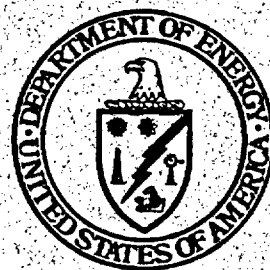


1991 Annual Prelicensing Inspection of the Salt Lake City (South Clive), Utah, UMTRA Project Disposal Site

September 1992

**U. S. Department of Energy
Albuquerque Field Office
Grand Junction Projects Office
Grand Junction, Colorado**



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**1991 Annual Prelicensing Inspection
of the Salt Lake City (South Clive), Utah,
UMTRA Project Disposal Site**

September 1992

**Prepared for
U.S. Department of Energy**

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1.0 Introduction

1.1 Purpose

This report presents the results of the U.S. Department of Energy's (DOE's) Uranium Mill Tailings Remedial Action (UMTRA) Project Office poststabilization Annual Prelicensing Inspection (API) of the Salt Lake City (South Clive), Utah, disposal site. This inspection was conducted on July 29 and 30, 1991, by D. L. Scheuerman, Chief Inspector, M. P. Plessinger, and A. T. Rubalcaba, Assistant Inspectors of Chem-Nuclear Geotech, Inc., operating contractor at the DOE Grand Junction Projects Office (GJPO). Also present in oversight and consulting capacities were R. Edge and C. H. Persson-Reeves of the Jacobs/Weston Technical Assistance Contractor (TAC) at the DOE UMTRA Project Office.

This inspection was the first poststabilization API at the South Clive disposal site. The inspection also served as an initial Verification and Orientation (V&O) inspection. Requirements of the V&O inspection are to (1) verify as-built and other features observed at the site and (2) orient the GJPO to the layout of the site and the location of long-term surveillance and maintenance features at the site. When the State of Utah provides a completion report with as-built information, the formal V&O inspection will be performed.

The procedures and specifications for this API are based on guidance provided in *Guidance for UMTRA Project Surveillance and Maintenance (Guidance Document)* (DOE, 1986) and draft *Surveillance and Maintenance Plan for the South Clive Disposal Site, Utah (SMP)* (DOE, 1987). Postremedial action groundwater monitoring is not required on the basis of data collected from 17 monitor wells drilled at the disposal site prior to relocation of the contaminated materials (DOE, 1984).

1.2 Site Description

The South Clive disposal site (Figure 1-1) is located in Tooele County, Utah, approximately 81 miles due west of Salt Lake City, in Section 32, Township 1 South, Range 11 West (DOE, 1984).

Currently, title to the South Clive disposal site is held by the State of Utah. The State of Utah will turn title to the site over to the Federal Government at the conclusion of remedial action (DOE, 1984).

The site is located within a relatively flat topographic area along the eastern edge of the Great Salt Lake desert. The desert area extends for approximately 60 miles from the Nevada/Utah border on the west to a series of north-south trending mountain ranges on the east. In the vicinity of the site, the eastern border of the desert is formed by the Cedar Mountains that rise to elevations of approximately 7,700 feet above sea level. The proximity of this mountain range results in a surficial drainage pattern for the site that is generally in a westerly direction.

Groundwater levels measured in monitoring wells installed at the South Clive site varied from about 25 to 35 feet in depth. The principal direction of groundwater flow within the South Clive region is to the west. Locally, however, the direction of groundwater flow is modified by both the surface topography and the stratigraphy at depth. Within the South Clive site, the direction of groundwater movement appears to be mainly to the northeast. The hydraulic gradient in this direction is small, approximately 3 feet per mile (DOE, 1984).

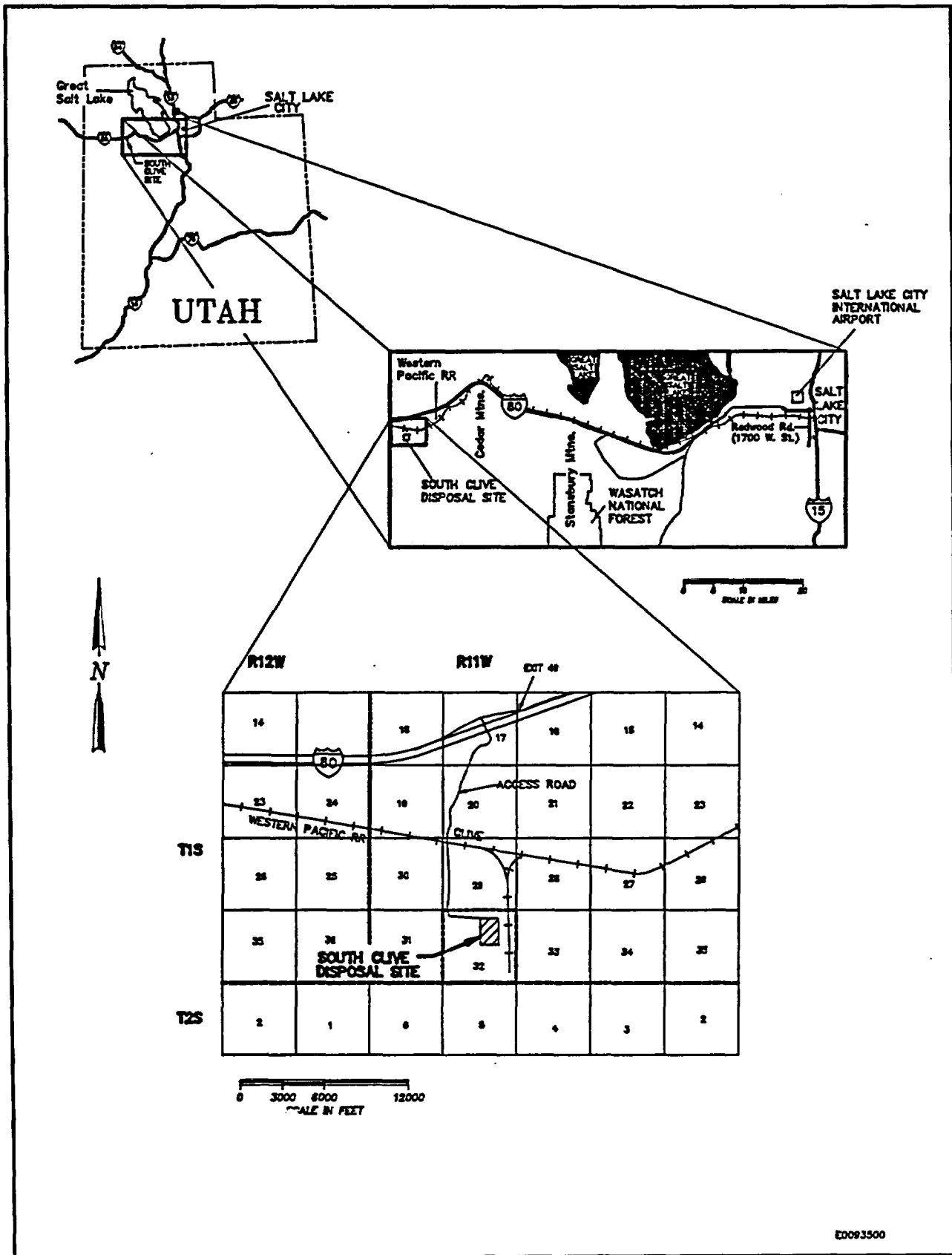


Figure 1-1. Location of South Clive, Utah, Disposal Site

The site is situated in a relatively flat area that slopes slightly toward the southwest. The maximum relief within the square-mile area is approximately 11 feet. Vegetation in the vicinity of the site is sparse and is typical of semidesert low-shrub land.

Temperatures at the site have ranged from -19 to 112 °F. The daily normal minimums range from 18.8 to 66.6 °F for January and July, respectively, while the daily normal maximums range from 36 to 92 °F for the same months.

Normal annual precipitation at the site is approximately 4.9 inches. The lowest normal monthly precipitation is 0.3 inch in January, while June has the highest with 0.7 inch. The maximum recorded 24-hour precipitation is 1.33 inches and the maximum monthly precipitation is 3.0 inches. Records show many months with no measurable precipitation. Snowfall is light; the maximum monthly amount recorded is approximately 14.6 inches in January with all other monthly maximums being less than 10 inches.

The climate at the site is arid, meaning that evapotranspiration is at least five times precipitation. No wind data are available, but a maximum peak gust of 71 miles per hour has been recorded 40 miles southeast of the site.

The site is surrounded by a private-sector waste disposal operation conducted by Envirocare of Utah, Inc. (Envirocare).

Envirocare's administration building is located immediately northwest of the northwest corner of the site. A heavily used access road constructed by Envirocare is parallel to the north security fence line. To form a controlled area, Envirocare has constructed a second fence parallel to and north of its access road.

Envirocare's north access road then proceeds south and is parallel to the site's east security fence line. A railroad spur with an unloading facility is located just east of this haul road. The elevation of Envirocare's east haul road is higher than the ground surface of the disposal site. The east access road then proceeds southwest into the company's waste burial area immediately south of the South Clive disposal site. Envirocare's waste burial area extends from the southeast corner to the southwest corner of the South Clive disposal site. Envirocare has installed groundwater monitoring wells adjacent to the disposal site's southern security fence.

Another Envirocare access road proceeds south from the administration building along the site's west security fence to Envirocare's waste disposal area. The South Clive disposal site is surrounded by the activities of Envirocare.

1.3 Site History

Residual radioactive materials (tailings) from the former Vitro Chemical Company processing site in South Salt Lake City, Utah, are stabilized on the South Clive site in trenches 1,000 to 2,000 feet in length, 100 to 150 feet wide, and about 20 feet deep. Surface remedial action under the direction of the UMTRA Project Office was begun in 1984 and was completed in 1988.

The South Clive site is currently in poststabilization, prelicensing status. The site is expected to remain in this status until licensed by the U.S. Nuclear Regulatory Commission under provisions of U.S. Code of Federal Regulations, 10 CFR 40, for long-term surveillance and maintenance.

1.4 Site Access

The South Clive disposal site is about 81 miles due west of Salt Lake City (Figure 1-1). To reach the site from the Salt Lake City International Airport, proceed west on U.S. Interstate 80 for about 69 miles. The turnoff from the interstate is unmarked. An unpaved road intersects the interstate north of Clive. Proceed south on the unpaved road for about 2.5 miles to the site. The northern boundary of the site is about 1 mile south of Clive, a railroad siding for the Union Pacific railway system.

2.0 Annual Prelicensing Inspection

Inspection methods and results are described under appropriate headings that follow. Supporting information is provided in Appendix A, Inspection Photo Log and Photographs; and Plate 1, inspection drawing.

2.1 Methods

The inspection was conducted by walking several transects across the site and one transect around the perimeter on the property boundary. Monuments, site markers, and other site features were inspected and photographed. The locations of specific features discussed below are shown on the inspection drawing (Plate 1). Specific site surveillance features are listed in Table 2-1.

Table 2-1. Specific Site Surveillance Features

Identifier	Feature	Photo Location
—	Entrance Sign	1
—	Perimeter Signs (15 total)	—
SMK-1	Site Marker 1	2
SMK-2	Site Marker 2	3
BM-1	Boundary Monument 1	4
BM-2	Boundary Monument 2	5
BM-3	Boundary Monument 3	Not Found
BM-4	Boundary Monument 4	6
SP-2NW	Settlement Plate 2 Northwest	7
SP-1	Settlement Plate 1	8
SP-10	Settlement Plate 10	9
SP-3	Settlement Plate 3	10
SP-7	Settlement Plate 7	11
SP-12	Settlement Plate 12	12
SP-11	Settlement Plate 11	13
SP-8	Settlement Plate 8	14
SP-2SE	Settlement Plate 2 Southeast	15

Equipment used during the inspection included a 35-mm camera, 2-foot scale with north arrow for showing scale and orientation of photographs, measuring tapes, Brunton compass, and notebook and forms for recording observations and photographs. Photographs were taken without filtration on color-negative film (Kodacolor ISO 200). Photographs are identified in the text of this report, in Appendix A, and on Plate 1 by photo location (PL) number. A total of 83 inspection photographs are included in Appendix A of this report.

2.2 Transects

To ensure that the site is thoroughly and efficiently inspected, the site was divided into small manageable units referred to as transects. Transects are areas of various sizes and shapes. Within each transect, inspectors examine all as-built features, as well as other features of note or interest. Normally, the inspection of one transect is completed before proceeding to the next. Transects used during the inspection of the South Clive disposal site are listed in Table 2-2.

**Table 2-2. Transects Used During the Inspection of the
South Clive Disposal Site**

Transect	Explanation
Top	The top surface of the embankment.
Side Slope	The north, east, south and west side slopes of the embankment are included in the same transect because of the geometry of the cell.
Toe Drain	The toe drain surrounds the embankment. The top and side slopes of the embankment drain into the toe drain. The toe drain drains across the inspection road at the southwest corner of the tailings embankment into the perimeter diversion channel.
Maintenance and Inspection Road	The maintenance road lies between the toe drain and the diversion channel and is parallel to each.
Diversion Channel	The diversion channel lies between the maintenance road and the security fence. It surrounds the site on all sides and drains off site to the southwest. The diversion follows the perimeter of the embankment. The diversion channel lies between the internal maintenance and inspection road transect and the site perimeter.
Site Perimeter (boundary)	The site perimeter transect includes the area between the diversion channel and security fence, the entrance and the perimeter signs, and the boundary monuments located outside the chain link security fence.

2.3 Results

Results of the 1991 inspection are reported under two main headings: site surveillance features and transects. Although most specific features are within a transect, they are reported separately, by category, because (1) they are an important focus of the inspection and (2) reporting by category allows the performance of each kind of as-built feature to be evaluated separately as a group. Specific features are discussed first, followed by a description of the condition of each transect.

Observations may include reference to specific photographs provided in Appendix A. Photographs are identified in the text, in Appendix A, and on Plate 1 by PL number. When more than one photograph was taken from a specific photograph location, photographs are identified by a letter suffix, (e.g., 4A, 4B).

2.3.1 Access Road and Specific Site Surveillance Features

Following a description of the access road, specific surveillance features are discussed in the order presented in Table 2-1.

Access Road

The access road that leads to the site from U.S. Interstate 80 is graded, graveled, and hard packed. It was in good condition at the time of the inspection.

Entrance and Perimeter Signs

The South Clive site has one entrance sign and 15 perimeter signs. The entrance sign is in place and it is not damaged (PL-1). All 15 perimeter signs are in their designated locations; none of the signs are damaged. The locations of the signs are shown on Plate 1, the inspection drawing. The entrance sign is designated with an "E." The perimeter signs are designated by a "P" followed by a number, such as P6. The perimeter signs were numbered to provide useful reference points for observation and to allow the inspector to specify a particular sign requiring replacement if required.

The entrance sign seems to be out of specification with the current UMTRA Project specifications for entrance signs, which state:

The perimeter sign at the entrance to the site, or in the absence of a defined entrance, the perimeter sign closest to the nearest public highway will display the name of the site, the name and telephone number of the responsible agency, and the international symbol that indicates the presence of radioactive materials (*Guidance for UMTRA Project Surveillance and Maintenance*, January, 1986, page 15).

The entrance sign for the South Clive site does not include this information and therefore does not meet the current UMTRA Project specification for an entrance sign.

Site Markers

Two site markers are in place at the South Clive site—SMK-1 and SMK-2. SMK-1 is located just inside the entrance gate (PL-2). SMK-2 is centrally located on top of the covering over the tailings (embankment) (PL-3). Both site markers are in excellent condition and show no sign of deterioration. There are, however, two problems.

First, the first site marker, SMK-1, is located at the entrance to the site and is oriented with the incised (engraved) face facing north. A visitor to the site cannot easily read the engraving from outside the fence because the engraving is rotated 90 degrees to the visitor's direct line of sight. Orientation of SMK-1 seems to be out of specification with the current UMTRA Project specifications for site markers, which state:

One site marker will be placed at the entrance to the site or, if there is no defined entrance, on the boundary of the site closest to the nearest public highway (*Guidance for UMTRA Project Surveillance and Maintenance*, January 1986, page 15).

Although the UMTRA Project specification is not perfectly clear, the intention seems to be that a visitor should be able to read the engraving from outside the site and thereby learn why the site is secured against casual entry. With SMK-1 in its current orientation, a visitor must first enter the site to have the "proper perspective" of the engraving on the marker. This seems at variance with the intent of the UMTRA Project specification for site markers.

Second, the incised message on both site markers, SMK-1 and SMK-2, does not coincide with the draft *Surveillance and Maintenance Plan, South Clive Disposal Site, Utah*, (SMP) for the South Clive site. The SMP says that the site markers will contain the following information:

The site will have two site markers (granite or equivalent) which will identify the site (South Clive Disposal Site, Utah), the date of closure (August, 1987), the location of the tailings at the designated site, an estimate of the tonnage of tailings (3.9 x 10.6 tons), and an estimate of the curies of radioactivity (1,400 curies radium-226). One site marker will be placed at the site's entrance at the northwest corner; the second will be placed near the center of the crest of the embankment

(Drawing SLC-CL-0017). (*Surveillance and Maintenance Plan for the South Clive Disposal Site, Utah* [Draft], February 1987, page 2.)

The problem is that the date of closure, the tonnage of tailings, and the estimate of the curies of radioactivity engraved on the site markers disagree with the same information provided in the SMP.

Survey Monuments

No permanent survey monuments exist at the South Clive disposal site. Survey monuments are a requirement of the current UMTRA Project specifications, which state:

A minimum of three permanent survey monuments will be established at each disposal site. These will be referenced to the U.S. Geological Survey (USGS) or National Geodetic Survey (NGS) control networks and the state plane coordinate system. (*Guidance for UMTRA Project Surveillance and Maintenance*, January 1986, page 11.)

The draft SMP for the South Clive site states that compliance will be reserved for a later date. The draft SMP states the following for survey monuments:

For an undetermined period following completion of construction at the South Clive disposal site, foundation settlement is expected to occur. In lieu of permanent survey monuments within the designated site boundary, three section corner monuments (southwest, northwest, and northeast) of Section 32, Township 2 South, Range 11 West will be used (Drawing SLC-CL-0017). (*Surveillance and Maintenance Plan for the South Clive Disposal Site, Utah* [Draft], February 1987, Page 2.)

The northeast section corner monument is shown on Plate 1, the inspection drawing. The UMTRA Project Office has reported that the three off-site survey monuments are acceptable and that the National Regulatory Commission has not objected to the locations. The final SMP will explain the reason for the variance from the guidance document requirements.

Boundary Monuments

Four boundary monuments are set at the South Clive disposal site—BM-1, BM-2, BM-3, and BM-4. These monuments are offset outside the security fence at the northwest, northeast, southeast, and southwest corners of the fence (PL-4A and PL-4B, PL-5A and PL-5B, and PL-6A and PL-6B). The third boundary monument, BM-3, was not found. It is believed that Envirocare placed the steel post barricades around BM-1 and BM-2.

The location of boundary monuments BM-1, BM-2, and BM-4 seems to be out of specification with the current UMTRA Project specifications for boundary monuments, which state:

Boundary monuments will be set at all corners of the legal boundaries of a rectilinear site. If the site is irregularly shaped, sufficient boundary monuments will be set to permit recognition of the site's boundaries. The position of the boundary monuments will be determined by a survey at the same precision as used in establishing the site survey monuments. (*Guidance for UMTRA Project Surveillance and Maintenance* [Draft], January 1986, pages 11 and 14.)

The SMP for the South Clive site states the following regarding boundary monuments:

Four boundary monuments will be placed at the corners of the designated site within the fence, as shown on Drawing SLC-CL-0017. The Berntsen Federal aluminum survey monument (Model A-1) will be set at least 12 inches below frost line (36 inches; Roshek, 1987). The final locations will be established to second-order standards and linked to the survey monument (section corners) system. Additional details are available in Section 2.6.2 of the *Guidance Document* (DOE, 1986). (*Surveillance and Maintenance Plan for the South Clive Disposal Site, Utah* [Draft], February, 1987, page 2.)

The three boundary monuments found (BM-1, BM-2, and BM-4) are clearly not placed within the fence as stated in the SMP. The northwest and northeast corners of the fence are set approximately 15 feet inside BM-1 and BM-2. The southeast and southwest corners of the fence are set approximately 50 feet inside BM-4 and the expected location at BM-3.

The inspection party spent considerable time trying to locate all boundary monuments. Only three were found—BM-1, BM-2, and BM-4. These monuments are located within an area of current environmental restoration and waste disposal activities being conducted by Envirocare. Two members of the inspection party were required by Envirocare to participate in a health and safety orientation to become familiar with the hazardous substances, health hazards, and safety hazards of Envirocare's restoration activities, prior to being allowed on site to inspect boundary monuments.

Boundary monument BM-3 could not be found. The expected location for BM-3 had been covered with material by Envirocare's operation. The piled material can readily be seen in photos taken at PL-19A and PL-19B. Boundary monument BM-4 was found (PL-6A and PL-6B) just outside the centerline of an existing north-south electrical power line located west of the disposal site.

The locations of the four boundary monuments BM-1, BM-2, BM-3, and BM-4 appear to be out of specification with the current UMTRA Project specifications for boundary monuments. The UMTRA Project Office has reported that according to the State of Utah, the boundary markers are in the correct position. The security fence is not on the site boundary and Envirocare's operations that surround the site on all sides respect only the fence and not the site boundary.

Settlement Plates

Nine settlement plates are in place at the site: SP-1, SP-2 NW, SP-2 SE, SP-3, SP-7, SP-8, SP-10, SP-11, and SP-12. The numbers were difficult to read. All nine settlement plates are on top of the embankment and noted on Plate 1. All are identified by orange-colored threaded caps with numbers stamped on the caps. The numbering of the plates is random with two plates numbered "2." For purposes of this report the plates numbered "2" have been labeled SP-2 NW and SP-2 SE. SP-2 NW, SP-1, and SP-10 are located along the northern edge of the top transect (PL-7, PL-8, and PL-9). SP-3, SP-7, and SP-12 are located across the middle of the top transect, west to east (PL-10, PL-11, and PL-12). SP-11, SP-8, and SP-2 SE are located along the southern edge of the top transect (PL-13, PL-14, and PL-15). All settlement plate casings are in good condition except that the die-stamped numbers on the casing caps were difficult to discern and two caps are stamped with the same number "2."

The SMP states that the settlement plates will be monitored on an annual basis for 5 years or until settlement is complete. During this period, the settlement plates will be resurveyed to

first-order levels using the northwest corner of Section 32 as the reference bench mark (DOE, 1987). During the resurvey, the existing caps should be replaced with caps which have numbers that are readable and are in sequential order. For first-order accuracy, the caps should be welded to each respective casing.

2.3.2 Transects

Transects are listed in Table 2-2 and shown on Plate 1.

Top

The top of the embankment (top transect) is large, comprising approximately 45 acres. It was inspected by a series of north-south traverses, each spaced approximately 20 yards apart.

A panorama of the site taken from the location of SMK-2 is included in Appendix B, PL-3B through PL-3I. This panorama is a series of eight photographs taken clockwise at 45-degree azimuth intervals. The panorama shows the expanse of the top of the embankment, its generally vegetation-free condition, as well as the nature of the topography and environment that surrounds the disposal site on all sides.

The top of the embankment is mostly free of vegetation. Two areas of small plants were found. The first area noted is located northeast of SP-2 NW and measures 8 feet by 14 feet (PL-18). The area appears to be lacking the larger riprap used as an erosion barrier. The area is underlain by small gravel and interstitial dirt presumed to be fines from the bed of a dumping vehicle.

The second area included four small weed patches located about 280 feet south of site marker SMK-2. The bearing of each patch from SMK-2 is S 145 E, S 165 E, S 180, and S 190 W. The riprap where the small weed patches were located was not graded smooth (PL-3E and PL-3F). Ridges or "furrowed" riprap have allowed windblown sediments to form a seedbed for small plants. The unevenness of the riprap was common over the entire surface of the top of the embankment.

Both patches of fine-grained material will be monitored during future inspections for evidence of change. If deep-rooted species, such as phreatophytes, colonize these patches, their removal or control may be necessary.

There were no other observations on the top of the embankment. Potentially significant phenomena, such as settling, slumping, or erosion, were not observed.

Side Slope

All side slope transects were inspected by two parallel traverses, one along the top and one approximately in the middle of the side slope.

The general nature and condition of the north side slope is shown in photographs taken at PL-20A and PL-21A. The condition of the side slope is good. No evidence of subsidence, slumping, or erosion was seen.

The general nature and condition of the east side slope is shown in photographs taken at PL-21B, PL-22A and PL-22B, and PL-23A. The condition of the side slope is generally good. A uniform depression was observed at PL-36. The depression measured about 1 foot deep, 6 feet wide, and extended for about 75 feet up the slope beginning at the bottom of the slope. The

depression may be an artifact of constructing the embankment. At present, the depression is minor but will be monitored during future site inspections for gully erosion and slumping.

The general nature and condition of the south side slope is shown in photographs taken at PL-23B and PL-24A. The condition of the side slope is good. No evidence of subsidence, slumping, or erosion was seen.

The general nature and condition of the west side slope is shown in photographs taken at PL-24B, PL-25A, PL-25B, and PL-20B. The condition of the side slope is generally good. Another uniform depression was observed on the west side slope the (Plate 1, inspection drawing). The depression measured 6 feet wide, 18 feet long, and was approximately 1 foot deep. The depression began about 20 feet from the top transect. This depression may also be an artifact of constructing the embankment. At present, the depression is considered minor but will be monitored during future inspections for gully erosion and slumping

Toe Drain

The side slopes drain into the toe drain that is designed to drain runoff from the southwest corner of the embankment across the maintenance and inspection road into the perimeter diversion channel.

The general nature and condition of the north toe drain is shown in photographs taken at PL-26A and PL-27A; the east toe drain at PL-27B, PL-28A, PL-28B, and PL-29A; the south toe drain at PL-29B and PL-30A; and the west toe drain at PL-26B, PL-30B, PL-31A, and PL-31B.

The condition of the toe drain is generally good. The toe drain at the southeast corner of the embankment shows evidence of standing water (PL-29A). The dried sediments measured 3 to 8 feet wide and extended for about 805 feet. It appears that the toe drain leading west from the southeast corner of the embankment is higher in elevation than the east toe drain and does not allow proper drainage.

Maintenance and Inspection Road

The maintenance and inspection road enters the site between the head of the north and the west perimeter diversion channels (PL-32A and PL-42B). The road travels around the embankment between the perimeter diversion channel and the disposal cell toe drain, parallel to each.

The embankment toe drain drains into the perimeter diversion channel at the southwest corner of the site. To do so, runoff must cross the access road to reach the diversion channel. There is no culvert. This has caused erosion of the access road as seen in photograph PL-38. A swale was constructed in the access road to carry runoff from the toe drain to the diversion channel. It appears that the elevation of the swale is too high to handle the runoff. The consequence of this is the swale in the access road is being eroded.

Perimeter Diversion Channel

The perimeter diversion channel at the South Clive site is just inside the security fence. It protects the disposal site from off-site runoff. The diversion channel also drains runoff from the disposal site to a floodplain southwest of the site. The diversion channel consists of two sections that encircle the site and meet at the southwest corner of the site before diverting runoff to the southwest (PL-40).

The head of each section begins at the site entrance gate (PL-32A and PL-42B) located at the northwest corner of the site. The general nature and condition of the northern section of the

channel is shown in photographs taken at PL-32A, PL-32B, and PL-34A. There is evidence of plant growth (PL-32B) and missing riprap in photographs PL-33A and PL-33B. The riprap is missing on the south side of the northern section from the top to just above the bottom of the channel. The missing riprap extends for about 100 yards along the channel.

The general nature and condition of the eastern and southern sections of the channel are shown in photographs taken at PL-34B, PL-35A, PL-35B, PL-37A, PL-37B, and PL-39A. There is no evidence of plant growth, ponding, or soil accumulation at this time. The dried sedimentation seen in PL-38 and PL-39A is probably from erosion of the access road.

The general nature and condition of the western section of the channel is shown in photographs taken at PL-39B, PL-41A, PL-41B, PL-42A, and PL-42B. There is no evidence of plant growth, ponding, or soil accumulation at this time.

The SMP did not define the construction and emplacement specifications for the riprap erosion barriers. The riprap specifications should be determined and the missing riprap put in place.

Site Perimeter

This transect includes the site boundary, boundary monuments, security fence, and the area immediately surrounding these features.

The most serious problem at this site occurs within the site perimeter transect. The security fence is not on the site boundary and Envirocare's operation surrounding the site does not recognize the site boundary but only the security fence. Envirocare is currently conducting operations on disposal site property on the north, east, south, and west perimeters of the site. Envirocare is restricting DOE access to the north, east, and south perimeters of the site.

On the north, Envirocare is storing equipment on site property and has erected barriers around BM-1 and BM-2. On the east, Envirocare has constructed an access road that appears to be located on site property. On the south, Envirocare has erected a fence around its waste disposal operation that prevents the DOE from access to the areas between the southern security fence and the southern property boundary. This fence, plus the Envirocare fence located at the northwest corner of the site, prevents the DOE from access to site property outside the security fence on the east.

The security fence wire mesh, barbed wire, gate, fence posts, and hardware are all in excellent condition with one exception. East of the northwest corner of the fence boundary at the third "panel," the wire mesh is pushed in at the bottom, approximately 6 inches from some barrels. It is believed that the barrels belong to Envirocare because of their current environmental disposal activities. The condition of the security fence will be monitored during future site inspections.

2.3.3 Area Adjacent to the Site

The area adjacent to the site was examined for signs of erosion, development, or other disturbance that may affect the site.

The primary land use around the site is waste disposal activities being conducted by Envirocare. It is believed that Envirocare owns all the land in Section 32 with the exception of the South Clive disposal site. The South Clive site is completely surrounded by Envirocare property (the DOE has an easement for access to the South Clive site). Envirocare is using the land as a waste disposal facility. Envirocare's administration building is located immediately

north of the northwest corner of the South Clive disposal site. An active waste haul road extends from the administration building east to the northeast corner of the South Clive site, then south to Envirocare's disposal site immediately south of the South Clive site.

Envirocare is excavating and burying waste material south of the South Clive site, some of which appears to lie on disposal site property. Envirocare is storing some waste in a building southeast of the South Clive site. A railroad spur used to haul and unload the radioactive materials from the former Vitro Chemical Company processing site to the South Clive site exists immediately east of the site. An active access road immediately west of the South Clive site connects Envirocare's administrative building with its disposal site. Envirocare has erected a washdown facility adjacent to the southwest corner of the South Clive disposal site boundary. The active disposal activities can be seen in photographs taken at PL-4A, PL-5A, PL-22, PL-23, PL-24A, PL-25A, PL-29, PL-30A, PL-32A, PL-35, PL-37, PL-39A, and PL-42. The impact of Envirocare's activities should be assessed to determine current and future impacts to the South Clive site.

3.0 Conclusions and Recommendations

3.1 Conclusions

The South Clive disposal site is in fair condition at this time. Because the 1991 inspection is the first annual precicensing inspection of the site, there were no observations from previous inspections to be reinspected and evaluated. The report of the 1991 inspection provides baseline information on site conditions for future inspections.

3.2 Observations and Recommendations

Observations and recommendations from the 1991 inspection are:

1. Site marker SMK-1 appears to be out of specification. The marker cannot be read from outside the entrance gate.

Recommendation: The UMTRA Project Office should determine if the variance is acceptable. If the variance is unacceptable, the UMTRA Project Office may direct that a new site marker be installed. (The existing marker cannot simply be rotated 90 degrees because then the engraved north arrow and the orientation of the tailings embankment would be incorrect.)

If the UMTRA Project Office finds this variance acceptable, the SMP or other site-specific document should be modified or amended to reflect the UMTRA Project's acceptance of this variance. Also, the final SMP should include the current incised message on both placed site markers (SMK-1 and SMK-2). If the incised message is changed, the orientation of SMK-1 can be changed to meet current guidance.

2. The incised message on site markers SMK-1 and SMK-2 does not agree with the SMP. The date of closure, the tonnage of tailings, and the estimate of the curies of radioactivity engraved on the site markers disagree with the same information provided in the SMP.

Recommendation: If the incised message on site markers SMK-1 and SMK-2 is correct, then the SMP should be revised. If the message is not correct, then both site markers SMK-1 and SMK-2 should be replaced. When the State of Utah provides a disposal completion report, the incised message can be checked for accuracy.

3. The entrance sign (PL-1) does not contain the name of the responsible agency (DOE), a telephone number for the DOE, and the name of the particular tailings repository.

Recommendation: Replace the entrance sign with a sign that meets current specifications.

4. The boundary monument BM-3 could not be found. If BM-3 was set southeast of the southeast fence corner, it could not be found because of current disposal operations by Envirocare immediately around the site.

Recommendation: Replace the missing boundary monument, BM-3.

5. The numbers stamped on the nine settlement-plate casing caps located on top of the disposal cell were difficult to read. Also, two of the plates were stamped with the number "2."

Recommendation: When the settlement plates are resurveyed to first-order levels, replace the caps with caps which have numbers that are readable and are in sequential order. Weld the caps onto the settlement-plate casings.

6. The toe drain shows signs of standing water in the southeast corner.

Recommendation: Survey the toe drain to determine gradient to the southwest corner. Any high spots should be leveled to provide appropriate drainage of the toe drain.

7. The swale located on the southwest corner of the access road is designed to allow drainage from the toe drain across the swale into the perimeter diversion channel. The elevation of the swale is too high to allow proper drainage.

Recommendation: Replace the swale with a culvert. The culvert will allow proper drainage and maintain the integrity of the on-site access road.

8. The northern run of the perimeter diversion channel is missing larger diameter riprap. The larger diameter material is necessary to dissipate the energy of any collected runoff.

Recommendation: Determine the specification for riprap for the diversion channel. Place sufficient riprap where appropriate.

9. Envirocare is actively storing and disposing of waste material immediately south of the South Clive disposal site. An active waste hauling route extends from the northwest corner of the South Clive site, east to the northeast corner, then south to Envirocare's disposal site. Envirocare's administrative building is located immediately north of the northwest corner of the South Clive disposal site. An active access road immediately west of the South Clive disposal site connects Envirocare's administrative building with their disposal site. The South Clive disposal site is completely surrounded by the activities of Envirocare.

Recommendation: If the UMTRA Project Office believes that Envirocare's activities will have a long-term negative impact on the South Clive disposal site, then Envirocare's activities should be assessed. The DOE should ensure that access to the South Clive disposal site is maintained unencumbered.

3.3 Site Maintenance

No site maintenance is recommended at this time.

3.4 Contingency Plans

As indicated in the draft SMP, the DOE will establish notification procedures with the National Weather Service, Utah Comprehensive Emergency Management, Earthquake Information Center, and the Tooele County Sheriff's Department. These agencies will contact the DOE should any unusual event come to their attention that might affect the security or integrity of the South Clive site.

4.0 References

DOE (U.S. Department of Energy), 1983. *Draft Environmental Impact Statement, Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah*, DOE/EIS-0099-D, prepared by the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

_____, 1984. *Final Environmental Impact Statement, Remedial Actions at the Former Vitro Chemical Company Site, South Salt Lake, Salt Lake County, Utah*, DOE/EIS-0099-F, prepared by the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

_____, 1986. *Guidance for UMTRA Project Surveillance and Maintenance*, UMTRA-DOE/AL-350124.0000, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico

_____, 1987. *Surveillance and Maintenance Plan, South Clive Disposal Site, Utah*, draft, UMTRA-DOE/AL-350202.0000, DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

10 CFR 40.27. *Custody and Long-Term Care of Uranium and Thorium Mill Tailings Disposal Sites*, October 30, 1990.

Appendix A

Inspection Photo Log and Photographs

Inspection Photo Log

Explanation

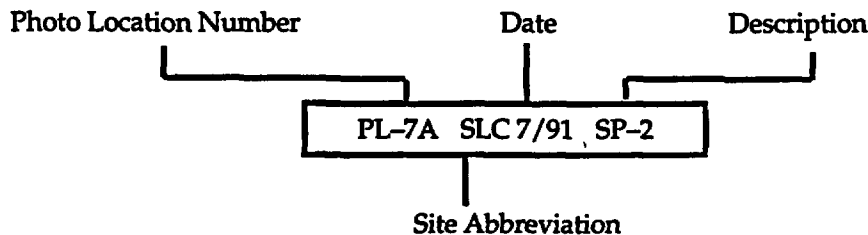
Photographs referred to in the text of this report, as well as a list of these photographs, are included in this appendix (Appendix A). Photographs are identified by photograph location (PL) number. PL numbers also appear on the inspection drawing (Plate 1).

Specifications

All photographs were taken on Kodacolor 135 film, ISO 200, with a variable focal length (zoom) lens. Focal lengths vary between 35 mm and 105 mm. All photographs were exposed with daylight illumination and without filtration.

Photograph Labels

Photographs in Appendix A are labelled as follows:



When more than one photograph was taken at a given photograph location, different photographs are identified by a letter suffix, e.g., 4A, 4B.

Abbreviations

The following abbreviations are used in the photo log:

N	North	SP	Settlement Plate
NW	Northwest	SMK	Site Marker
E	East	BM	Boundary monument
SE	Southeast	in.	inches
S	South	ft.	feet
SW	Southwest	Az	Azimuth

Inspection Photo Log

Site: South Clive, Utah

Date of Inspection: July 29 and 30, 1991

Time of Day: July 29: 10:00 a.m. to 4:00 p.m.

July 30: 9:00 a.m. to 12:00 p.m.

Weather Conditions: July 29: Partly cloudy, hot, slight breeze. Temperature mid-90s °F.

July 30: Clear, hot, slight breeze. Temperature mid-80s °F.

Photographer's Location No. ^a	Azimuth ^b	Photo Description/Remarks
1	090	Entrance sign
2	000	Site marker SMK-1; near entrance.
3A	000	Site marker SMK-2; top transect.
3B	000	Panorama from location of SMK-2; view N.
3C	045	Panorama from location of SMK-2; view NE.
3D	090	Panorama from location of SMK-2; view E.
3E	135	Panorama from location of SMK-2; view SE.
3F	180	Panorama from location of SMK-2; view S.
3G	225	Panorama from location of SMK-2; view SW.
3H	270	Panorama from location of SMK-2; view W.
3I	315	Panorama from location of SMK-2; view NW.
4A		Boundary Monument BM-1 with bumper guards; BM-1 within Envirocare controlled area.
4B		Same as PL-4A; detail
5A		Boundary Monument BM-2 with bumper guards; BM-2 within Envirocare controlled area.
5B		Same as PL-5A; detail
6A		Boundary Monument BM-4.
6B		Same as PL-6A; detail.
7A		Settlement plate SP-2 NW; NW corner of top transect.
7B		Same as PL-7A; detail.
8A		Settlement plate SP-1.
8B		Same as PL-8A; detail.
9A		Settlement plate PL-10
9B		Same as PL-9A, detail.
10A		Settlement plate SP-3.
10B		Same as PL-10A; detail.
11A		Settlement plate SP-7.
11B		Same as PL-11A; detail.
12A		Settlement plate SP-12.
12B		Same as PL-12A; detail.
13A		Settlement plate SP-11.
13B		Same as PL-13A; detail.
14A		Settlement plate SP-8.
14B		Same as PL-14A; detail.
15A		Settlement plate SP-2 SE; SE corner of top transect.
15B		Same as PL-15A; detail.
16		Riprap detail; top transect.
17	180	Riprap detail; N side slope.
18		Weed patch top transect; one-stemmed plants.

^aPhoto location number. See Plate 1 for map of photo locations.

^bDeclination angle: 16° E.

Inspection Photo Log

Site: South Clive, Utah

Date of Inspection: July 29 and 30, 1991

Time of Day: July 29: 10:00 a.m. to 4:00 p.m.

July 30: 9:00 a.m. to 12:00 p.m.

Weather Conditions: July 29: Partly cloudy, hot, slight breeze. Temperature mid-90s °F.

July 30: Clear, hot, slight breeze. Temperature mid-80s °F.

Photographer's Location No. ^a	Azimuth ^b	Photo Description/Remarks
19A	225	Envirocare activity south of pile within 0.25 mile of site.
19B	135	Envirocare activity south of pile within 0.25 mile of site.
20A	090	N side slope; W end; view E.
20B	180	W side slope; N end; view S.
21A	270	N side slope; E end; view W.
21B	180	E side slope; N end; view S.
22A	000	E side slope; middle; view N.
22B	180	E side slope; middle; view S.
23A	000	E side slope; S end; view N.
23B	270	S side slope; E end; view W.
24A	090	S side slope; W end; view E.
24B	000	W side slope; S end; view N.
25A	180	W side slope; middle; view S.
25B	000	W side slope; middle; view N.
26A	090	N toe drain; W end; view E.
26B	180	W toe drain; N end; view S.
27A	270	N toe drain; E end; view W.
27B	180	E toe drain; N end; view S.
28A	000	E toe drain; middle; view N.
28B	180	E toe drain; middle; view S.
29A	000	E toe drain; S end; view N.
29B	270	S toe drain; E end; view W.
30A	090	S toe drain; W end; view E.
30B	000	W toe drain; S end; view N.
31A	180	W toe drain; middle; view S.
31B	000	W toe drain; middle; view N.
32A	290	N perimeter diversion channel.
32B	090	N perimeter diversion channel; view E.
33A	225	N perimeter diversion channel; missing riprap.
33B	135	N perimeter diversion channel; missing riprap.
34A	270	N perimeter diversion channel; E end; view W.
34B	180	E perimeter diversion channel; N end; view S.
35A	000	E perimeter diversion channel; middle; view N.
35B	180	E perimeter diversion channel; middle; view S.
36		Depression in E side slope.
37A	000	E perimeter diversion channel; S end; view N.
37B	270	S perimeter diversion channel; E end; view W.
38	000	Erosion of perimeter access road from pile toe drains.
39A	090	S perimeter diversion channel; W end; view E.
39B	000	W perimeter diversion channel; S end; view N.
40	270	Perimeter diversion channel off-site drainage culvert; drainage to floodplain SW of site.

^aPhoto location number. See Plate 1 for map of photo locations.

^bDeclination angle: 16° E.

Inspection Photo Log

Site: South Clive, Utah

Date of Inspection: July 29 and 30, 1991

Time of Day: July 29: 10:00 a.m. to 4:00 p.m.

July 30: 9:00 a.m. to 12:00 p.m.

Weather Conditions: July 29: Partly cloudy, hot, slight breeze. Temperature mid-90s °F.

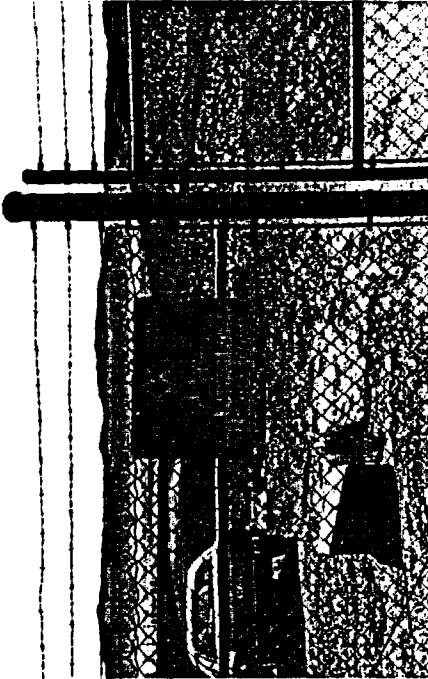
July 30: Clear, hot, slight breeze. Temperature mid-80s °F.

Photographer's Location No. ^a	Azimuth ^b	Photo Description/Remarks
41A	180	W perimeter diversion channel; middle; view S.
41B	000	W perimeter diversion channel; middle; view N.
42A	180	W perimeter diversion channel; N end; view S.
42B	280	W perimeter diversion channel; entrance gate; Envirocare administrative building.

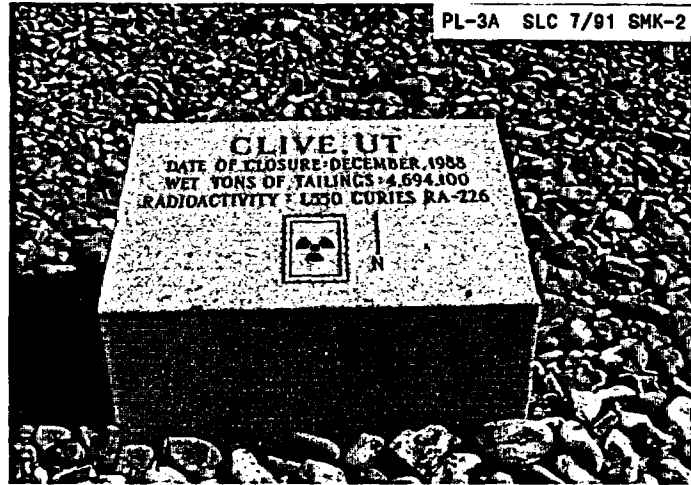
^aPhoto location number. See Plate 1 for map of photo locations.

^bDeclination angle: 16° E.

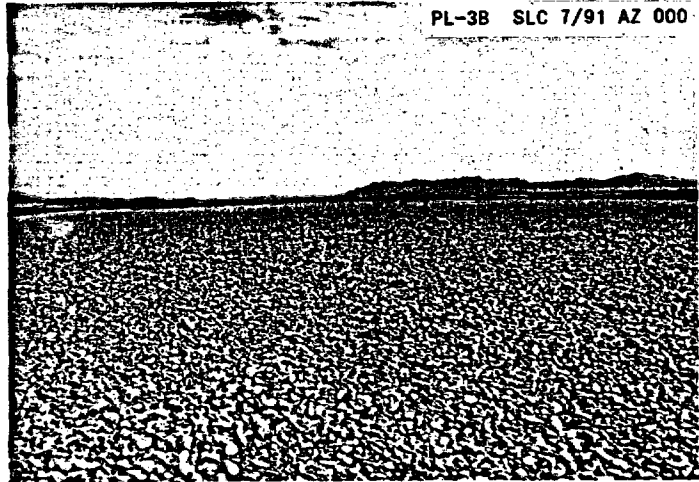
PL-1 SLC 7/91 ENTRANCE SIGN



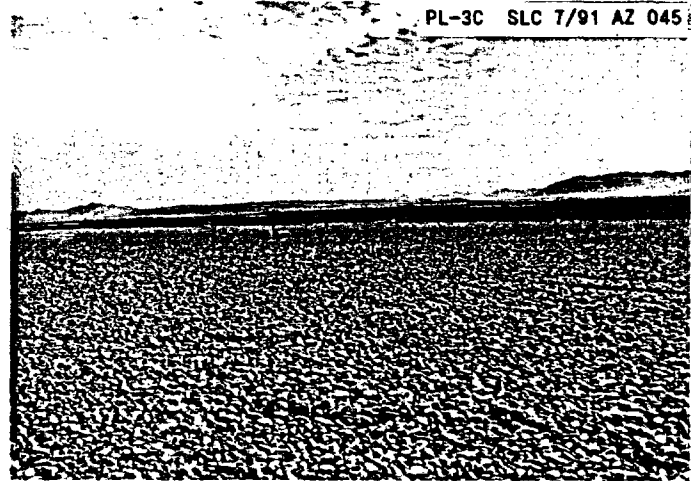
PL-3A SLC 7/91 SMK-2



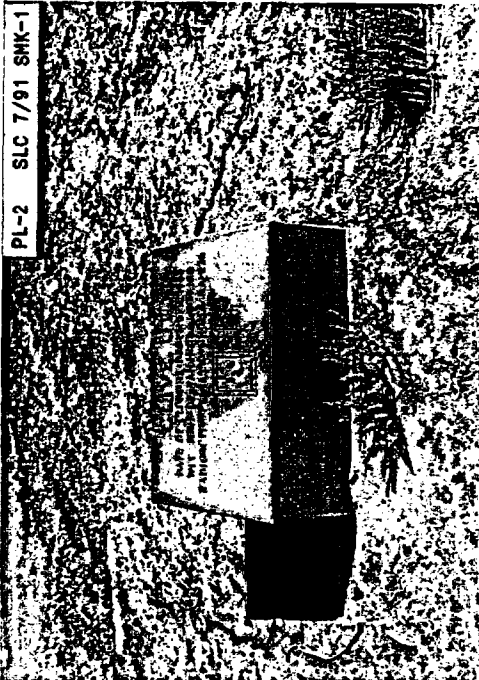
PL-3B SLC 7/91 AZ 000



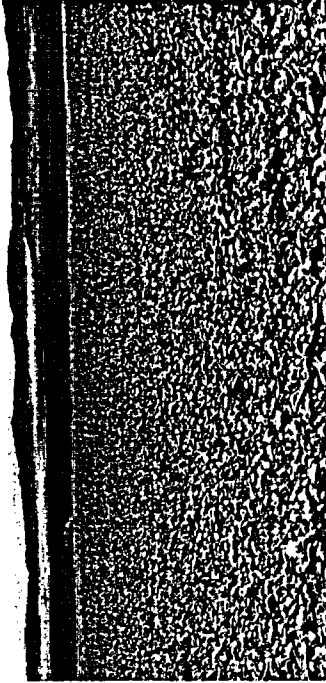
PL-3C SLC 7/91 AZ 045



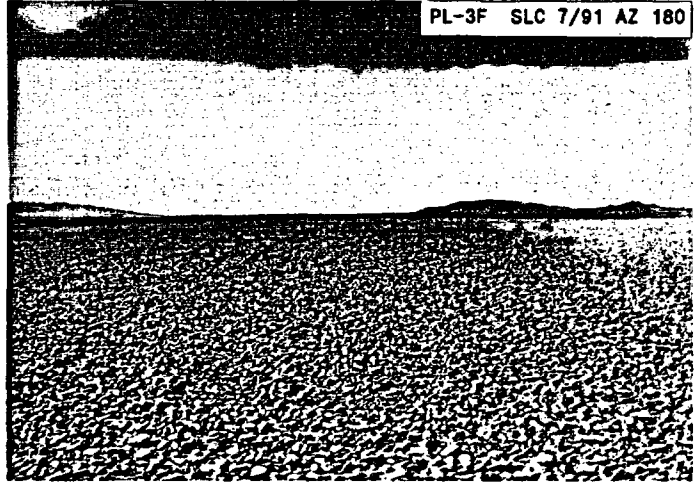
PL-2 SLC 7/91 SMK-1



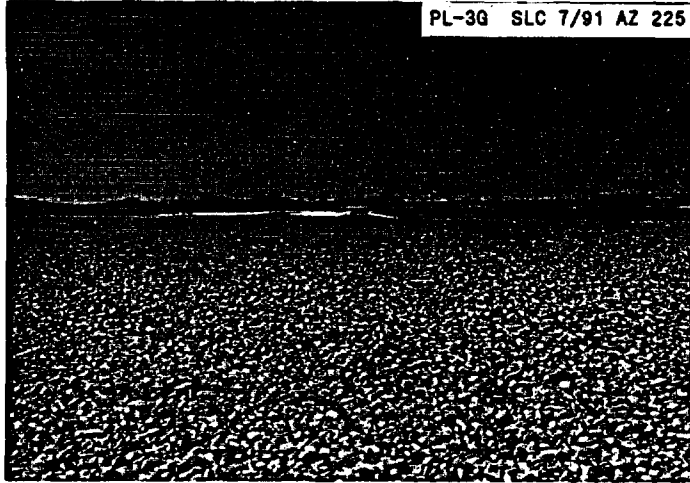
PL-3D SLC 7/91 AZ 090



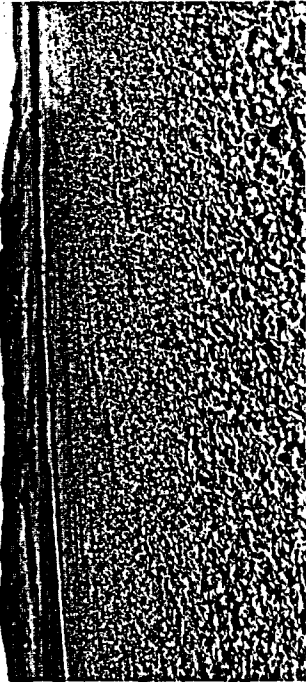
PL-3F SLC 7/91 AZ 180



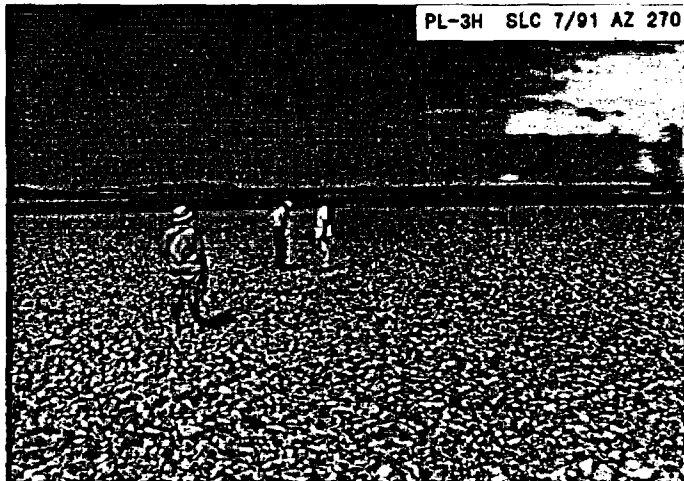
PL-3G SLC 7/91 AZ 225

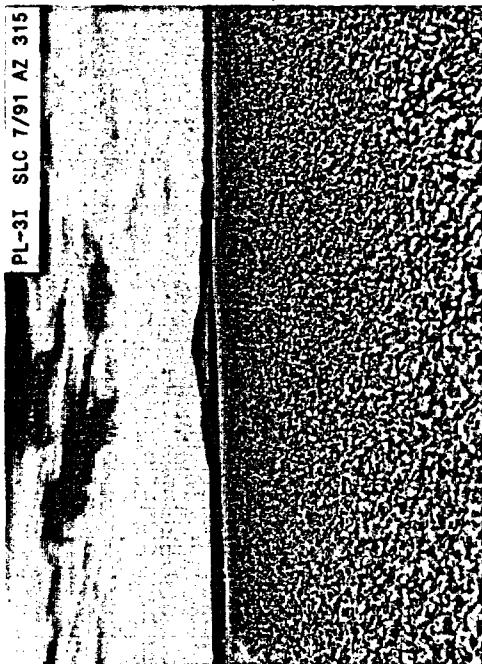


PL-3E SLC 7/91 AZ 135



PL-3H SLC 7/91 AZ 270





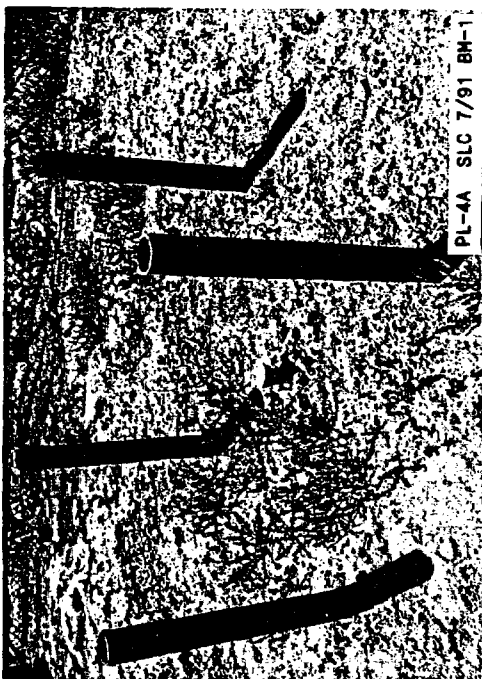
PL-31 SLC 7/91 AZ 315



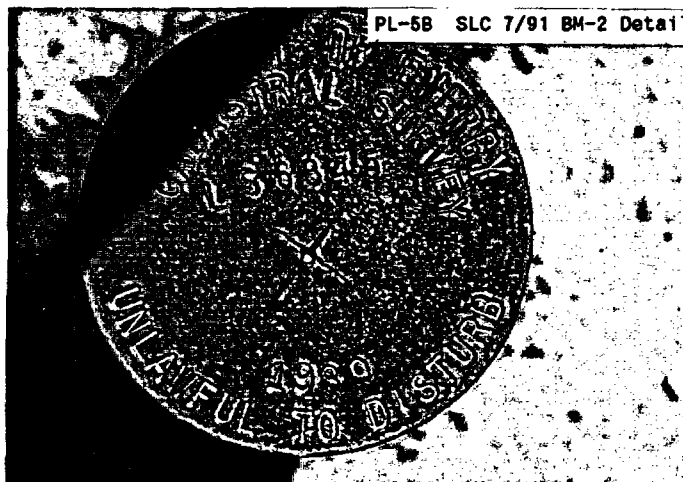
PL-4B SLC 7/91 BM-1 Detail



PL-5A SLC 7/91 BM-2



PL-4A SLC 7/91 BM-1

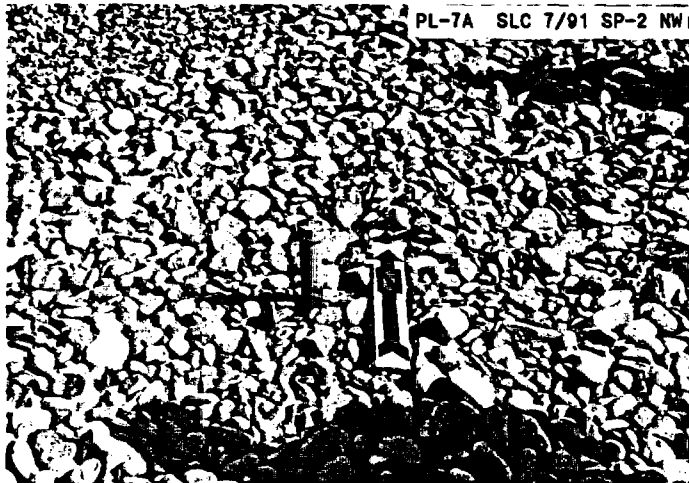


PL-5B SLC 7/91 BM-2 Detail

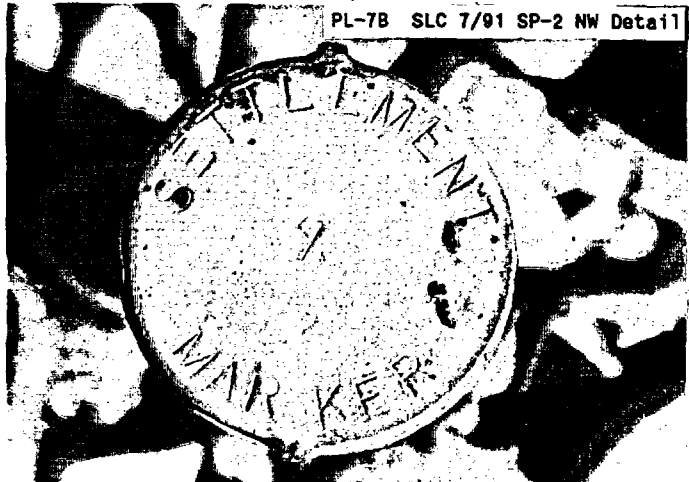
PL-6A SLC 7/91 BH-4



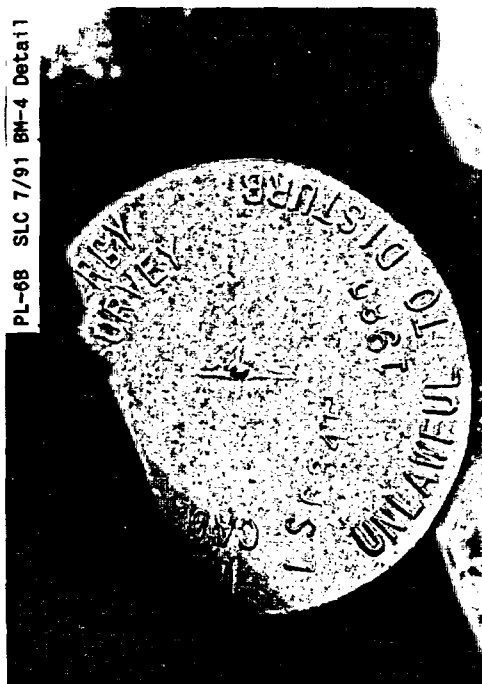
PL-7A SLC 7/91 SP-2 NW



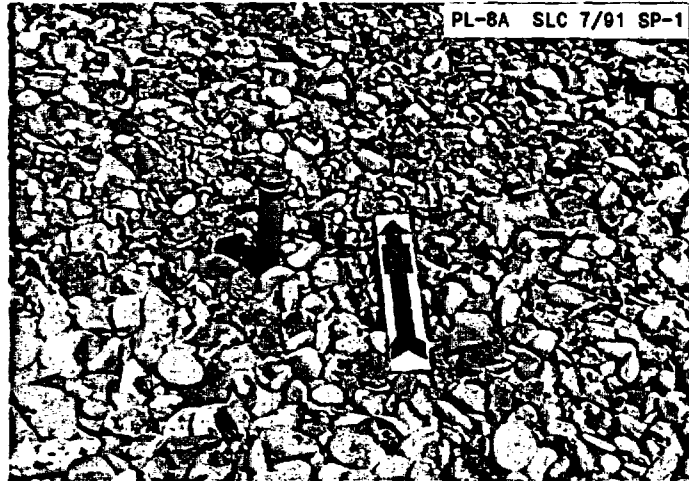
PL-7B SLC 7/91 SP-2 NW Detail



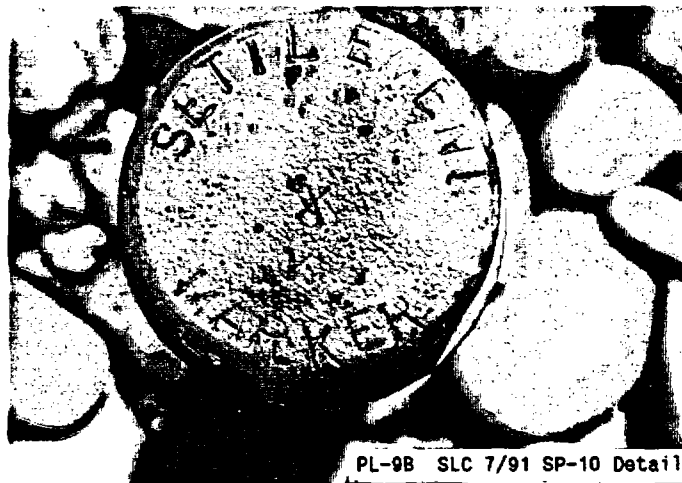
PL-8B SLC 7/91 BH-4 Detail



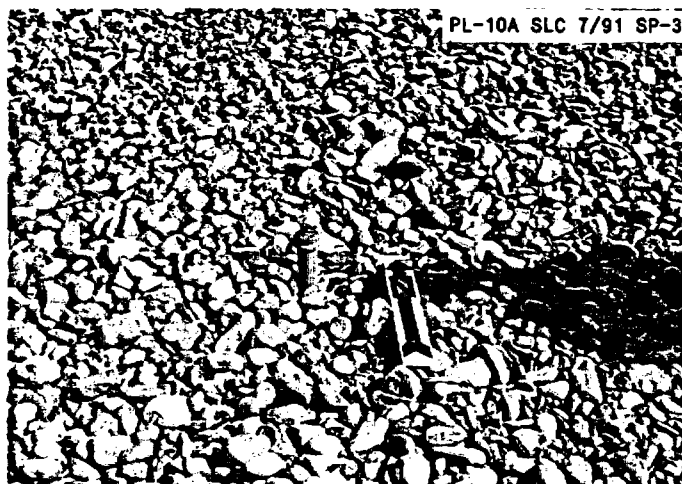
PL-8A SLC 7/91 SP-1



PL-8B SLC 7/91 SP-1 Detail

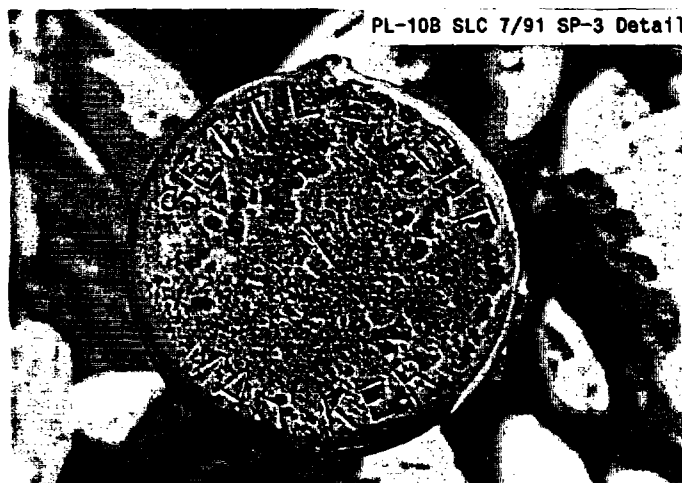
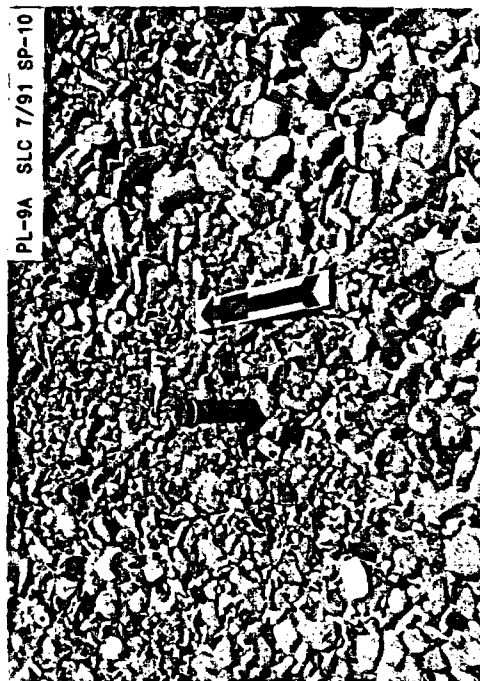


PL-9B SLC 7/91 SP-10 Detail

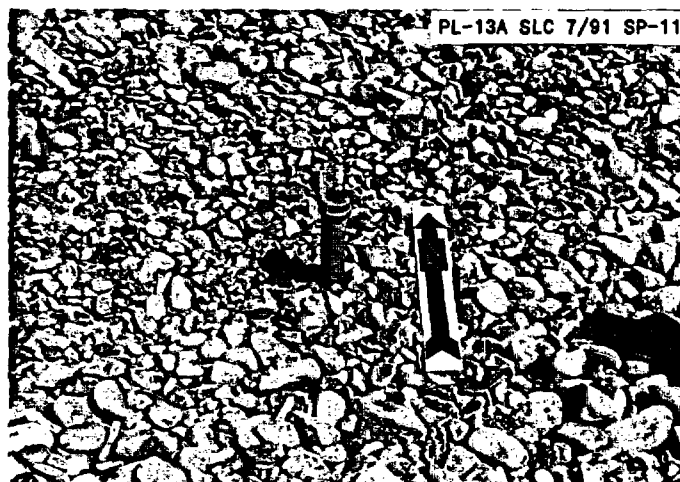
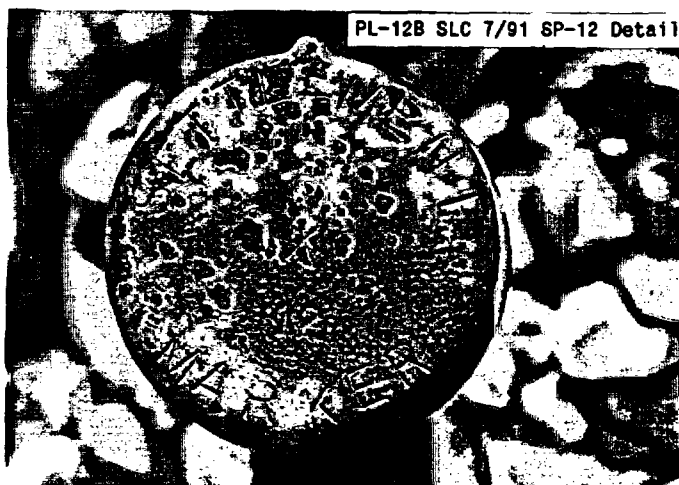


PL-10A SLC 7/91 SP-3

PL-9A SLC 7/91 SP-10



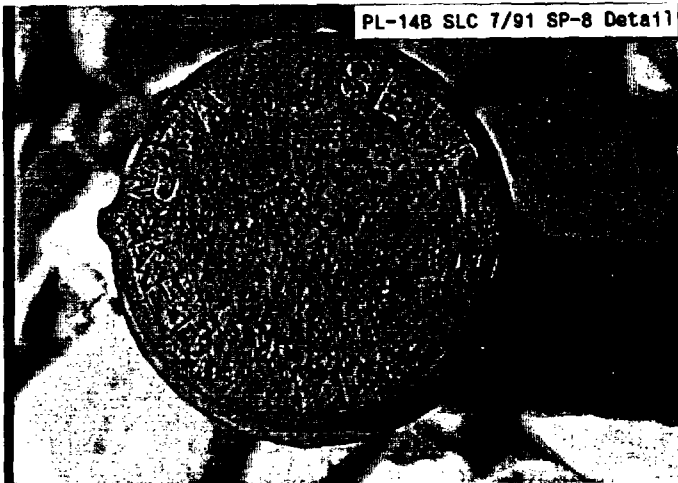
PL-10B SLC 7/91 SP-3 Detail



PL-13B SLC 7/91 SP-11 Detail



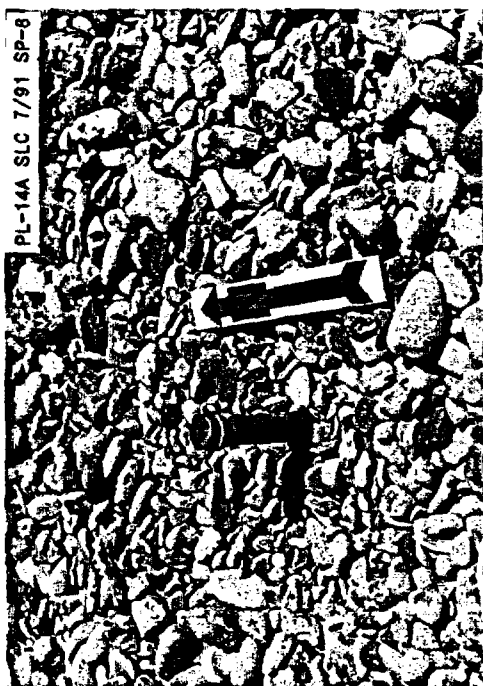
PL-14B SLC 7/91 SP-8 Detail



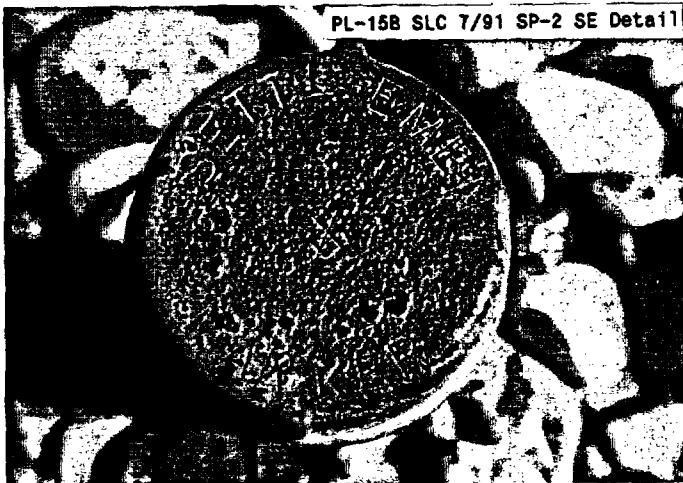
PL-15A SLC 7/91 SP-2 SE



PL-14A SLC 7/91 SP-8



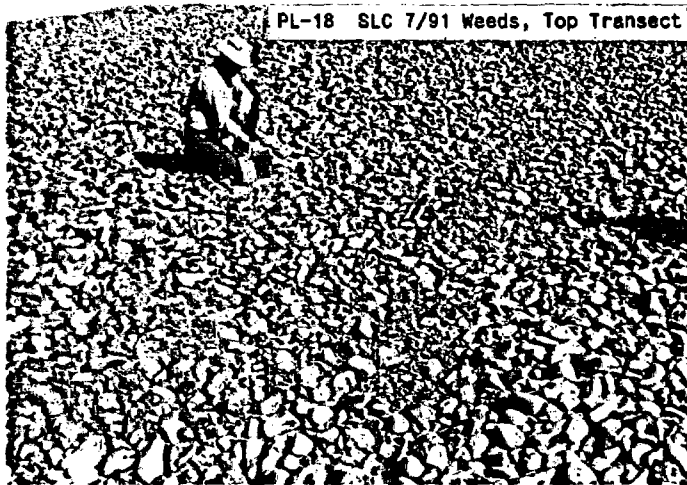
PL-15B SLC 7/91 SP-2 SE Detail



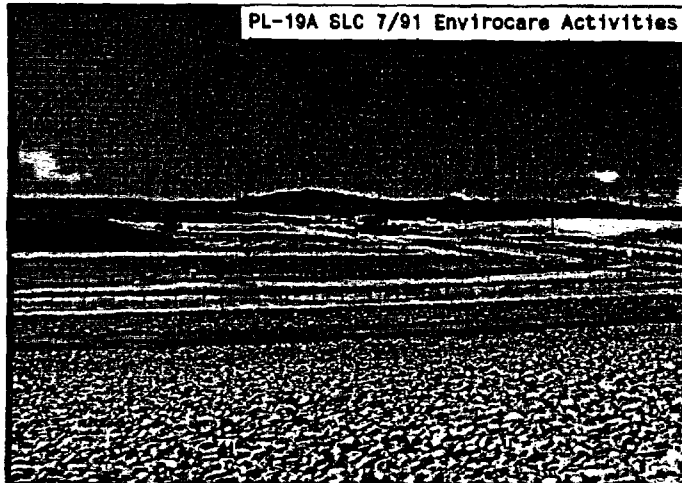
PL-16 SLC 7/91 Riprap, Top Transect



PL-18 SLC 7/91 Weeds, Top Transect



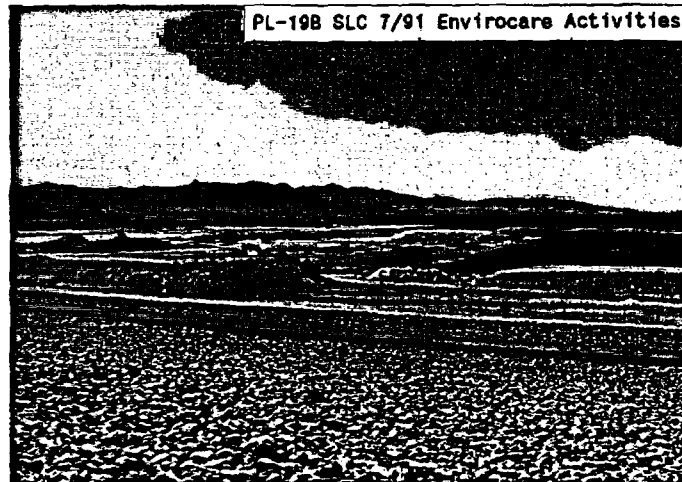
PL-19A SLC 7/91 Envirocare Activities



PL-17 SLC 7/91 Riprap, N Side Slope



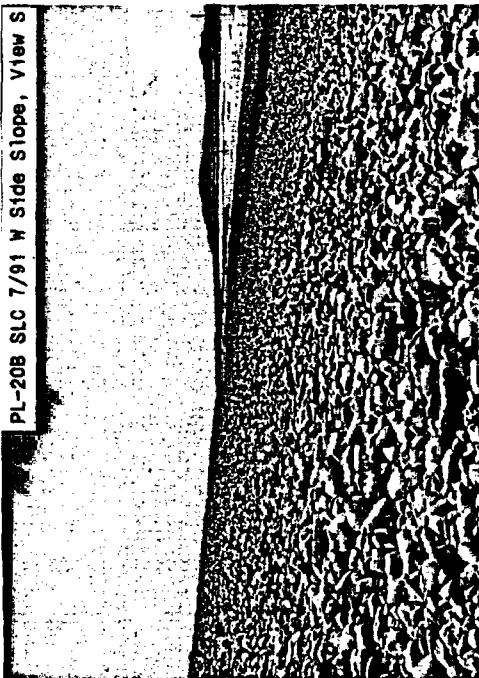
PL-19B SLC 7/91 Envirocare Activities



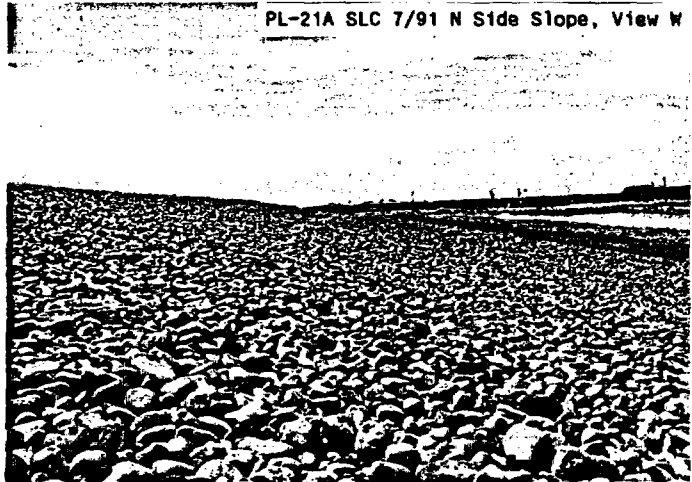
PL-20A SLC 7/91 N Side Slope, View E



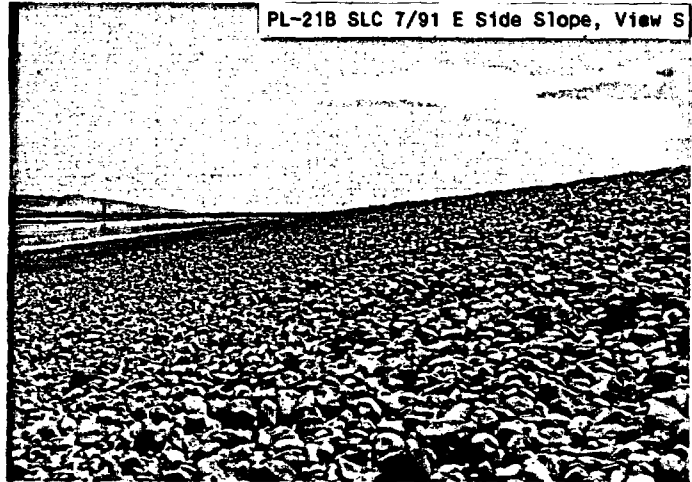
PL-20B SLC 7/91 W Side Slope, View S



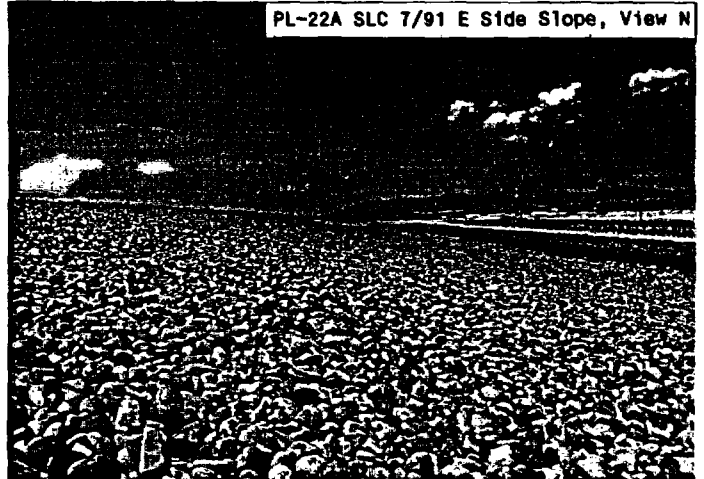
PL-21A SLC 7/91 N Side Slope, View W



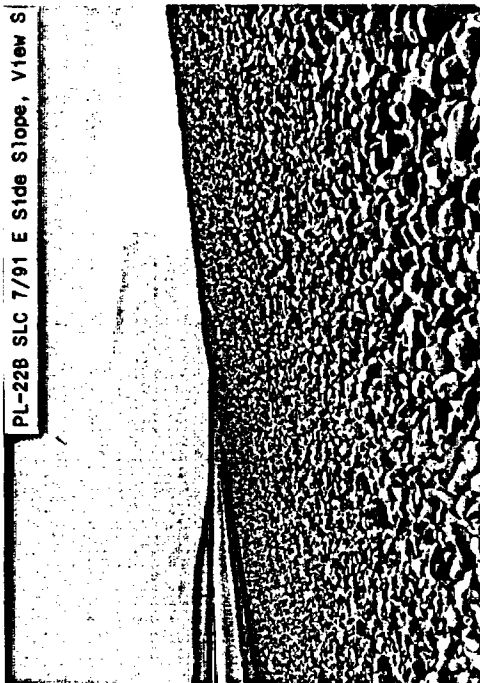
PL-21B SLC 7/91 E Side Slope, View S



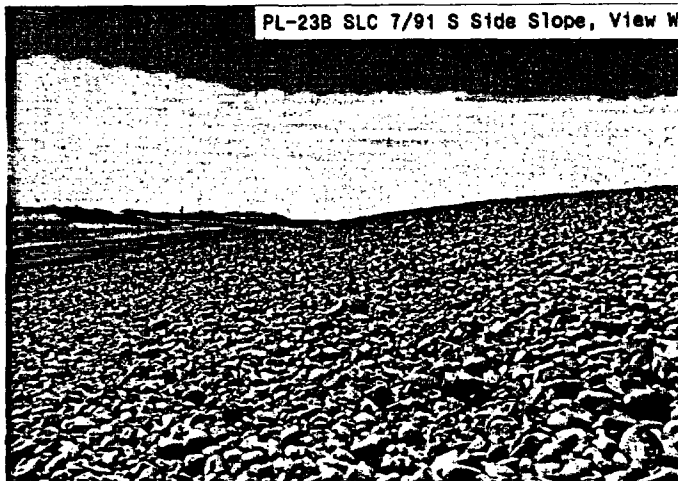
PL-22A SLC 7/91 E Side Slope, View N



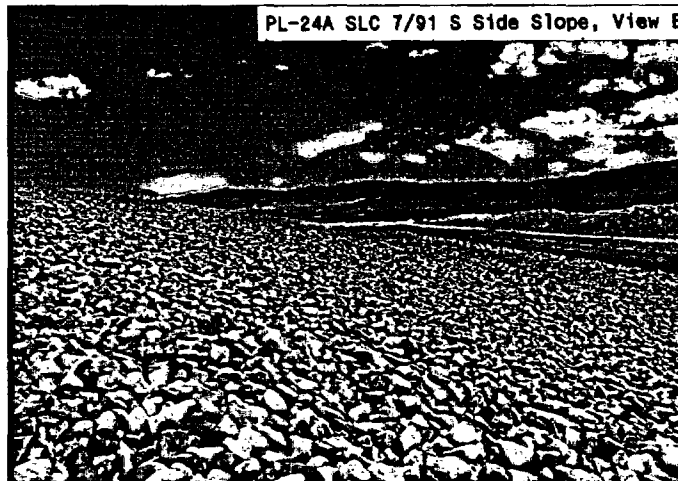
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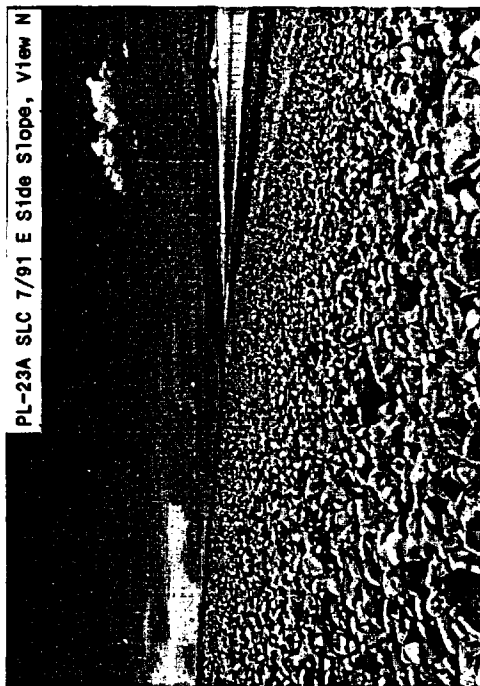
PL-23B SLC 7/91 S Side Slope, View W



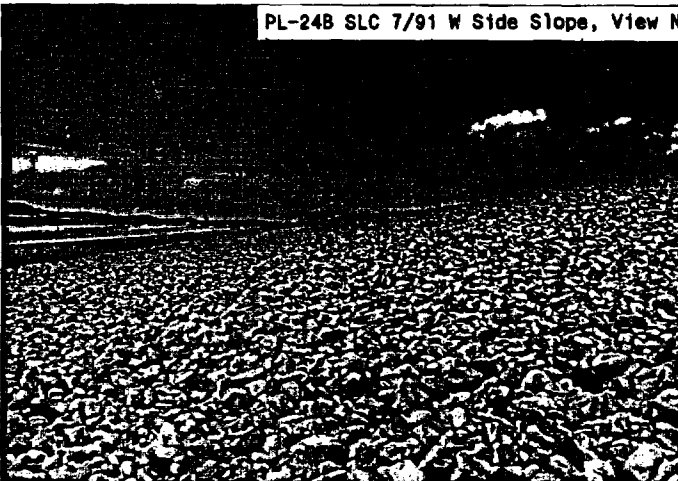
PL-24A SLC 7/91 S Side Slope, View E



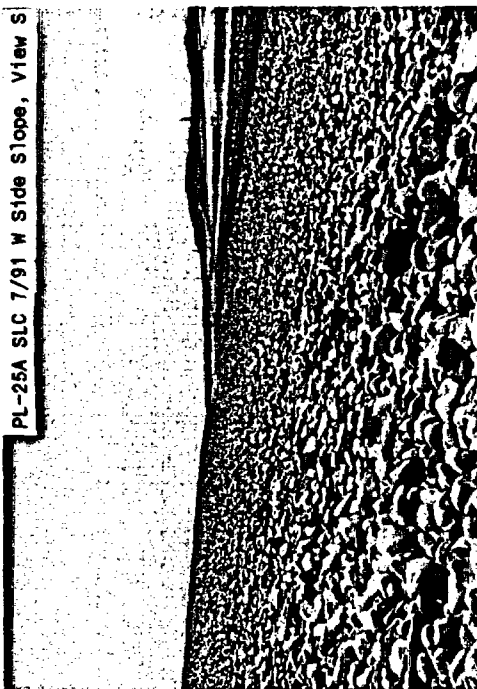
PL-23A SLC 7/91 E Side Slope, View N



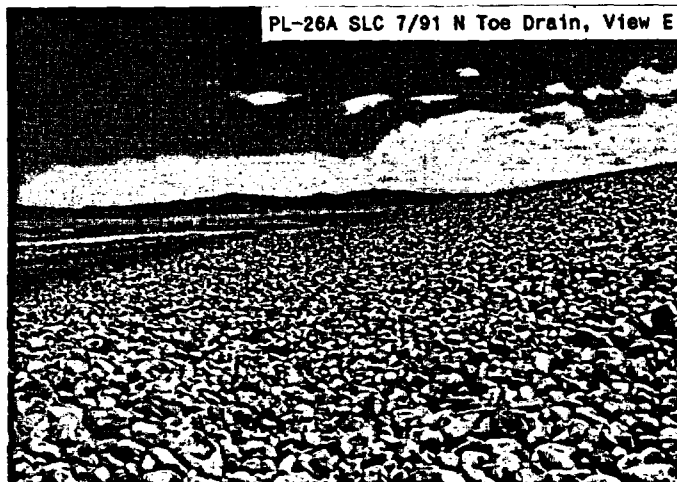
PL-24B SLC 7/91 W Side Slope, View N



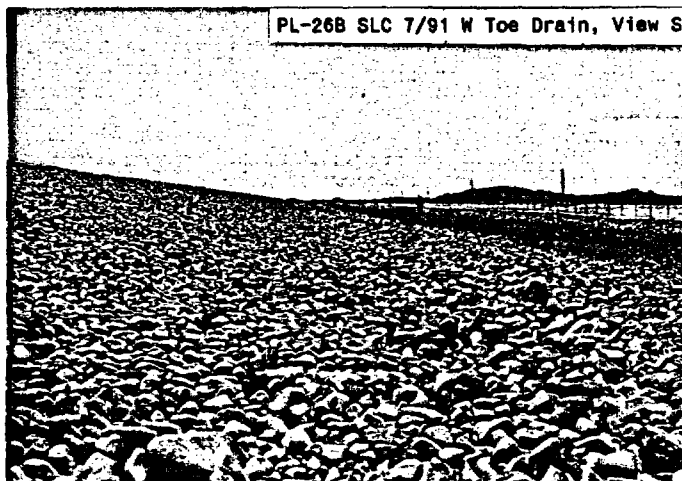
PL-25A SLC 7/91 W Side Slope, View S



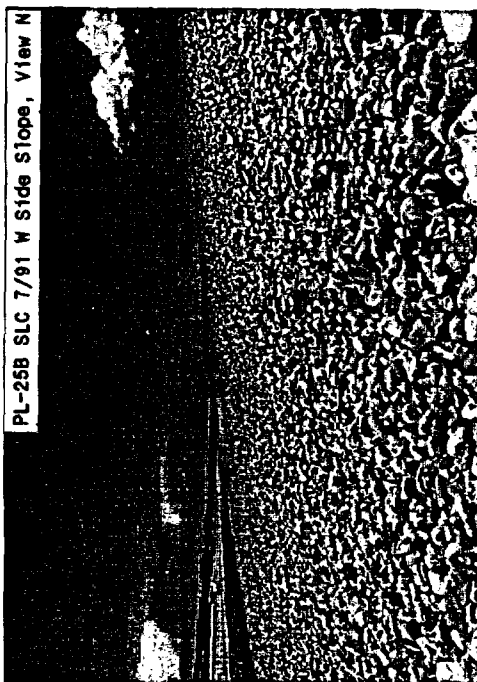
PL-26A SLC 7/91 N Toe Drain, View E



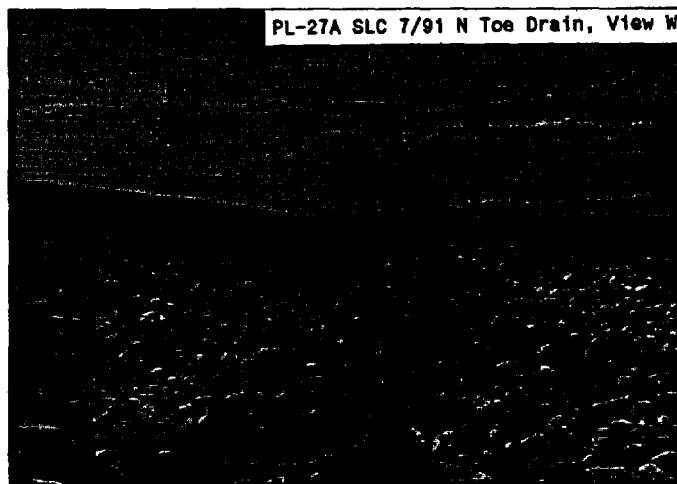
PL-26B SLC 7/91 W Toe Drain, View S

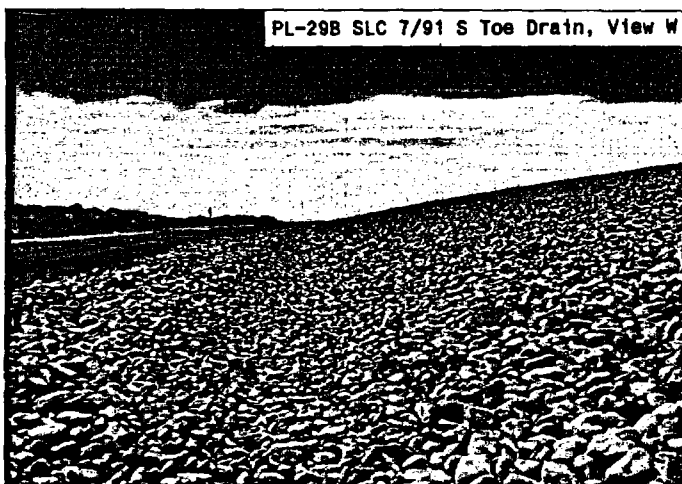
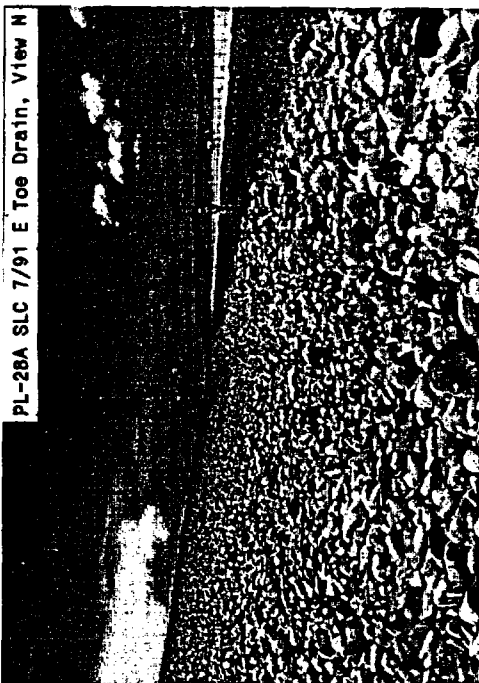
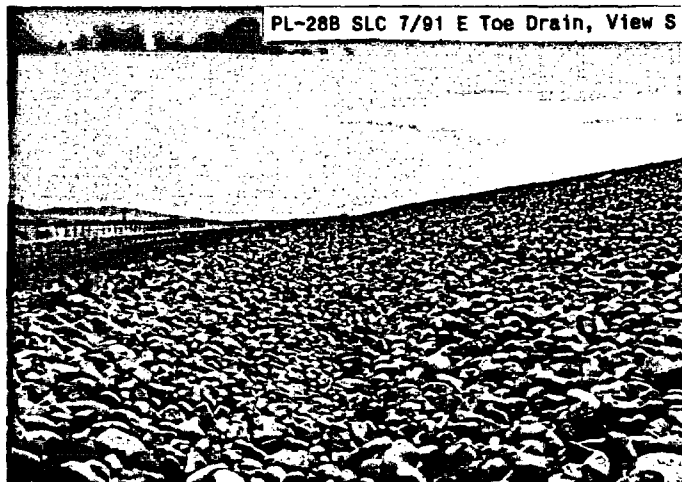
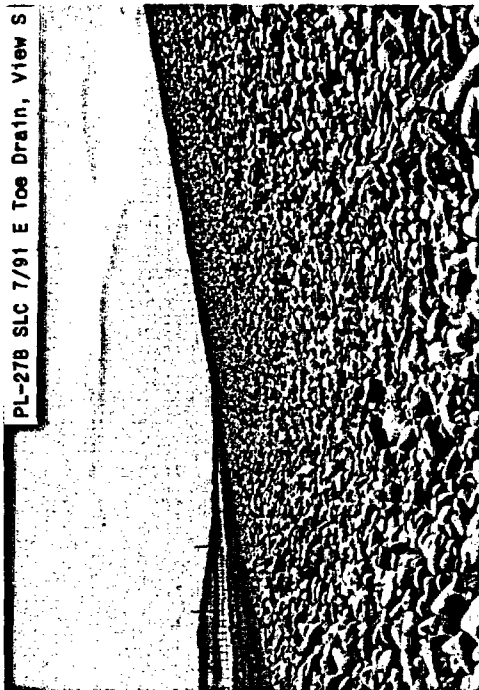


PL-25B SLC 7/91 W Side Slope, View N

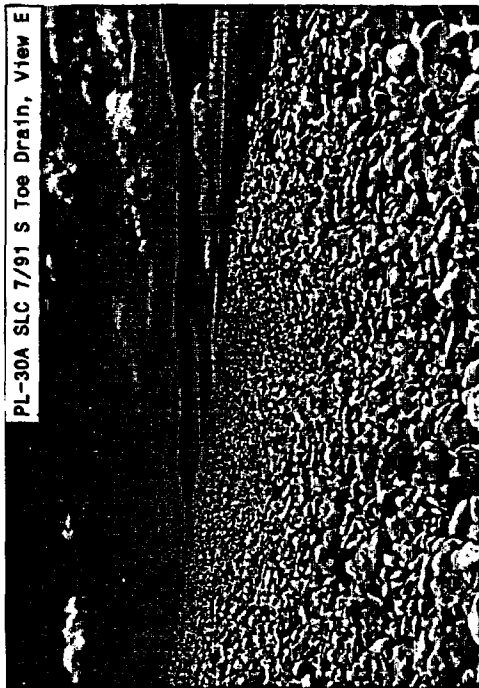


PL-27A SLC 7/91 N Toe Drain, View W

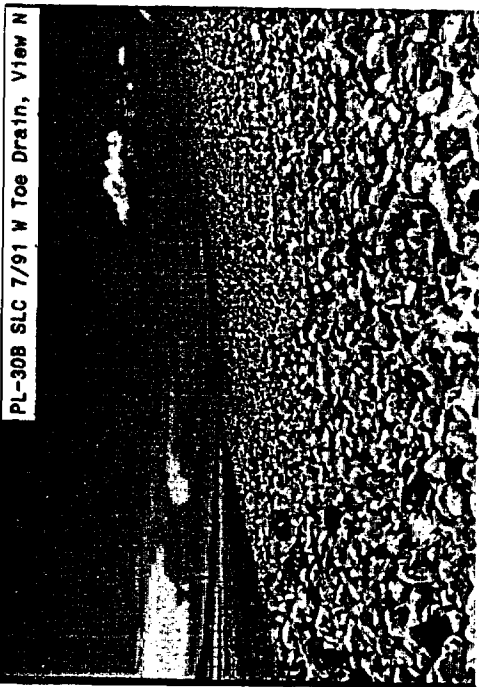




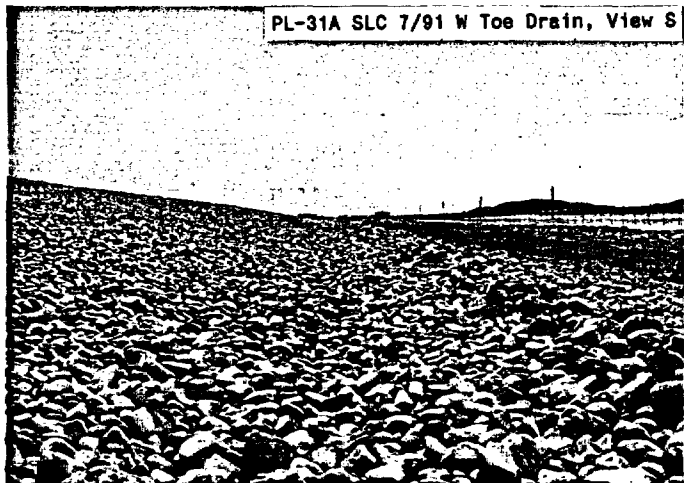
PL-30A SLC 7/91 S Toe Drain, View E



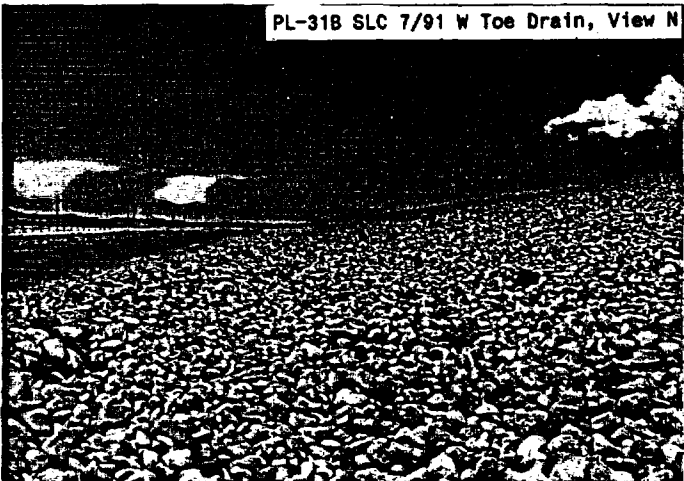
PL-30B SLC 7/91 W Toe Drain, View N



PL-31A SLC 7/91 W Toe Drain, View S



PL-31B SLC 7/91 W Toe Drain, View N



PL-32A SLC 7/91 Head N Diversion Channel, AZ 290



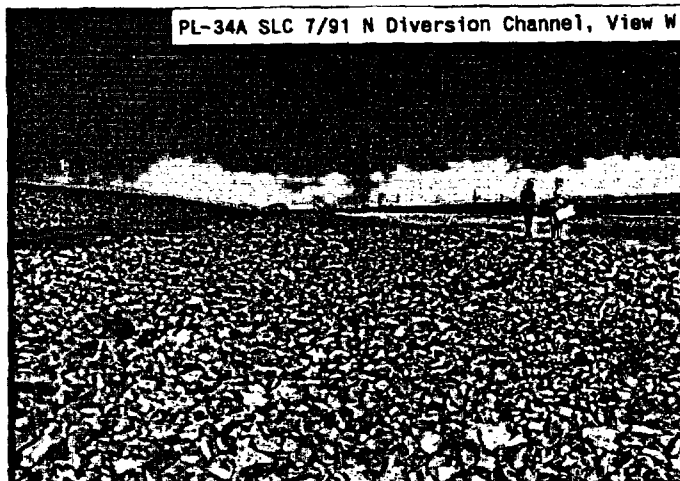
PL-328 SLC 7/91 N Diversion Channel, View E



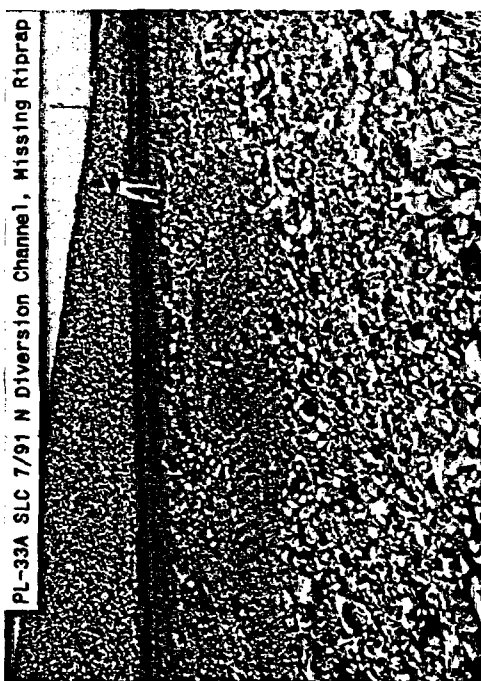
PL-33B SLC 7/91 N Diversion Channel, Missing Riprap



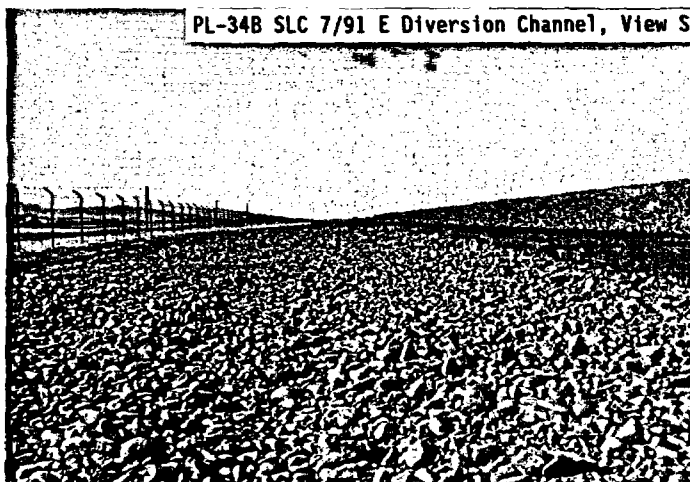
PL-34A SLC 7/91 N Diversion Channel, View W

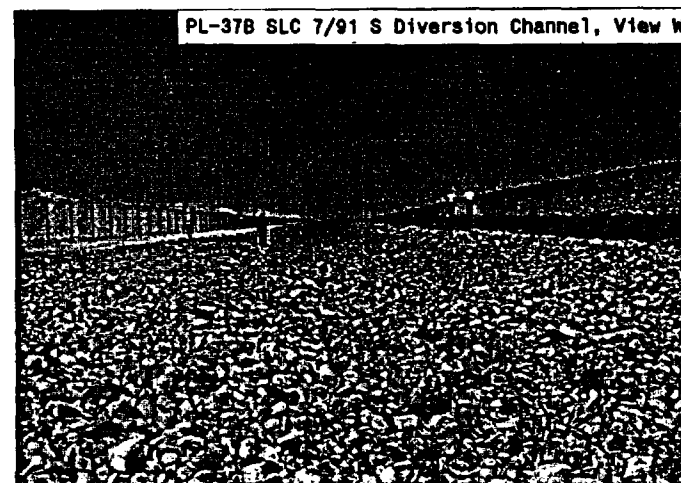
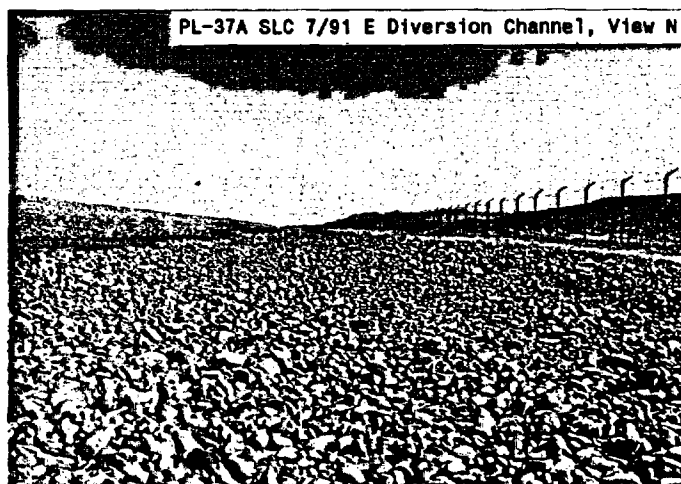
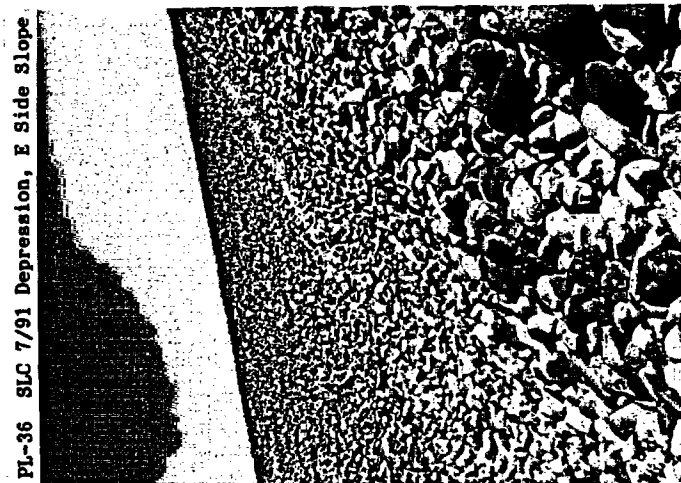
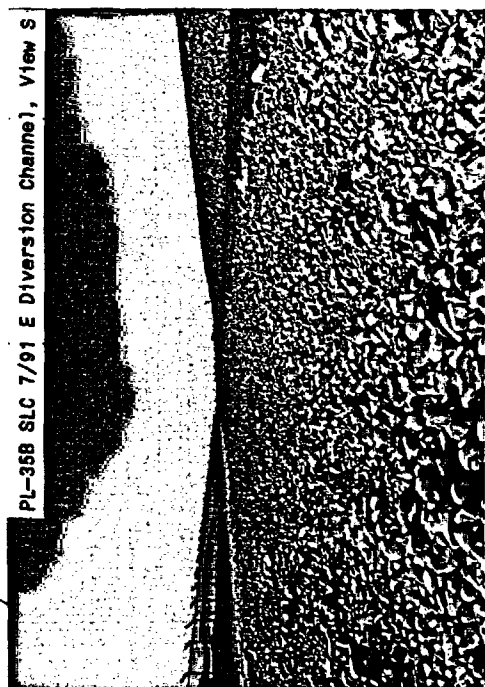
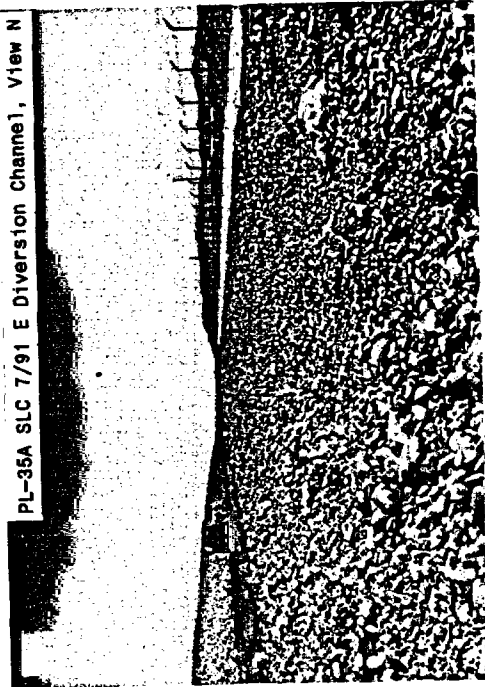


PL-33A SLC 7/91 N Diversion Channel, Missing Riprap

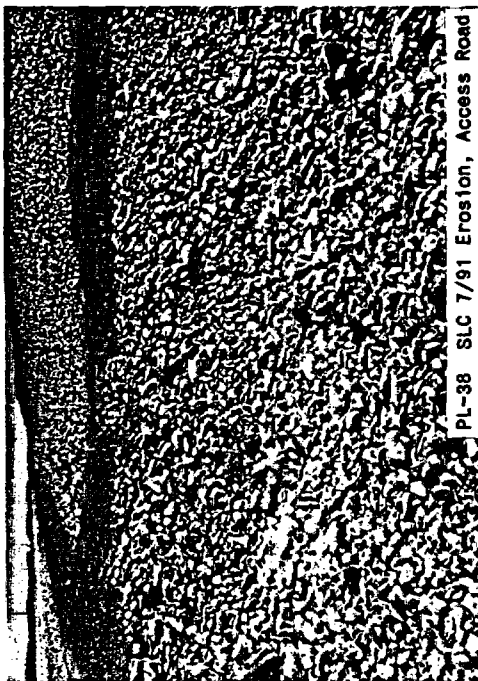
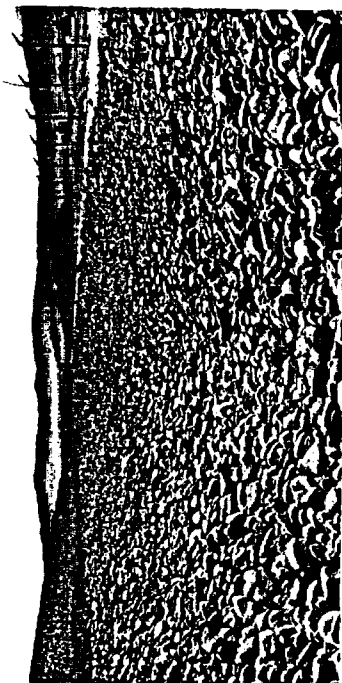


PL-34B SLC 7/91 E Diversion Channel, View S



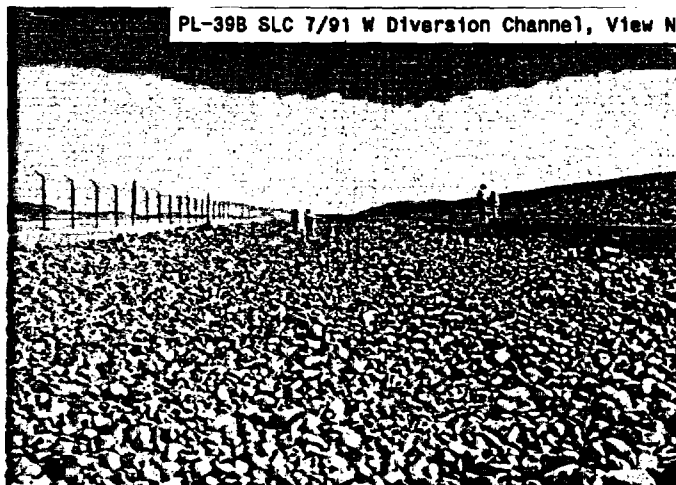


PL-39A SLC 7/91 S Diversion Channel, View E

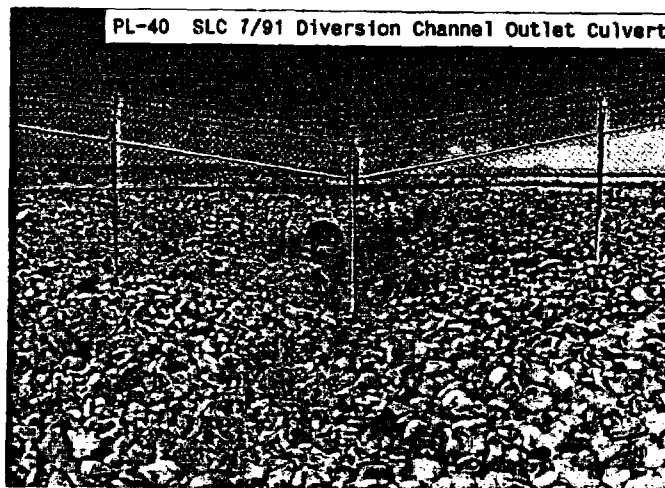


PL-38 SLC 7/91 Erosion, Access Road

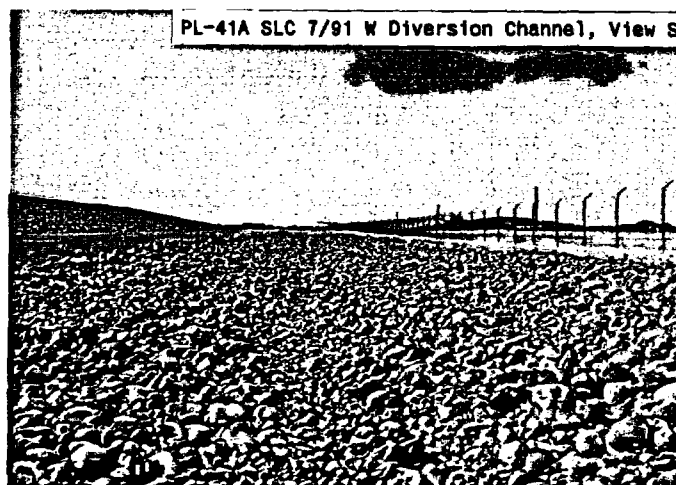
PL-39B SLC 7/91 W Diversion Channel, View N

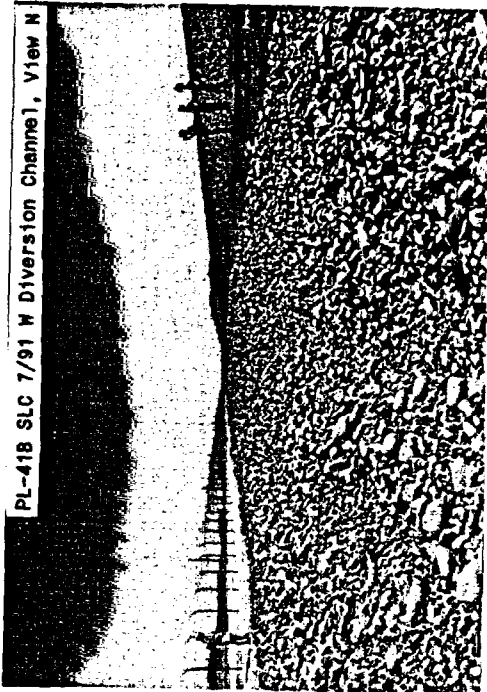


PL-40 SLC 7/91 Diversion Channel Outlet Culvert

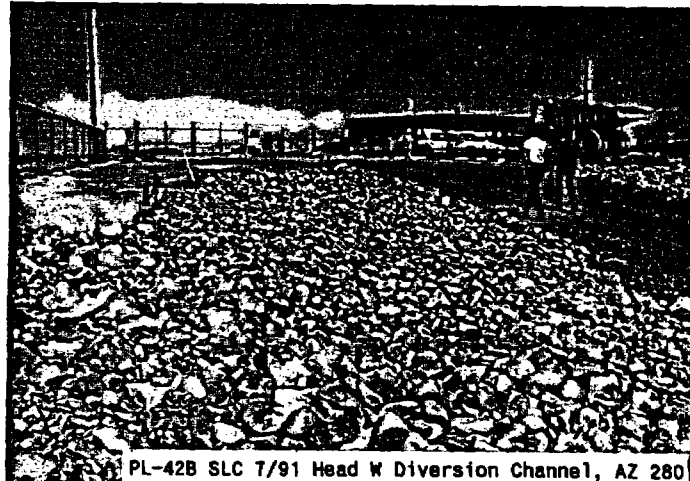


PL-41A SLC 7/91 W Diversion Channel, View S

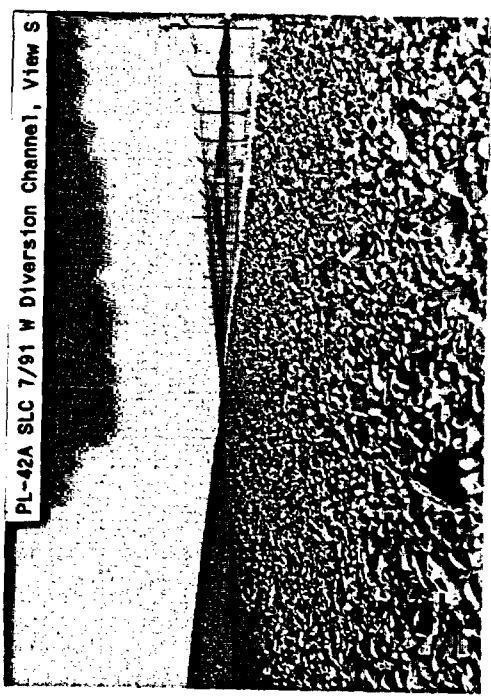




PL-41B SLC 7/91 W Diversion Channel, View N



PL-42B SLC 7/91 Head W Diversion Channel, AZ 280



PL-42A SLC 7/91 W Diversion Channel, View S

Appendix B

Résumés of Inspectors

David L. Scheuerman

Fields of Competence

Hazardous waste remediation, uranium mill and tailings decommissioning, environmental restoration, project development and management of contract operator, project scheduling, construction procedures with associated Quality Assurance inspections, fiscal management and resource maximization, structure and foundation design, and public relations.

Experience Summary

Twenty-three years of professional experience including 6 years of managing environmental restoration, 4 years of uranium mine technical and economic/financial feasibility studies, 8 years of structural and foundation design, and 5 years of national and international security.

Credentials

B.S., Civil Engineering, University of Wyoming, Laramie, Wyoming

Graduate Studies, Business Administration, University of Tennessee, Knoxville, Tennessee

Employment History

1990–Present Chem-Nuclear Geotech, Inc., Grand Junction, Colorado

1971–1990 Tennessee Valley Authority, Chattanooga, Tennessee, and Casper, Wyoming

1966–1971 United States Air Force, U.S. and International Locations

Key Projects

Project Manager for the Monticello Remedial Action Project (MRAP), Utah. The former millsite with associated buried tailings, materials, and equipment will be environmentally restored.

Project Manager for the Long-Term Surveillance and Maintenance (LTSM) Program, Grand Junction, Colorado. Perform constructibility inspections and associated maintenance activities.

Project Manager for the Edgemont Mill Decommissioning, South Dakota. Managed contract operator to excavate and transport 4.5 million tons of radioactive waste to an engineered disposal site. Coordinated on-site logistics for contract agreements with DOE (GJPO and Chem-Nuclear), the U.S. Environmental Protection Agency, the city of Edgemont, and the State of South Dakota.

Project Manager for the Marquez Uranium Mine, New Mexico. Evaluated feasibility of contract operator proposed mine plan. Coordinated plan and budget approvals and prepared a technical and economic/financial feasibility study.

Designed new electrical transmission line right-of-way locations working with property owners and governmental agencies. Prepared and conducted public meetings discussing all aspects of the design. Designed and drafted structural details for various transmission line and substation structures with supporting foundations.

Mark P. Plessinger

Fields of Competence

Hazardous waste site remediation technologies; feasibility studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); underground storage tank site remediation; environmental regulatory considerations; nuclear engineering and radioactive waste handling; heat transfer/fluid mechanics experimental research.

Experience Summary

Ten years of varied professional experience including four years of CERCLA remedial investigation/feasibility study-related work. Underground storage tank site remedial actions, transuranic radioactive and mixed-waste handling studies, management of design group performing feasibility studies and site remedial action designs. Also experienced with nuclear reactor operations and experimental research in nuclear reactor thermal hydraulics.

Credentials

B.S., Mechanical Engineering, Colorado State University, Fort Collins, Colorado

M.S., Mechanical Engineering, University of Idaho, Moscow, Idaho

Registered Professional Engineer, Colorado and Idaho

Member, American Society of Mechanical Engineers

Member, American Nuclear Society

Author or co-author of six technical publications.

Employment History

1989–Present Chem-Nuclear Geotech, Inc., Grand Junction, Colorado

1981–1989 EG&G Idaho, Inc., Idaho National Engineering Laboratory, Idaho Falls, Idaho

Key Projects

Managerial responsibility for a feasibility study under CERCLA for a federal facility in Texas. The site has a variety of hazardous waste problems including soil and groundwater contamination.

Managerial responsibility for a feasibility study under CERCLA for a U. S. Air Force base in Illinois. The site had a variety of hazardous waste problems.

Primary author of a feasibility study under CERCLA for a U. S. Air Force base in Massachusetts. The site had a variety of hazardous waste problems, including groundwater contamination, fuel spill areas, and landfills.

Design oversight for a number of underground storage tank removals at federal facilities in Colorado and Hawaii.

Conducted studies for the characterization of transuranic (TRU) and mixed radioactive wastes to determine waste volumes and packaging requirements to enable final waste disposal.

Numerous experiments and several publications related to nuclear reactor thermal hydraulics and associated instrumentation.

Alvin T. Rubalcaba

Fields of Competence

- Engineering Analysis
- Project Planning and Management
- Engineering Design

Experience Summary

One year of experience involving project planning, project cost estimating, and project scheduling for environmental remedial action projects.

Three years of experience in engineering design and analysis for remedial action projects.

Credentials

B.S., Engineering, University of Colorado, Boulder, Colorado

National Society of Professional Engineers (NSPE)

Professional Engineers of Colorado (PEC)

Employment History

1991–Present Senior Project Estimator/Scheduler, Chem-Nuclear Geotech, Inc.

1989–1991 Design Engineer, UNC Geotech, Inc.

1988–1989 Associate Design Engineer, UNC Geotech, Inc.

Key Projects

Engineering design, project cost estimating, and project scheduling for removal of uranium mill tailings at vicinity residential, commercial, and industrial sites for the U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action Program.

Cost analysis and engineering design for remediation of leaking underground storage tank sites at U.S. Air Force property PJKS and Hickam Air Force Base.

Responsibilities in assisting the surveillance and maintenance of remote DOE permanent disposal sites for the Long-Term Surveillance and Maintenance Program.