrance Gates and Signs

All three entrance gates—the new main entrance gate at the east corner of the site (near the terrace escarpment), the gate at the north corner of the site that provides access to the northern part of the terrace escarpment, and the old entrance gate at the southwest corner of the site—were in good condition. The entrance signs at these gates, E1, E2, and E3, were also in good condition.

Perimeter Fence and Signs

The security fence along the site boundary is in good condition. It remains damaged along the Navajo Engineering and Construction Authority (NECA) property on the west, but still provides a full security.

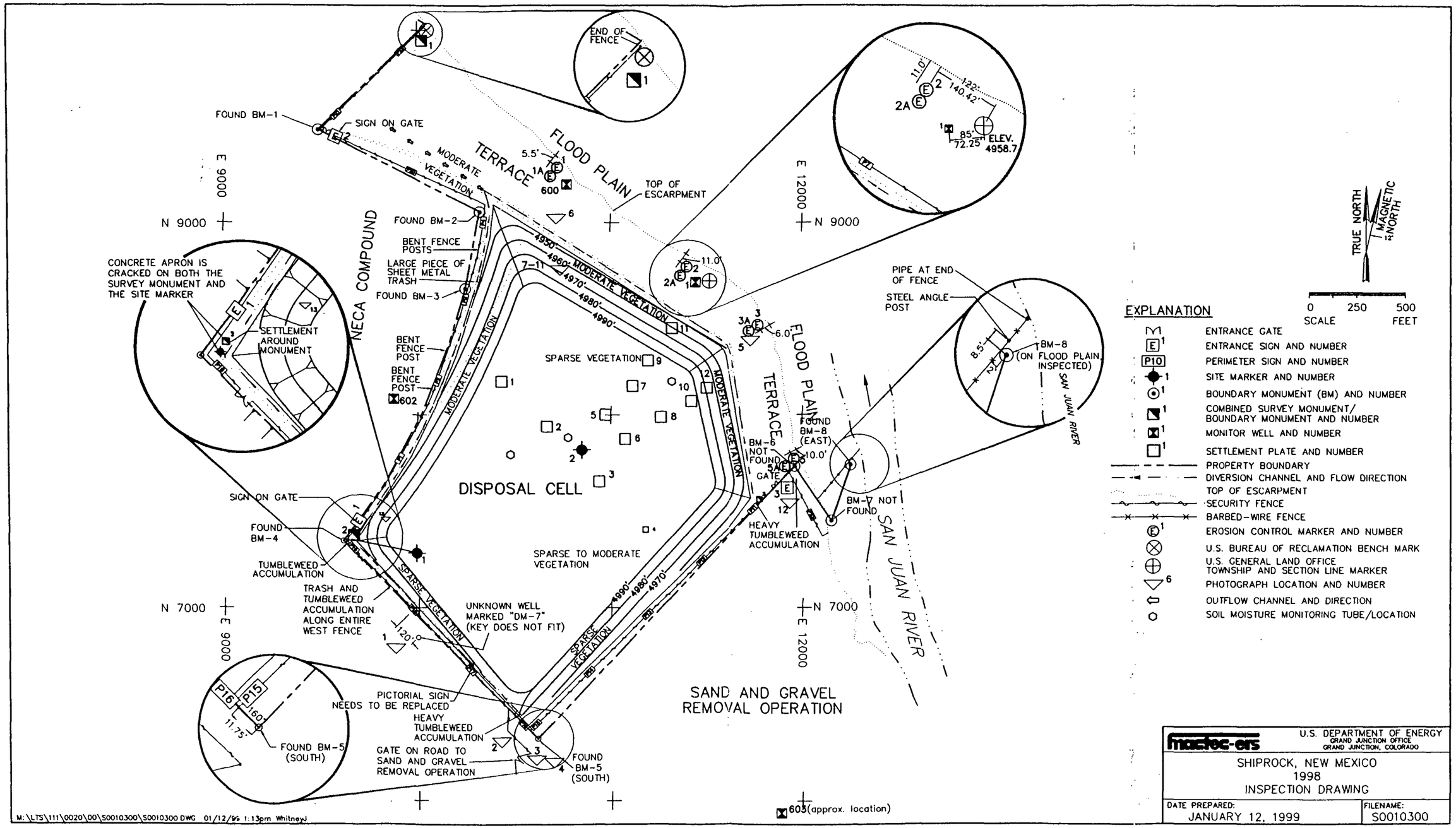
In 1996, the security fence along the terrace, north and northeast of the disposal cell, was removed to stop tumbleweeds from accumulating along the fence. Tumbleweeds do, however, continue to accumulate along the fence at other places. At the time of this year's inspection, there were significant tumbleweed accumulations along the west security fence (SHP PL-1, SHP PL-2, and SHP PL-3); in the southeast corner of the fence, near the old entrance gate (SHP PL-4); in the vicinity of perimeter sign P16 (both inside and outside the fence); near entrance sign E3 on the outside of the fence; outside the fence near boundary monument BM-2; and in the vicinity of boundary monument BM-6. The accumulations were so thick at BM-6 that the monument could not be inspected. Tumbleweeds will be removed so that the fence and site surveillance features along the fence can be properly inspected and to improve the appearance of the site.

A small to moderate amount of windblown trash is caught in the fence between perimeter signs P1 and P3 and between perimeter signs P19 and P16 (SHP PL-1 through SHP PL-4). Trash will be removed as part of the tumbleweed removal project.

Perimeter signs are attached to the security fence in pairs, one standard DOE sign above and one pictorial sign below. There are 18 pairs of perimeter signs. All are in good condition except perimeter sign P17. The paint on the pictorial warning at P17 is peeling. It is still legible, but eventually will have to be replaced.

Site Markers

There are two site markers: SMK-1, just inside the old entrance gate at the southern corner of the site; and SMK-2, on top of the disposal cell. Both are in good condition, although the concrete around the base of SMK-1 has a few hairline cracks.



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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

SHIPROCK, NEW MEXICO
1998
INSPECTION DRAWING

DATE PREPARED:	FILENAME:
JANUARY 12, 1999	S0010300

Survey Monuments and Boundary Monuments

Two of the three survey monuments, SM-1 and SM-3, were undisturbed and in good condition. Previous inspection reports noted that rocks in the soil near survey monument SM-2 may have settled and moved away from the base of the monument, thus raising the question whether the monument too may have moved. SM-2 and the area around it now appear stable. The monument may have been reset when the site was resurveyed in 1996. Survey coordinates for this monument will be checked before it is used as a survey control point, but the monument in its current state and position is sufficient as a visual reference to locate the site boundary.

The LTSP states that there are eight boundary monuments at the site. During this year's inspection, BM-1 through BM-5 and BM-8 were found; BM-6 and BM-7 were not. The location of BM-6 is in an area of dense tumbleweed accumulation. The monument may be present, only hidden by weeds. Monument BM-7 is apparently destroyed. It is not essential because it is an outlier and not on the site boundary. If it is ever needed, it can be reestablished by resurvey.

Erosion Control Markers

There are four pairs of erosion control markers along the edge of the terrace escarpment: E1 and E1A; E2 and E2A; E3 and E3A; and E5 and E5A. All markers are in good condition. None has been lost to retreat of the escarpment.

2.2 Transects

Top, Side Slopes, Diversion Channels, and Outflow Channel

The top and side slopes of the disposal cell are covered with riprap. (Strictly speaking, the rock is not riprap but river-rounded quartzite that ranges in size from cobbles to small boulders. The rock is not crushed.) The rock is extremely hard, durable, and in good condition. No evidence of settling, erosion, or animal burrowing was found in any "riprapped" area.

Diversion channels around the base of the disposal cell (on all sides except the southeast) are in good condition. Encroachment of plants in the northwest diversion channel, reported previously, was controlled by herbicide spraying in November 1997.

Offsite drainage is directed toward the outflow channel at the northwest corner of the site. Rock cover in the outflow channel was in good condition. Vegetation in the outflow channel, primarily kochia, Russian thistle, and tamarisk, was mostly dead as a result of herbicide spraying and is not at this time a threat to channel performance in event of a heavy storm. Tamarisk will continue to be controlled with appropriate herbicide on an as-needed basis. (See Plant Encroachment, below.)

Plant Encroachment. Populations of tumbleweeds (Russian thistle and kochia) grow annually on the top of the disposal cell and on the east, northeast, and northwest side slopes. These plants

were sprayed with systemic herbicides in 1996 and 1997 without lasting effect. The plants are annuals that sprout each year from windblown seeds.

A preemergent herbicide was applied to the ground in November 1997 with some expectation that the preemergent might be effective over more than one growing season. The intention was for the preemergent herbicide to wash off the riprap and impregnate the underlying soil layer. This apparently happened. During this year's inspection only a few small patches of weeds were present. These included kochia, Russian thistle, prickly lettuce, Jim Hill mustard, grey horsebrush, and rabbitbrush (SHP PL-5 through SHP PL-11). Several specimens of rabbitbrush showed injury from the preemergent herbicide, but the plants were still alive (SHP PL-11).

A special herbicide is used to control tamarisk. It is applied topically to the plant when fully leafed out. Tamarisk was last treated in 1996, and the control seems to be effective.

Terrace

The terrace is that area between the north and northeast edge of the disposal cell and the escarpment above the San Juan River. No erosion on the terrace or mass wasting along the edge of the escarpment was seen.

A small stand of greasewood was noted on the northeast terrace near monitor well MW-1 (PL-12). Greasewood is a phreatophyte. Its survival depends upon a supply of water relatively near the surface. It is unlikely that these plants rely on ground water as deep as the floodplain that lies 70 feet (ft) in elevation below the disposal cell.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected.

NECA Gravel Pit Operations. A sand and gravel operation by the NECA is present southeast of the site. At the time of the 1997 inspection, sand and gravel operations were approximately 150 yards from the southeast site boundary. During the 1998 inspection, inspectors noted that gravel pit activity appeared to be limited mostly to traffic from trucks and heavy equipment and the stockpiling of excavated gravel pit materials. Although there is significant activity in this area, the current gravel pit operations do not appear to pose an immediate risk or threat to the disposal cell. To ensure DOE access to the disposal cell along the east side of the site, and to ensure that gravel pit operations do not encroach upon the site perimeter, DOE will continue to monitor these operations.

Borrow Area. A borrow area from which radon barrier material was obtained is across the public road south of the disposal cell. The area is fenced. In 1995, the DOE-AL Environmental Restoration Division (ERD)-Uranium Mill Tailings Remedial Action (UMTRA) Office armored drainage channels on a side slope of the borrow area to channel storm water into the bottom of the borrow. The borrow area was also reseeded at that time. In July 1996, several of the armored drainage channels were damaged by erosion after heavy rains. ERD-UMTRA was to

repair the erosion damage in the fall of 1996. Inspectors, in 1997 and this year, could not determine if these repairs were made.

Because the first (post-remediation) reseeding of the borrow area was not successful, it was reseeded in August 1996 by ERD-UMTRA. Vegetation observed during the 1998 inspection consisted primarily of annual weeds (kochia, Russian thistle, and halogeton) and an annual barley, which sprouted from the straw mulch. Volunteer four-wing saltbush, Indian ricegrass, and winter fat were also observed on the south slopes of the borrow area. Very little vegetation is present on the west slope of the borrow area, and rill erosion is present. Stands of tamarisk grow in the bottom of the borrow area where water may stand for several days after a storm. When compared to native vegetation in (1) the area surrounding the disposal site and (2) the undisturbed areas adjacent to the borrow area, and when the dry climate in the area is considered, the vegetation in the borrow area appears to be faring as well as can be expected. Erosion and revegetation in the borrow area will continue to be monitored during future inspections.

3.0 Ground-Water Monitoring

Ground-water monitoring is not required at this site because the aquifer beneath the disposal cell is a limited-use aquifer. Water in the aquifer is of poor quality, limited in areal extent, and has low yield.

4.0 Conclusions

The Shiprock site is in good condition. Tumbleweeds continue to collect along the security fence at several locations and will be removed periodically. No requirement for a follow-up inspection was identified.

5.0 Photographs

Table SHP-1. Photographs taken at Shiprock, New Mexico, Disposal Site

Photograph Location Number	Photograph Description/Remarks
SHP PL-1	Tumbleweeds on fence near SW corner of perimeter fence.
SHP PL-2	Another view of tumbleweeds at SW corner of perimeter fence.
SHP PL-3	Panoramic view of extent of tumbleweeds near SW corner of perimeter fence.
SHP PL-4	Tumbleweeds on fence at E corner.
SHP PL-5	Vegetation on N side slope.
SHP PL-6	Plants on N side slope.
SHP PL-7	Plants on N side slope.
SHP PL-8	Plants on N side slope.
SHP PL-9	Plants on N side slope
SHP PL-10	Plants on N side slope.
SHP PL-11	Rabbitbrush on W side slope.
SHP PL-12	Greasewood on N terrace.

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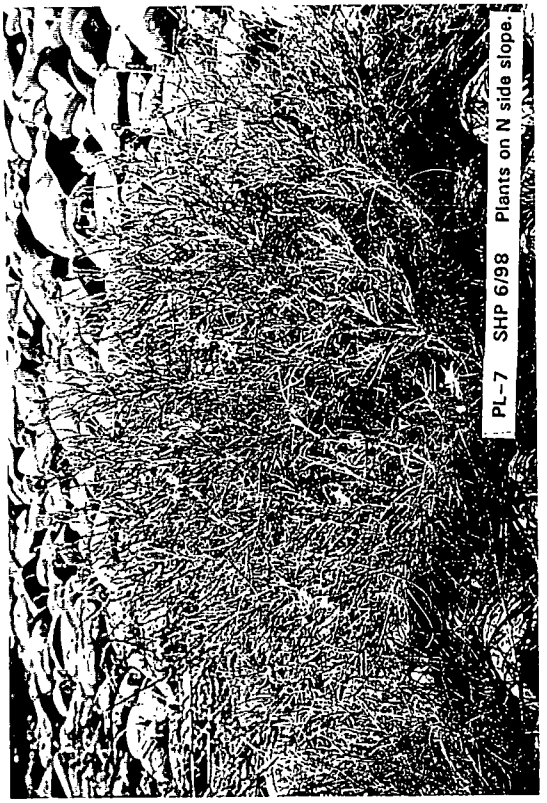
PL-1 SHP 6/98 Tumbleweeds on fence near SW corner of perimeter fence.

PL-2 SHP 6/98 Another view of tumbleweeds at SW corner of perimeter fence.

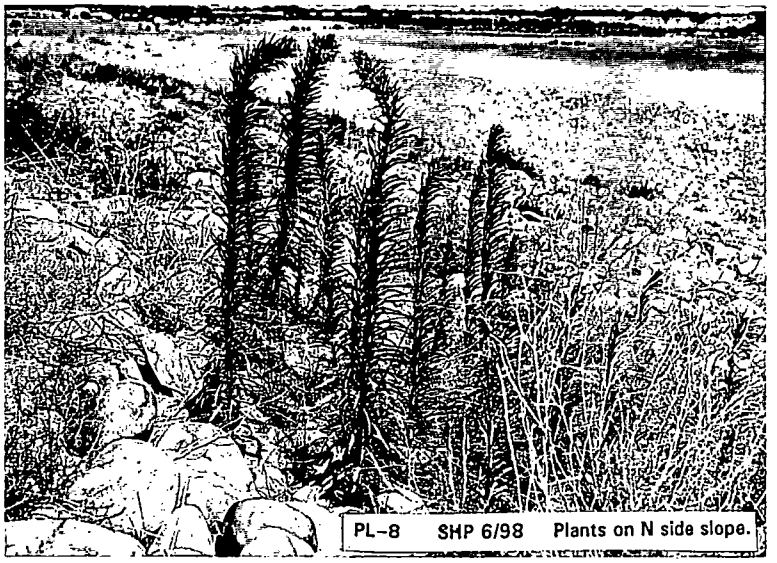
PL-3 SHP 6/98 Panoramic view of extent of tumbleweeds near SW corner of perimeter fence.

PL-4 SHP 6/98 Tumbleweeds on fence at E corner.

PL-5 SHP 6/98 Vegetation on N side slope.



PL-7 SHP 6/98 Plants on N side slope.

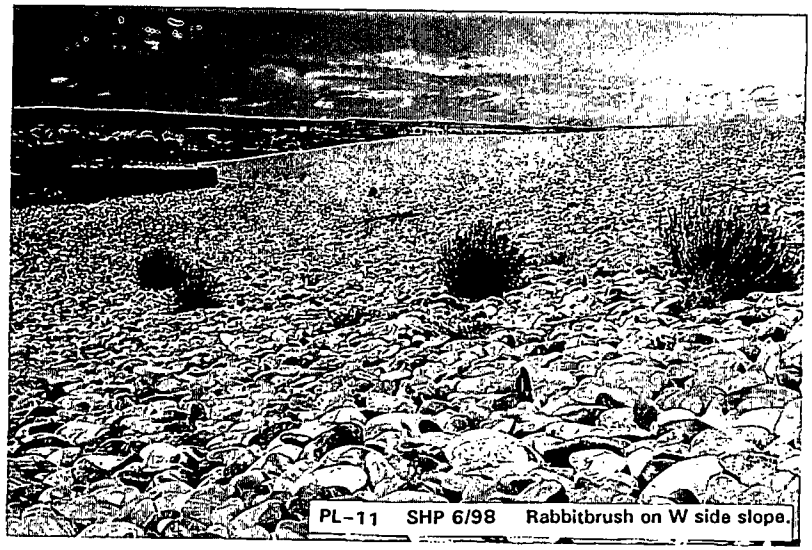


PL-8 SHP 6/98 Plants on N side slope.

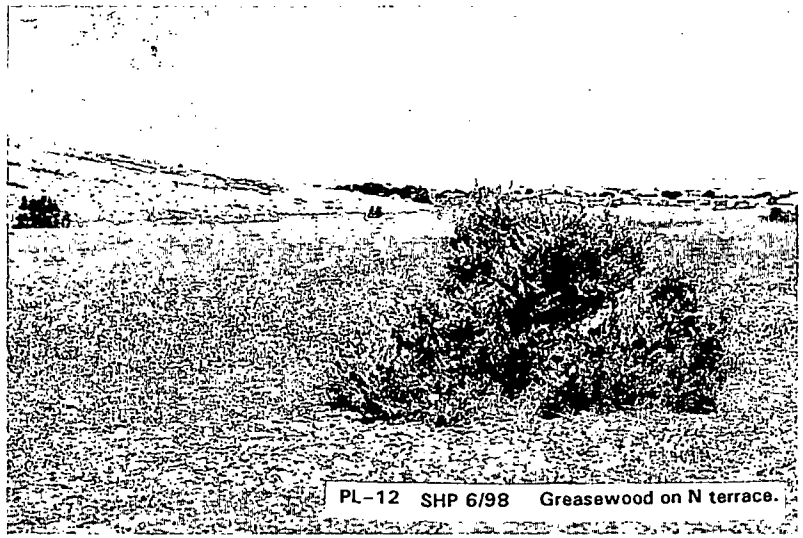
PL-9 SHP 6/98 Plants on N side slope.

PL-6 SHP 6/98 Plants on N side slope.

PL-10 SHP 6/98 Plants on N side slope.



PL-11 SHP 6/98 Rabbitbrush on W side slope.



PL-12 SHP 6/98 Greasewood on N terrace.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Slick Rock, Colorado, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Summary

The Slick Rock disposal site, inspected on July 16, 1998, is in good to excellent condition. The primary concern is the establishment of perennial vegetation to control erosion on the spoils pile and in disturbed areas around the disposal cell. Vegetative cover has increased since 1997, but the dominant plant is Russian thistle, an annual weed. Three maintenance tasks are identified: (1) tire ruts in the rock armor near two former standpipes will be filled or smoothed, (2) an old silt fence will be removed to improve the appearance of the site, and (3) a few minor fence repairs will be completed. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Slick Rock, Colorado.

M.K. Kastens, Chief Inspector, and C.S. Goodknight, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on July 16, 1998. P. Oliver of the Colorado Department of Public Health and Environment participated in the inspection. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Burro Canyon Disposal Cell Slick Rock, Colorado*, August 1997. U.S. DOE, Albuquerque, N.M., DOE/AL/62350-236, Rev. 0) for this site, and (2) procedures established by GJO to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

Ground-water monitoring is not required by the LTSP at this site. However, DOE does record water levels in two standpipes installed in the disposal cell in response to a request from the state. An update on water levels in these two standpipes is included in this report.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) the riprapped top and side slopes of the disposal cell including the key trench and apron; (2) the area between the disposal cell and the site boundary, including the stock pond, the graded and reseeded area, and the stock fence; and (3) outlying areas beyond the site boundary including the spoils pile. Each of these transects was inspected by walking a series of traverses. Part of the outlying area transect was inspected from a distance.

Within each transect, inspectors examined specific site surveillance features, such as survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of

erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure SRK-1.

2.1 Specific Site Surveillance Features

Access Road, Entrance Gate, and Perimeter Signs

Site access is by an improved gravel and dirt road maintained by San Miguel County. The road is in excellent condition. The road crosses the site boundary at the southwest corner of the site.

The entrance gate and the fence around the site are strung with two strands of smooth (barbless) wire. The gate is closed by a wire loop that slips over the top of the adjoining fence post and by a chain and padlock that secures the gate to the adjoining fence post. The fence and gate provide minimal security; they are only partially successful in preventing cattle from entering and overgrazing revegetated areas of the site.

The entrance sign is inside the stock fence immediately east of the entrance gate. Thirty-two perimeter signs, designated P1 through P32, are spaced at approximately 200-foot (ft) intervals around the site. All signs are attached to steel posts set in concrete about 5 ft inside the site boundary. The sign post at P1 has a bullet hole (SRK PL-1) and the sign at P32 has a bullet hole and is bent (SRK PL-2). All other signs are in excellent condition.

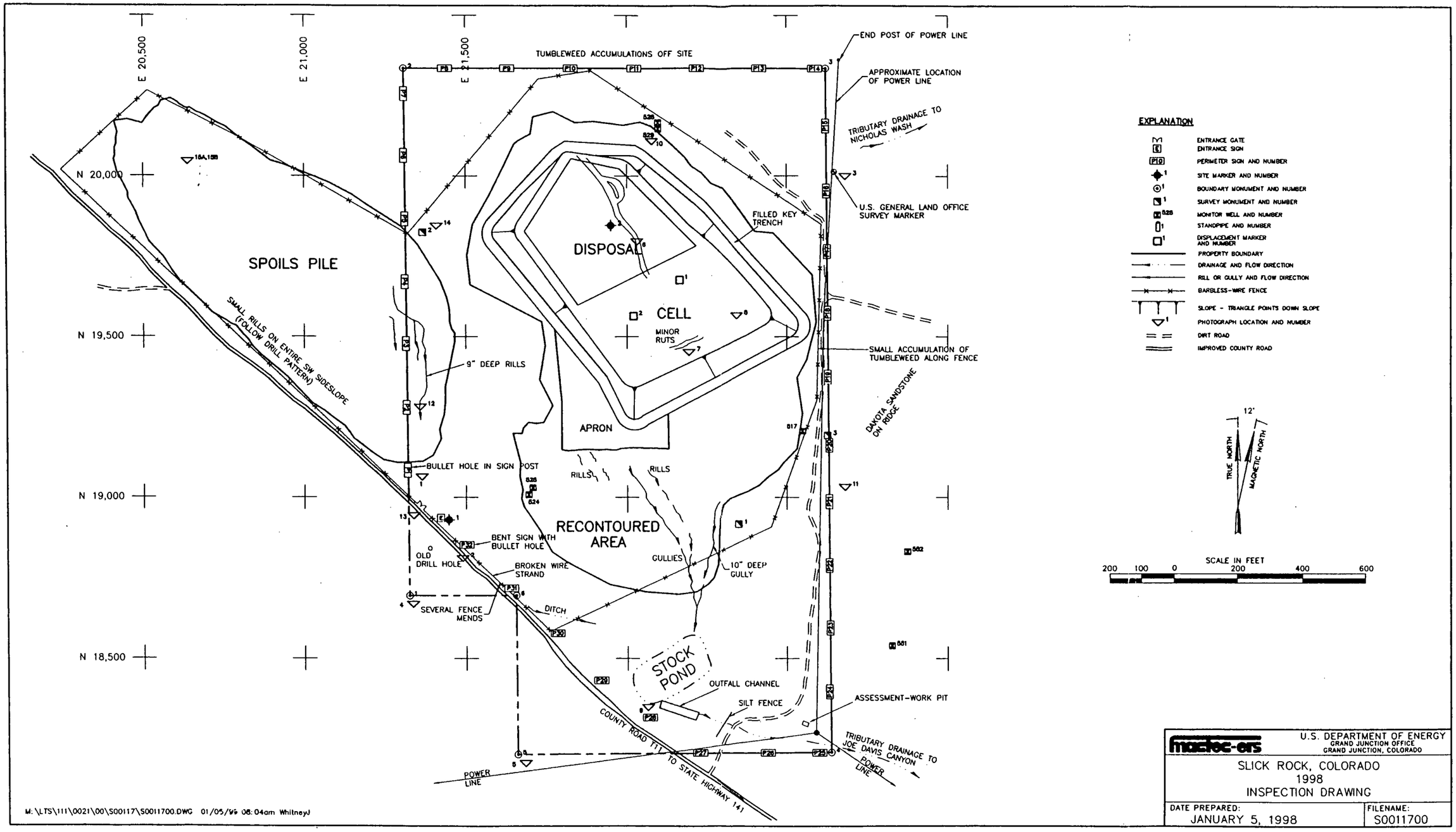
Site Markers, Survey and Boundary Monuments

There are two granite site markers at this site: SMK-1, near the entrance gate, just east of the entrance sign; and SMK-2, on top of the disposal cell. Both markers are in excellent condition.

There are three survey monuments on site, SM-1, SM-2, and SM-3. None lie exactly on the site boundary but SM-3 is close. All are situated near the stock fence and easy to find. Each survey monument is identified by letters stamped in the aluminum cap:

Monument	Identifier
SM-1	BC-S
SM-2	BC-N
SM-3	BC-C

The LTSP states that the three survey monuments are tied to the project survey control point that is about 700 ft east of the southeast corner of the site. Despite an extended search, the project survey control point was not found. All three survey monuments are in excellent condition.


E 20,500
E 21,000
E 21,500
N 20,000
N 19,500
N 19,000
N 18,500
TUMBLEWEED ACCUMULATIONS OFF SITE
END POST OF POWER LINE
APPROXIMATE LOCATION OF POWER LINE
TRIBUTARY DRAINAGE TO NICHOLAS WASH
U.S. GENERAL LAND OFFICE SURVEY MARKER
FILLED KEY TRENCH
SPOILS PILE
DISPOSAL
CELL
MINOR RUTS
SMALL ACCUMULATION OF TUMBLEWEED ALONG FENCE
DAKOTA SANDSTONE ON RIDGE
SMALL RILLS ON ENTIRE SW SIDESLOPE (FOLLOW DRILL PATTERN)
9" DEEP RILLS
APRON
BULLET HOLE IN SIGN POST
RILLS
RECONTOURED AREA
BENT SIGN WITH BULLET HOLE
OLD DRILL HOLE
BROKEN WIRE STRAND
GULLIES
10" DEEP GULLY
SEVERAL FENCE MENDS
DITCH
STOCK POND
OUTFALL CHANNEL
SILT FENCE
ASSESSMENT-WORK PIT
COUNTY ROAD 111 TO STATE HIGHWAY 141
TRIBUTARY DRAINAGE TO JOE DAVIS CANYON
POWER LINE
EXPLANATION
ENTRANCE GATE
ENTRANCE SIGN
PERIMETER SIGN AND NUMBER
SITE MARKER AND NUMBER
BOUNDARY MONUMENT AND NUMBER
SURVEY MONUMENT AND NUMBER
MONITOR WELL AND NUMBER
STANDPIPE AND NUMBER
DISPLACEMENT MARKER AND NUMBER
PROPERTY BOUNDARY
DRAINAGE AND FLOW DIRECTION
RILL OR GULLY AND FLOW DIRECTION
BARBLESS-WIRE FENCE
SLOPE - TRIANGLE POINTS DOWN SLOPE
PHOTOGRAPH LOCATION AND NUMBER
DIRT ROAD
IMPROVED COUNTY ROAD
12°
TRUE NORTH
MAGNETIC NORTH
SCALE IN FEET
200 100 0 200 400 600
M:\LTS\111\0021\00\S00117\S0011700.DWG 01/05/98 08:04am Whitneyj
macfac-ers
U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO
SLICK ROCK, COLORADO
1998
INSPECTION DRAWING
DATE PREPARED:
JANUARY 5, 1998
FILENAME:
S0011700

Six boundary monuments define the site boundary. Two boundary monuments, BM-1 and BM-5, were not found during the 1997 inspection but were found during this year's inspection (SRK PL-4 and SRK PL-5). The cap on each monument is stamped with the monument number, e.g., BM-1. All six boundary monuments are in excellent condition.

2.2 Transects

Disposal Cell Top (including Standpipes), Side Slopes, Key Trench, and Apron

Top of the Disposal Cell. The top of the disposal cell, the side slopes, key trench, and apron are armored with rounded, cobble-to-pebble sized rock. The rock is in excellent condition. There was no evidence of cracking, settling, slumping, erosion, or other indication of instability.

There are tire tracks in the riprap north and east of site marker SMK-2 between standpipes SP-3 and SP-4 (SRK PL-6). The tracks were made by heavy equipment when two standpipes in the disposal cell were decommissioned and two were reinstalled. To maintain the appearance of the site, these tracks will be filled or smoothed. (See Standpipes below.)

A few scattered Russian thistle plants, most less than 6 inches (in.) tall, were present on the top of the disposal cell. Plant encroachment (biointrusion) in rock-covered areas may increase if precipitation is favorable. Plant encroachment will be monitored during future inspections.

Side Slopes, Key Trenches, and Apron. Side slopes descend from the top of the disposal cell at a maximum grade of 25 percent. At the base of the side slopes is a key trench. The key trenches encircle the disposal cell and are as much as 5-ft deep and 20-ft wide. South of the disposal cell, a rock apron extends down slope for 50 to 200 ft beyond the key trench. Side slopes, key trenches, and apron are all armored with rock and are in excellent condition. Plant encroachment, so far, has not occurred in any of these areas.

Standpipes. Four standpipes were installed in the disposal cell at the state's request when the site was constructed. The purpose of the standpipes was to measure the level of transient water in the disposal cell to evaluate the potential for water to migrate laterally into two sandstone layers exposed in the downslope sidewall of the disposal cell. (The disposal cell at Slick Rock is constructed partially below grade.)

The standpipes may have been installed incorrectly or were subsequently damaged: Data loggers in the standpipes responded to rainfall and snow melt, both of which instantly and temporarily increased the depth of the water in the standpipes. To correct this problem, DOE and the state agreed to abandon the two up-gradient standpipes, SP-1 and SP-2, and reinstall the two downgradient standpipes, SP-3 and SP-4.

Standpipes SP-1 and SP-2 were decommissioned in May 1998. A steel t-post marks the former location of each of standpipe.

Standpipes SP-3 and SP-4 were reinstalled in August 1998. Data loggers installed in the new standpipes are shown in SRK PL-7 and SRK PL-8.

The two sandstone units of concern are the Kd-1 and Kd-2 beds in the Dakota Sandstone. The base of the lower sandstone, Kd-1, is at an elevation of 5,838 ft; the base of Kd-2 is at 5,852 ft. Water level measurements began in 1996. At that time, water levels stood at about 5,841 ft in SP-3 and 5,839 ft in SP-4—both above the base of the Kd-1 sandstone bed. Water levels increased slightly during the early part of 1996. Thereafter, they began a slow downward trend.

The most recent downloading of data loggers, December 1998, shows water levels at 5,837.1 ft in SP-3 (Figure SRK-2) and 5,837.6 ft in SP-4 (Figure SRK-3). Both are below the 5,838 ft datum for Kd-1, the lowermost sandstone unit. The data in Figures SRK-2 and SRK-3 show a gradually decreasing elevation for ground water in the two standpipes over the last 6 months of 1998. (Noise or "bounce" in the data is attributed to changes in barometric pressure.) DOE regards the regression line superimposed on the data in both figures to represent mean water level. Data loggers are down-loaded quarterly.

The LTSP outlines the procedure for monitoring water levels in the standpipes and the criteria for determining when water level monitoring will be discontinued and the two remaining standpipes, SP- 3 and SP-4, will be decommissioned.

DOE will continue to monitor water levels in the two standpipes until a downward trend is consistently observed for three consecutive quarters *and* the water level in both standpipes is at or below the base of the Kd-1 sandstone bed (5,838 ft). At that time, DOE will decommission the remaining standpipes.

Area Between the Disposal Cell and the Site Boundary

The area between the disposal cell and the site boundary includes the stock pond, the regraded area, and the stock fence.

Runoff from the disposal cell flows southward into the stock pond that lies at the southern tip of the site. The stock pond was originally constructed as a retention pond during site construction. The pond was dry at the time of this year's inspection (SRK PL-9). The outflow channel below the pond is armored for a short distance with cobbles. The channel continues to the east where it becomes a tributary to Joe Davis Canyon. A silt fence, remaining from site construction, crosses the channel downstream from the armored portion of the channel. The silt fence is no longer needed or functional. It will be removed to improve the appearance of the site.

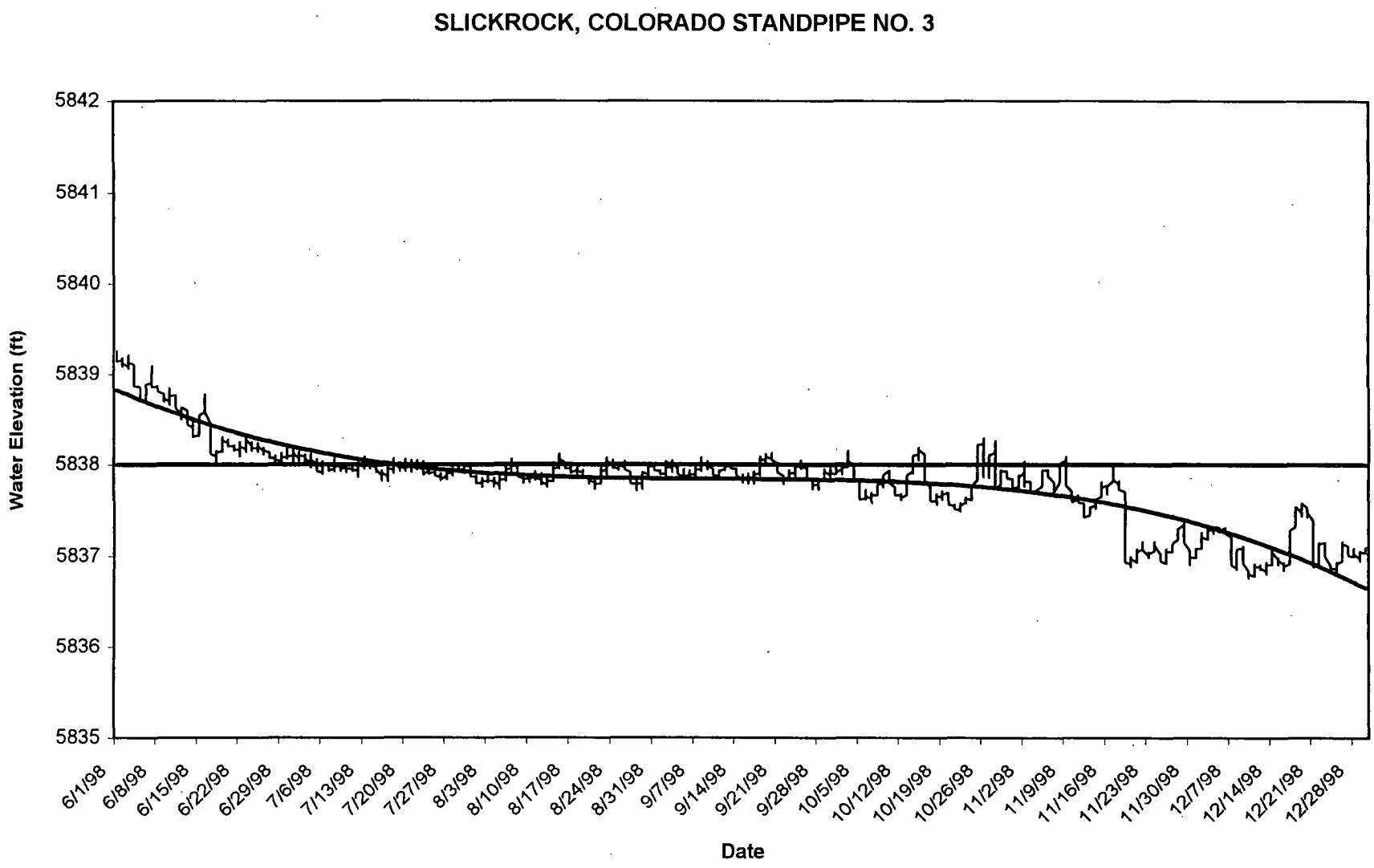


Figure SRK-2. Slick Rock, Colorado Standpipe No. 3

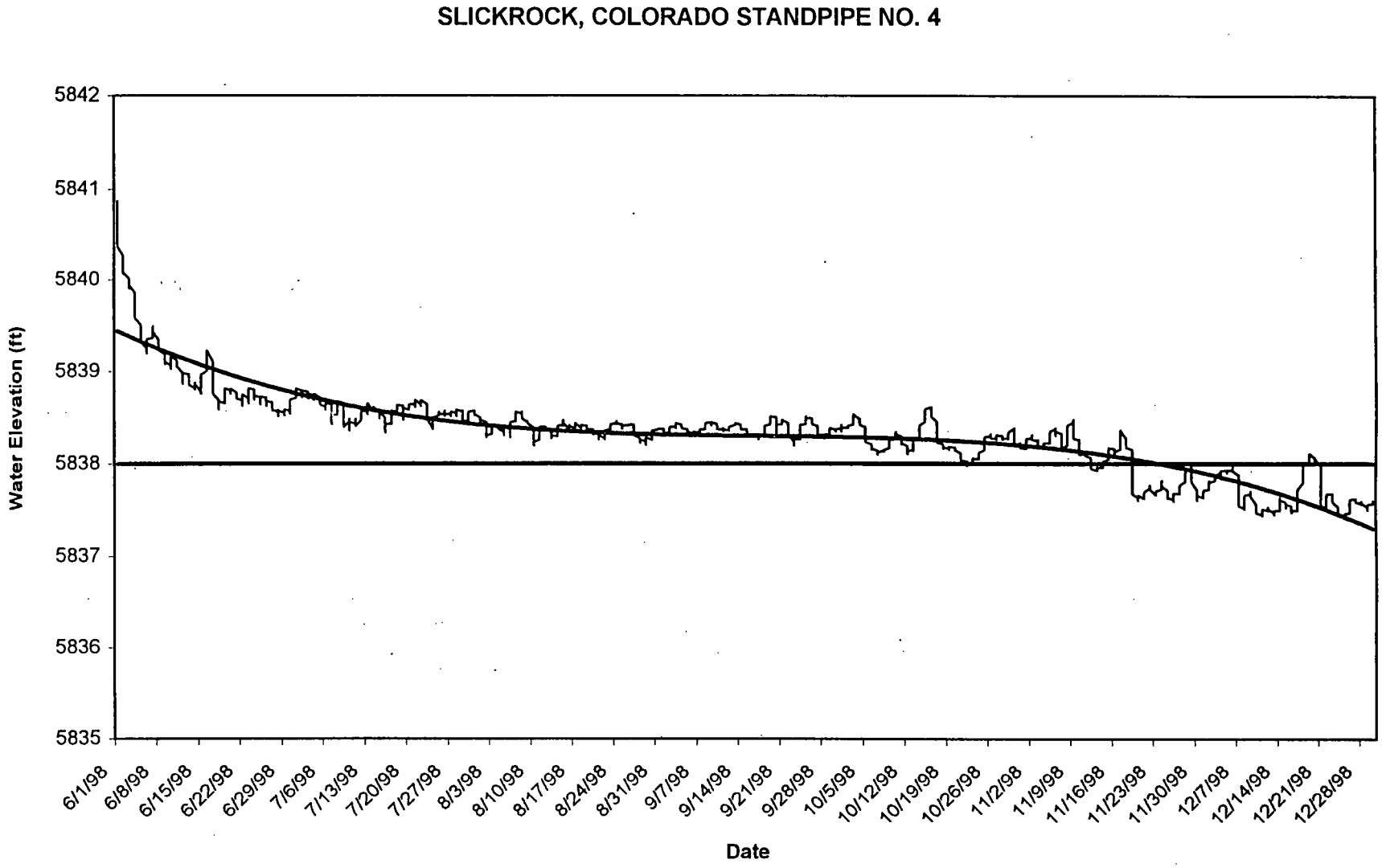


Figure SRK-3. Slick Rock, Colorado Standpipe No. 4

Areas disturbed during construction of the disposal cell are mainly in the southern and northeastern parts of the site. These areas were reseeded in 1996 with a mix of native vegetation believed to include thickspike wheatgrass, Arizona fescue, Indian ricegrass, tall fescue, four-wing saltbush, and small burnet. Vegetative cover now ranges from 5 to 30 percent (by visual estimate) and is composed primarily of Russian thistle, an annual weed. However, there is indication that four-wing saltbush, small burnet, and wheatgrass may be establishing. Other species noted in the reseeded areas included Indian ricegrass, tumble mustard, and yellow sweet clover.

Typical vegetative cover in the northeastern part of the site is pictured in SRK PL-10 and in the southeast part of the site in SRK PL-11. It is too soon to evaluate the long-term success of the seeding because the vegetation is only in its second growing season. With time, it is hoped that native perennial vegetation will replace Russian thistle and prevent erosion from occurring. In several places, planting furrows from the reseeding process run parallel to the slope instead of across the slope. This situation has caused or worsened erosion at some places. Progress of revegetation will continue to be monitored.

Minor rill and gully erosion was noted during the 1997 inspection in the recontoured area between the disposal cell apron and the stock pond and between perimeter signs P2 and P4. Some of the rills are as deep as 9 in. The number and depth of rills in this area appeared relatively unchanged from 1997. Vegetation has established in many of the rills, and this condition may inhibit further erosion.

The rills along the west edge of the site, in the area between perimeter signs P2 and P4, appeared to have lengthened since 1997 (SRK PL-12). Whereas they were primarily restricted to the area between P4 and P3 in 1997, they extended to P2 in 1998, and appeared to have deepened. Rills as deep as 9 in. were measured. The progress of erosion in all recontoured areas will continue to be monitored.

A stock fence of sorts surrounds the disposal cell, most of the reseeded areas, and the spoils pile west of the disposal cell. The approximate location of the fence is shown on Figure SRK-1. The fence, such as it is, is in excellent condition except between perimeter signs P31 and P32 where a strand of wire is broken, and west of the entrance gate, where several wires are slack (SRK PL-13).

Inspectors noted that the fence was mended at several places near P32. It is surmised that livestock may have broken through the fence at these locations, and that the holder of the adjacent grazing lease may have made the repairs.

There was evidence at several places that livestock had been inside the fence. A representative of the Colorado Department of Wildlife advised GJO in March that cattle were grazing inside the site.

When cattle graze on young plants, the entire plant is often pulled out of the ground or damaged to the extent that it does not recover. To prevent this situation, and to give desirable young plants an opportunity to fully establish, it is essential that the fence be reinforced to keep cattle

out for the next several years. Adding additional strands of wire to the fence is recommended. It is understood that a smooth wire fence was requested by the U.S. Bureau of Land Management (BLM) to allow antelope to pass without injury. Consideration will be given to adding barbed wire to the fence. Barbed wire at the top of the fence will still permit antelope to crawl under the fence as they are usually wont to do.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development or disturbance that could affect the site was observed.

The area outside the site boundary is used for grazing. To the north and east, the land supports grass and a few piñon and juniper trees. Elsewhere, the land is mostly grassed. Steep hillsides north and northeast of the site drain eastward into Nicholas Wash. Evidence of off-road recreational vehicle traffic northwest, north, and east of the site was noted.

A spoils pile, composed of material excavated during site construction, forms a mound about 50-ft high west of the site boundary. Reseeding on the spoils pile has produced a cover primarily of Russian thistle with very few desirable perennial plants (SRK PL-14, SRK PL-15A, and SRK PL-15B). On the northeast-facing slope of the spoils pile, growing conditions are apparently a little better and the vegetative cover can be described as moderate. Establishment of vegetation across the entire spoils pile is a goal in order to stabilize the pile and prevent erosion. A series of small rills occurs along the southwest slope of the spoils pile where the drill-seeding furrows run parallel to the slope. The progress of revegetation and erosion control on the spoils pile will continue to be monitored.

3.0 Ground-Water Monitoring

Ground-water monitoring is not required by the LTSP for this site. Continuous monitoring of water levels in standpipes is discussed on pages SRK-5 and SRK-6 of this report.

4.0 Conclusions

The site is in good to excellent condition. Success of revegetation in areas around the disposal cell continues to be the primary concern. Maintenance requirements include repair of tire tracks in the riprap and fence repair. No cause for a follow-up inspection was identified.

5.0 Photographs

Table SRK-1. Photographs taken at Slick Rock, Colorado, Disposal Site

Photograph Location Number	Photograph Description/Remarks
SRK PL-1	Bullet hole in P1 sign post.
SRK PL-2	Vandalism of P32 sign face.
SRK PL-3	U.S. General Land Office survey marker.
SRK PL-4	BM-1.
SRK PL-5	BM-5.
SRK PL-6	View NW of SMK-2 and ruts in riprap.
SRK PL-7	Standpipe 3 (new lid and data logger).
SRK PL-8	Standpipe 4 (new lid and data logger).
SRK PL-9	Dry stock pond.
SRK PL-10	View looking SE of revegetated area, standing near MW-529.
SRK PL-11	View looking NW at revegetated area, standing near P21.
SRK PL-12	Rills between P2 and P3.
SRK PL-13	Loose wire strands on stock fence, near entrance gate.
SRK PL-14	View looking NW at revegetation on spoils pile.
SRK PL-15A	View looking S at vegetation on spoils pile.
SRK PL-15B	View looking SE at vegetation on spoils pile.

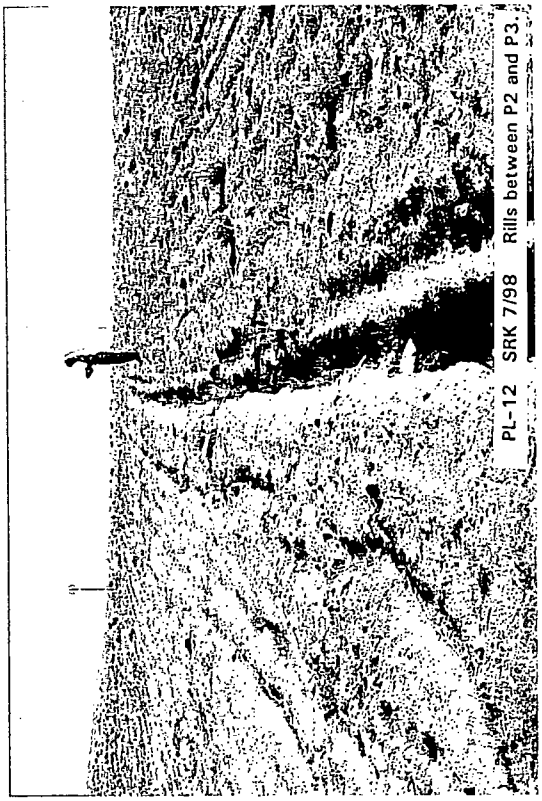
PL-7 SRK 7/98 Standpipe 3 (new lid and data logger).

PL-8 SRK 7/98 Standpipe 4 (new lid and data logger).

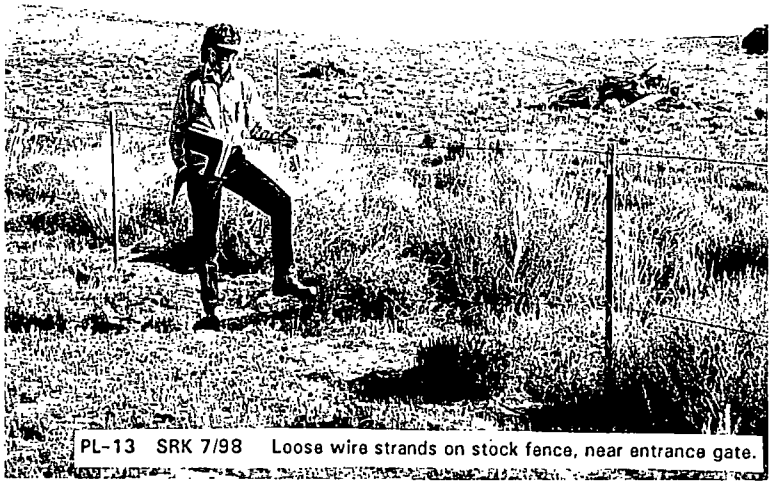
PL-9 SRK 7/98 Dry stock pond.

PL-6 SRK 7/98 View NW of SMK-2 and ruts in riprap.

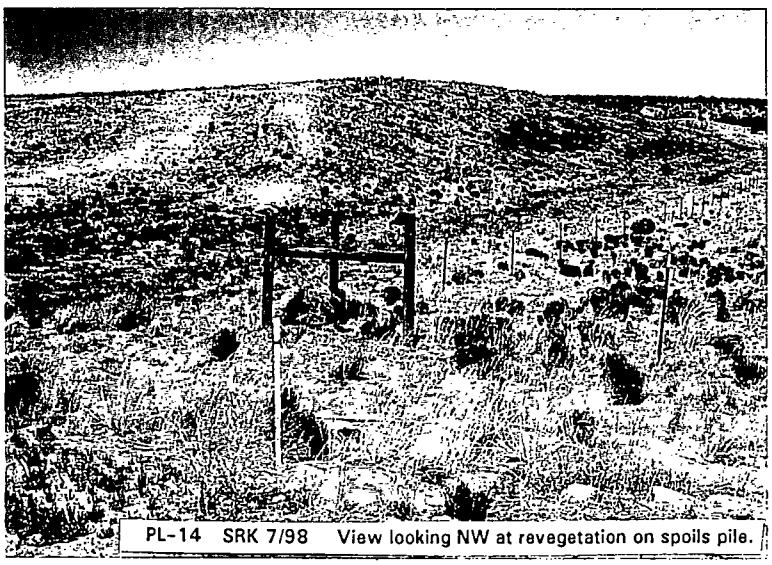
PL-10 SRK 7/98 View looking SE of revegetated area, standing near MW-529.



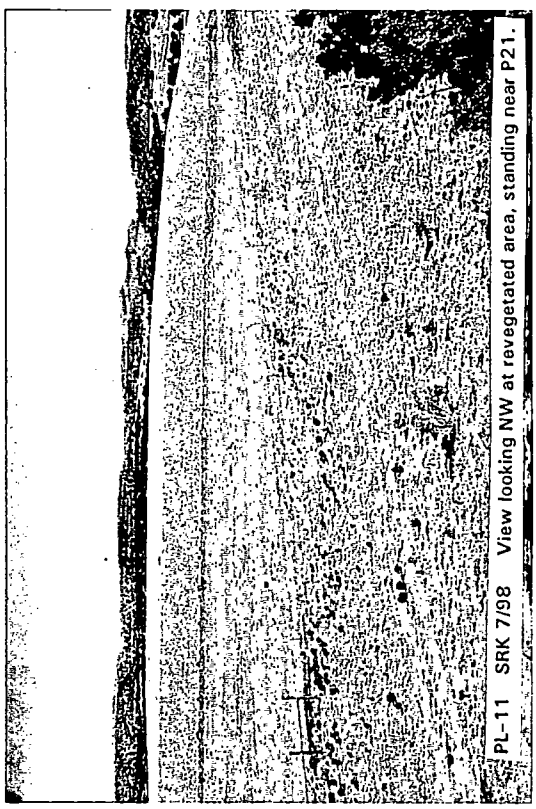
PL-12 SRK 7/98 Rills between P2 and P3.



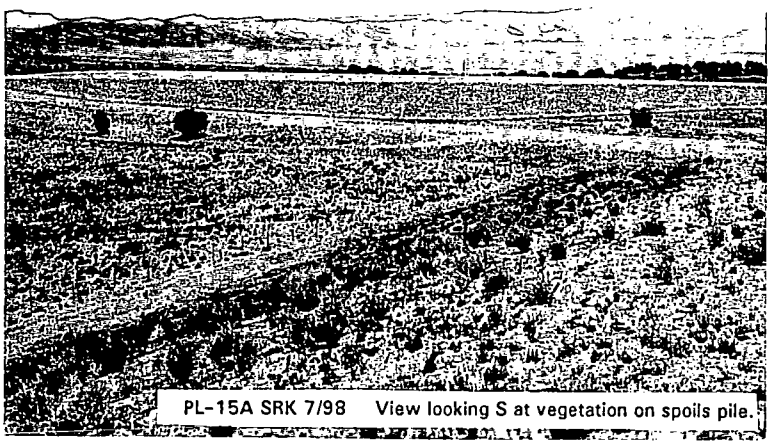
PL-13 SRK 7/98 Loose wire strands on stock fence, near entrance gate.



PL-14 SRK 7/98 View looking NW at revegetation on spoils pile.



PL-11 SRK 7/98 View looking NW at revegetated area, standing near P21.



PL-15A SRK 7/98 View looking S at vegetation on spoils pile.

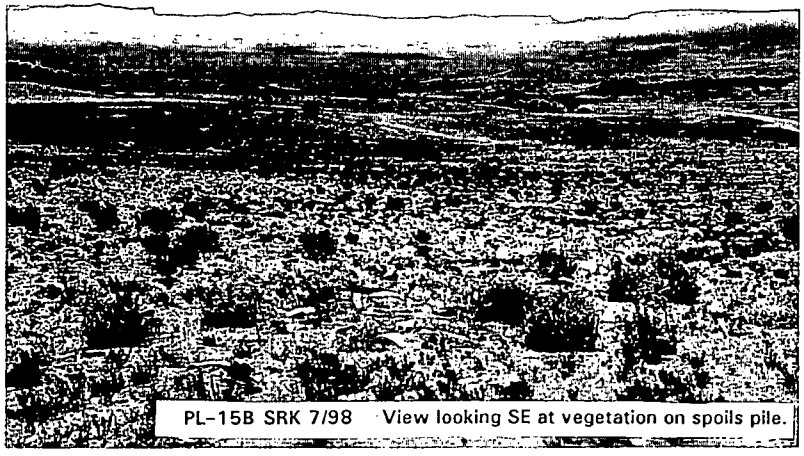
PL-1 SRK 7/98 Bullet hole in P1 sign post.

PL-2 SRK 7/98 Vandalism of P32 sign face.

PL-3 SRK 7/98 U.S. General Land Office survey marker.

PL-4 SRK 7/98 BM-1.

PL-5 SRK 7/98 BM-5.



PL-15B SRK 7/98 View looking SE at vegetation on spoils pile.

Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Spook, Wyoming, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
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Summary

The Spook site was inspected on June 15, 1998. The site was in excellent condition. No maintenance is required, and no cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Spook, Wyoming.

M.K. Kastens, Chief Inspector, and C.A. Jones, Assistant Inspector, of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office (GJO), conducted the inspection on June 15, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Spook, Wyoming, Disposal Site*, January 1993. U.S. DOE, Albuquerque, N.M., DOE/AL/350215.0000) for this site, and (2) procedures established by the GJO to comply with the requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

2.0 Results of Inspection

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) site perimeter, (2) disposal site, and (3) the outlying area. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Features mentioned in this report are shown on the drawing, Figure SPK-1.

2.1 Specific Site Surveillance Features

The road to the site is graded and hard packed. North of the Dry Fork of the Cheyenne River, the road narrows to a seldomly used dirt track. Rills forming in the track may eventually make the road impassable to low clearance vehicles. The track is not graveled and may be difficult in wet weather.

There are ten perimeter signs and one entrance sign. All were in place and undamaged except for a bullet hole in perimeter sign P3.

The two site markers, eight boundary monuments, and three survey monuments were in excellent condition. The concrete bases around several of the boundary monuments rise an inch or so above the surface of the surrounding soil. This appears to be an artifact of installation and is not a concern. There is no evidence of erosion around the boundary monuments, although a minor amount of sheet-wash erosion or deflation may have occurred before vegetation established.

2.2 Areal Features

Site Perimeter

Inspectors walked the site perimeter, beginning at the entrance sign, to inspect the site boundary and to examine as-built features, such as warning signs and boundary monuments, along the property line. All as-built features were in good to excellent condition, as described above, and no erosion or other disturbance was found.

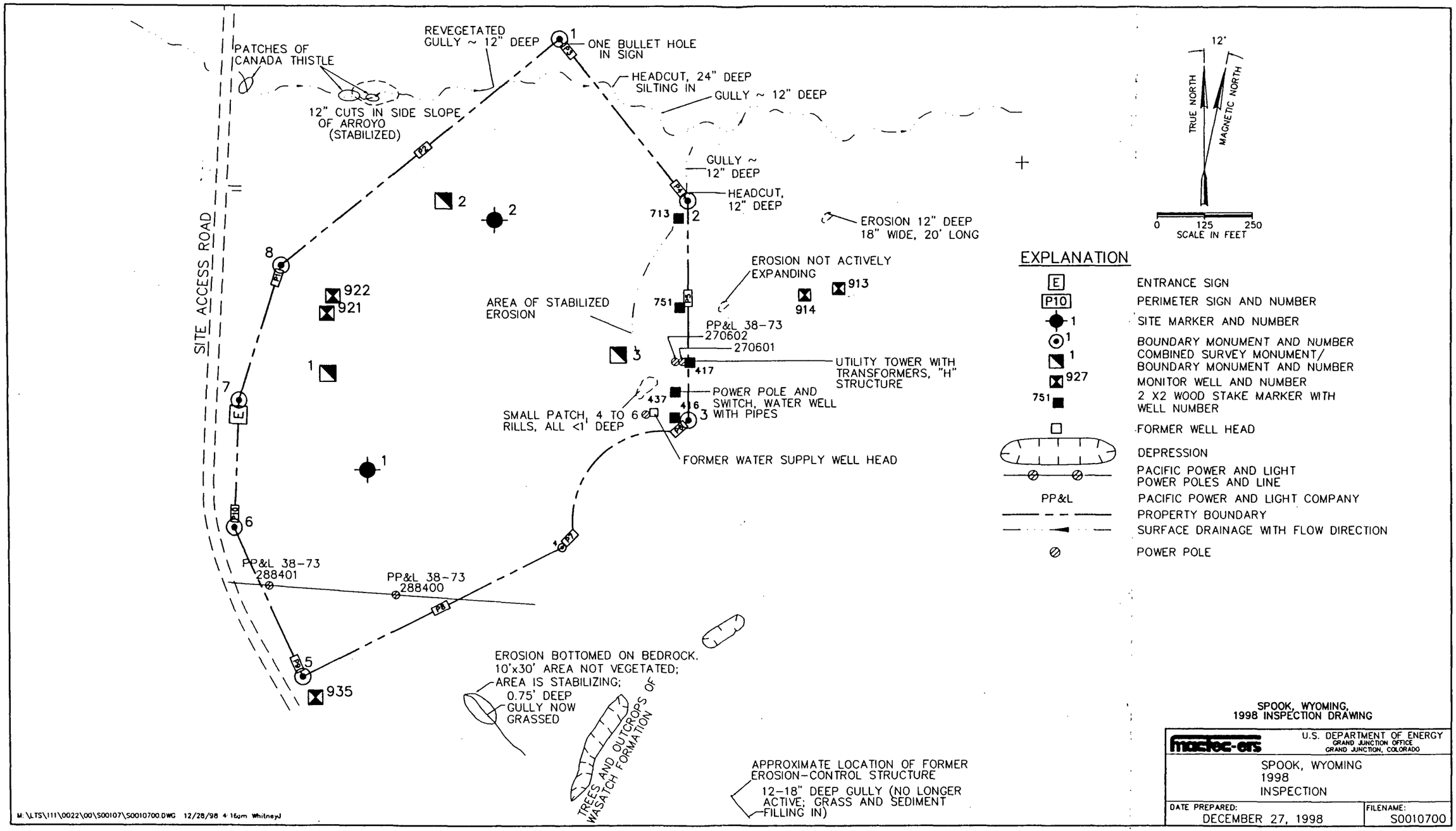
Disposal Site

The Spook site is unique among Title I sites in that tailings were backfilled into an open pit and covered with approximately 45 feet (ft) of clean fill and topsoil. None of the observations and concerns routinely associated with above-grade disposal cells, such as quality of the riprap, stability of side slopes, or the presence of deep-rooted plants, applies to this site.

The surface of the disposal site was generally in excellent condition. No evidence of settling was present over the old disposal pit that is now the disposal cell. Vegetation across the disposal site consists of grasses and forbs. For the most part, these plants are healthy and well-established. Except for the lack of sagebrush in the graded and reseeded areas, the vegetation is almost indistinguishable from that which grows on the surrounding hills and valleys. Except for sagebrush, the same species are present, and the overall health and density of vegetation are very much the same. Efforts to restore the site to grassland appear successful. Sheep were grazing on the site at the time of the inspection. The site is not fenced, and open-range grazing by sheep, cattle, and wildlife is part of the long-term plan for the site.

Minor gully erosion has been noted since the site was first inspected by GJO in 1992. Gully erosion is not a threat to the deeply buried tailings. However, erosion is a potential concern because it could degrade final site contours and displace soil and vegetation.

The most noticeable erosion on site is confined to two areas, both part of the same small drainage system. One branch of this drainage system flows across the northern tip of the site from west to east; the other branch starts near the transformer platform, drains the east side of the site, and flows northward to join the first branch. Each branch contains one noticeable knickpoint noted



SPOOK, WYOMING,
1998 INSPECTION DRAWING

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

SPOOK, WYOMING
1998
INSPECTION

DATE PREPARED:	FILENAME:
DECEMBER 27, 1998	S0010700

during 1996 and 1997 inspections. Neither knickpoint has increased in height or migrated upstream from its 1997 position. The gullies appear to be filling with sediment, coming to grade, and revegetating naturally.

Outlying Areas

The area beyond the site boundary for a distance of about 0.25 mile was examined for erosion, disturbance, change in land use, or other features of possible concern. None was seen.

Southeast of the site, approximately 900 ft south-southeast of boundary monument BM–3, a formerly active area of erosion appears to be filling in with sediment and revegetating naturally. Immediately upstream of this old headcut, the gradient flattens and vegetation is well established. Erosion at this location is no longer a concern. The area will continue to be monitored in case erosion should resume.

3.0 Ground-Water Monitoring

Ground-water monitoring is not required at this site. The uppermost aquifer is confirmed as a Class III aquifer of limited use and value. Specifically, (1) this aquifer meets the limited use classification, (2) there is no apparent risk to human health or the environment from the ground water because of no known exposure pathway in the upper aquifer, (3) there is no discharge of ground water from this aquifer to deeper aquifers or to surface waters, (4) no one is using or is projected to use the uppermost aquifer since it meets the limited use classification, and (5) better quality water is readily available from deeper aquifers that are stratigraphically and hydrologically isolated from the uppermost aquifer.

4.0 Conclusions

The Spook site is in excellent condition. Because the tailings are deeply buried, the site is considered very low risk. Specific site surveillance features are undisturbed and grassland vegetation is well established over most of the site. No maintenance is required and there is no cause for a follow-up inspection.

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Long-Term Surveillance and Monitoring Program

Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Tuba City, Arizona, Site

1998 Annual Report

February 1999

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

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Table TUB-1. Photographs taken at Tuba City, Arizona, Disposal Site TUB-6

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Summary

The Tuba City site, inspected on September 15, 1998, is in excellent condition. Paint has peeled from the experimental Lexan perimeter signs. The signs will be replaced. Rill erosion has occurred east and west of the access road and on drainage channel embankments. Plant encroachment on the disposal cell is not yet significant but is increasing. No cause for a follow-up inspection was identified.

1.0 Introduction

This report presents the results of the U.S. Department of Energy's (DOE's) annual inspection of the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Tuba City, Arizona.

W.J. Waugh, Chief Inspector, and M.R. Widdop, Assistant Inspector, both of MACTEC-ERS, the Technical Assistance and Remediation contractor at the DOE Grand Junction Office, conducted the inspection on September 15, 1998. The inspection was conducted in accordance with (1) the Long-Term Surveillance Plan (LTSP) (*Long-Term Surveillance Plan for the Tuba City, Arizona, Disposal Site*, October 1996. U.S. Department of Energy, Albuquerque, N.M., DOE/AL/62350-182, Rev. 0) for this site, and (2) procedures established by DOE to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27.

The purposes of the annual inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

2.0 Inspection Results

To ensure a thorough and efficient inspection, the site was divided into three areas referred to as transects: (1) disposal cell, (2) regraded areas and site perimeter, and (3) the outlying areas. Each of these transects was inspected by walking a series of traverses.

Within each transect, inspectors examined specific site surveillance features, such as monitor wells, survey and boundary monuments, signs, and site markers. Inspectors examined each transect for evidence of erosion, settling, slumping, or other phenomena that might affect site integrity or the long-term performance of the site. Permanent features mentioned in this report are shown on the drawing, Figure TUB-1. (Temporary features associated with ground-water remediation activities and performance monitoring of the cover are not on the figure.)

2.1 Specific Site Surveillance Features

Recent storms caused piping to occur under the security fence near site marker SMK-1 (TUB PL-1).

The paint on two Lexan perimeter signs, P9 and P24, has peeled and the signs are no longer legible (TUB PL-2). Both signs will be replaced. The Lexan signs were installed at this site in 1994 to test the durability of the plastic material. Aluminum is apparently the better material and will be used to replace the Lexan signs. Of the 30 pairs of "no trespassing" and pictorial perimeter signs, 9 have bullet holes or dents (P4, P5, P10, P11, P12, P13, P14, P26, and P27). Dents appear to be caused by rocks thrown at the signs. All signs remain legible.

In the past, DOE has cleared tumbleweeds and sand from along the fence and has filled gaps under the fence to keep dogs, coyotes, and children out. Fence posts and the fence fabric, damaged during construction activities, were also repaired. Blowing sand and tumbleweeds at this site tend to collect along the fence line. The presence of tumbleweeds seems to promote the accumulation of sand along the bottom of the fence. The sand problem is, of course, in large part due to overgrazing on land that surrounds the site. The accumulation of tumbleweeds in the northeast corner of the site is again significant (TUB PL-3). The tumbleweeds completely cover boundary monument BM-3. The weeds will be removed as routine maintenance in 1999.

Deposition of windblown sand is a concern at this site. Unstable coppice dunes in outlying areas are evidence of the likelihood of continuing sand accumulation at various places on site, especially along the fence line, in diversion channels, and in the rock cover on the disposal cell. The accumulation of dune and other sand deposits will continue to be monitored. Sand removal may be necessary from time to time to prevent sand from building up along the fence, filling diversion channels, or creating a soil on the riprap that covers the disposal cell.

2.2 Transects

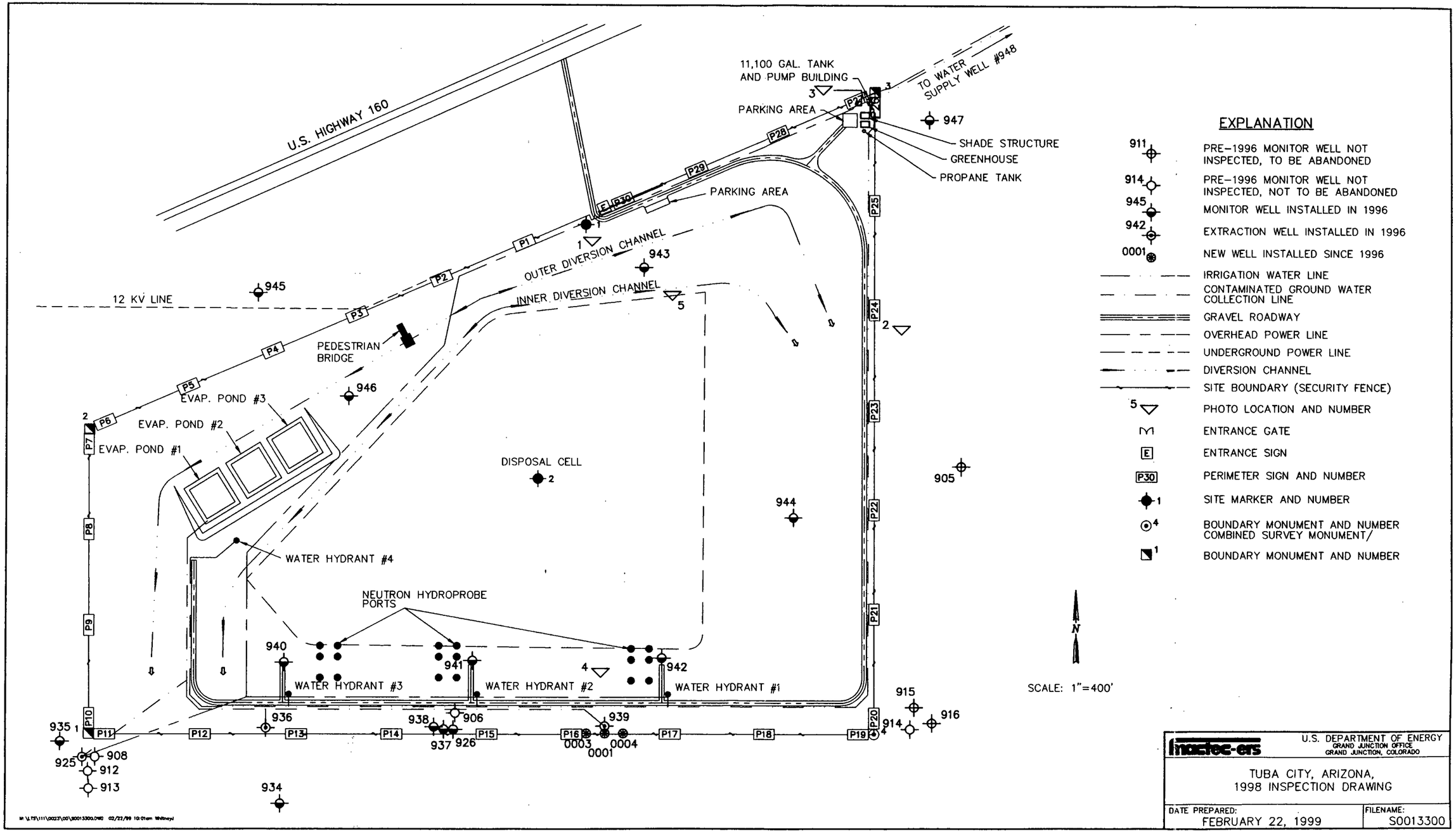
Disposal Cell

In the past, during hot summer months, heat loading of the dark basalt riprap that covers the disposal cell appeared to desiccate emerging seedlings. In 1997 and again in 1998, scattered patches of kochia and Russian thistle survived the summer heat on the top and south side slope of the disposal cell. Although the density of these plants remains very low, it has gradually increased. This may be a response to soil accretion evident at several places on the top of the disposal cell where the riprap layer is thin. More and larger shrubs and grasses growing in the riprap apron along the south edge of the disposal cell also appear to be in response to increasing sand accumulation (TUB PL-4). Plant encroachment will continue to be monitored.

Regraded Areas and Site Perimeter

This transect extends from the disposal cell outward to include the site boundary.

Revegetation of remediated areas surrounding the disposal cell in 1990 as well as plantings of desert shrubs and grasses inside the security fences upwind of the disposal cell in 1996 were intended to stabilize the soil and reduce sand movement onto the disposal cell. The seeding of regraded areas surrounding the disposal cell and outside the security fence, with a mixture of



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TUBA CITY, ARIZONA, 1998 INSPECTION DRAWING	
DATE PREPARED: FEBRUARY 22, 1999	FILENAME: S0013300

drought-tolerant plant species, was, at first, only marginally successful. Since about 1993, a combination of increasing plant abundance and formation of a gravel veneer as a consequence of sand winnowing, has, for the most part, stabilized regraded areas.

Rills are present on the northern embankments of the inner and outer diversion channels just south of the entrance gate (TUB PL-5) due no doubt to erosion during intense summer thunder storms. These rills will continue to be monitored. Rilling is also present on the slope east and west of the access road that leads to the site from the state highway. Some of the rills are as deep as 15 to 25 cm and expose bedrock in the bottom of the rill. Bedrock is likely to preclude deepening of the rills. Inspectors noted that vegetation is sparse in this area. Sparsity is likely due to low water retention in the shallow topsoil layer above the bedrock. Rilling may worsen the tendency for the soil to dry out. The stability of this slope and the condition of the access road requires continued monitoring.

Outlying Areas

The area outward from the disposal site for a distance of 0.25 mile was visually inspected. No development, disturbance, or change in land use that could affect the disposal site was observed.

3.0 Ground-Water Monitoring

Ground-water monitoring is required by the LTSP on an every-fifth-year basis. DOE plans to monitor ground water again in 2000.

4.0 Conclusions

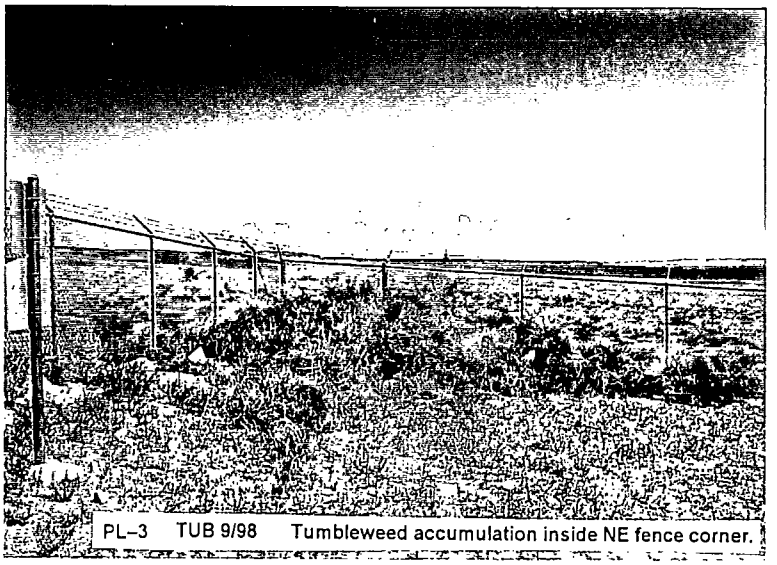
The site is in excellent condition. The only maintenance required is the replacement of two perimeter signs. Rill erosion and revegetation require continued monitoring. Plant encroachment on the disposal cell is increasing. No cause for a follow-up inspection was identified.

5.0 Photographs

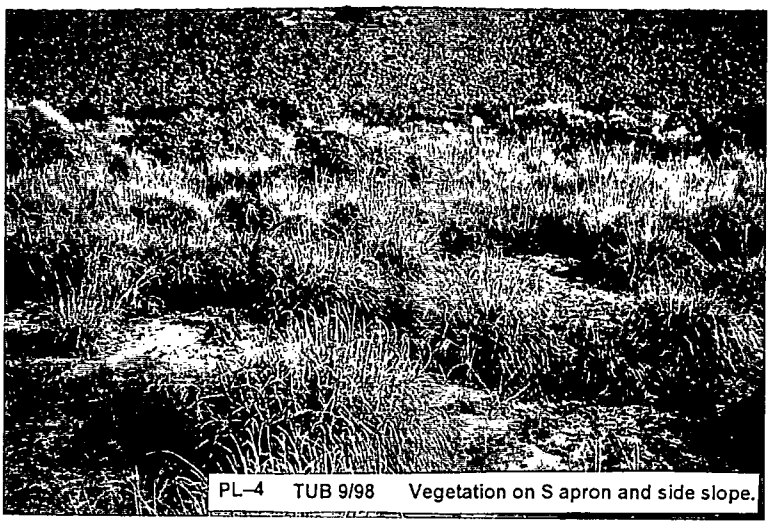
Table TUB-1. Photographs taken at Tuba City, Arizona, Disposal Site

Photograph Location Number	Photograph Description/Remarks
TUB PL-1	Piping erosion under fence north of SMK-1.
TUB PL-2	Peeling Lexan sign at perimeter sign P24.
TUB PL-3	Tumbleweed accumulation inside the northeast fence corner.
TUB PL-4	Vegetation on the south apron and side slope.
TUB PL-5	Rill erosion on north embankment of inner diversion channel.

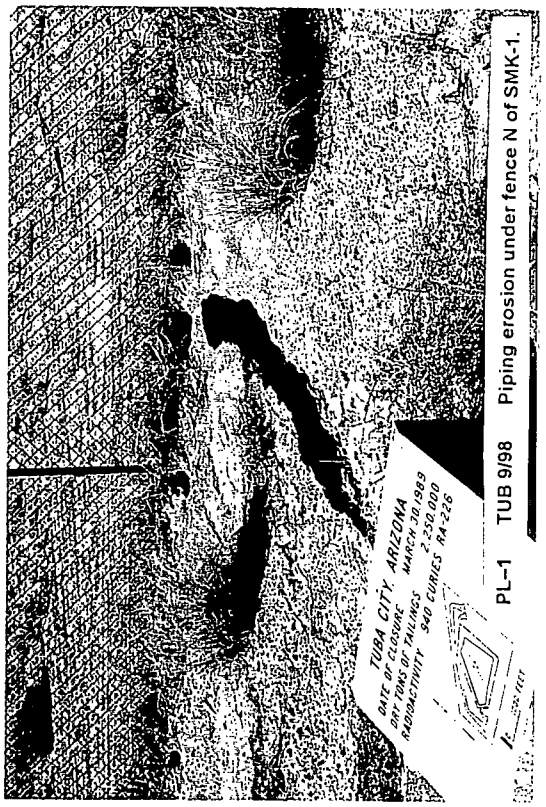
PL–2 TUB 9/98 Peeling Lexan sign at P-24.



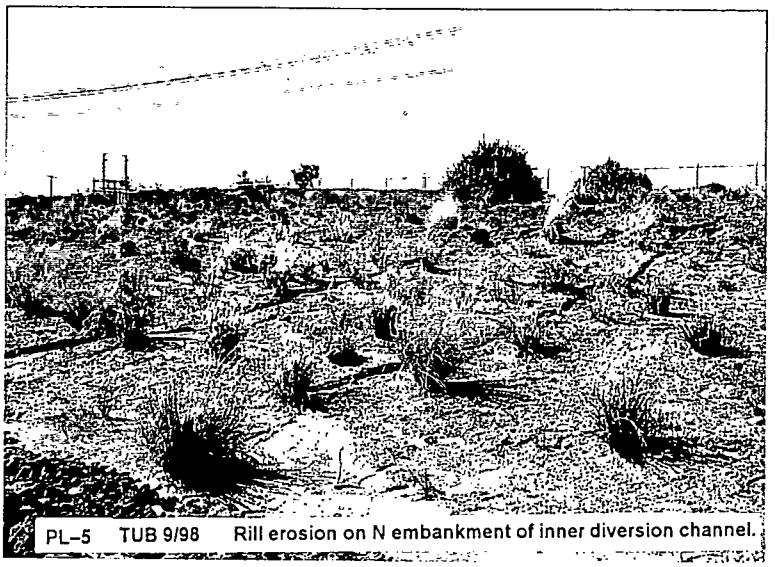
PL–3 TUB 9/98 Tumbleweed accumulation inside NE fence corner.



PL–4 TUB 9/98 Vegetation on S apron and side slope.



PL–1 TUB 9/98 Piping erosion under fence N of SMK-1.



PL–5 TUB 9/98 Rill erosion on N embankment of inner diversion channel.