# DOE DISPOSAL CELL DESIGN

# AND

# SURVEILLANCE AND MAINTENANCE PROGRAMS

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## ABSTRACT

The U.S. Department of Energy's Office of Remedial Action and Waste Technology is responsible for a number of remedial action programs that involve constructing disposal cells to contain wastes resulting from the milling of uranium and other similar activities. Once the cells have been constructed, the DOE is responsible for continuing surveillance and maintenance activities at the sites. In order to ensure dissemination of ideas and technical approaches across the various programs for which the Office is responsible, a number of working groups convened, special studies were undertaken, and new approaches to disposal cell design and surveillance and maintenance were identified. In particular, a checklist approach to the design of disposal cells was established; this involves a compendium of possible cell perimeter dike details and top cover components from which the designer selects elements appropriate to the conditions of the specific site.

## INTRODUCTION

The U.S. Department of Energy's (DOE's) Office of Remedial Action and Waste Technology, Office of Nuclear Energy (NE) convened a number of working groups to survey DOE practices in, among other things, the design of disposal cells and the surveillance and maintenance programs in progress or planned to monitor the cells controlled by the Office of Remedial Action and Waste Technology. This paper reports on the activities of the working groups on disposal cell design and surveillance and maintenance. Both groups considered the similarities of the technical approaches on the various DOE waste remediation programs, and recommended procedures for adopting appropriate technologies for common use.

## SURVEILLANCE AND MAINTENANCE WORKING GROUP ACTIVITIES

A working group, which met on three occasions, was composed of representatives from the following DOE remedial action programs: the Uranium Mill Tailings Remedial Action Project (UMTRA); Formerly Utilized Site Remedial Action Program (FUSRAP); West Valley Demonstration Project; Weldon Spring Site Remedial Action Project (WSSRAP); and the Kansas City Hydrological Site Characterization Project. The members compared approaches to surveillance and maintenance on their programs and prepared a report on their activities and findings (1). In addition, the working group compiled a generic surveillance and maintenance guidance document which is discussed in subsequent sections (2).

## UMTRA SURVEILLANCE AND MAINTENANCE ACTIVITIES

Surveillance and maintenance on the UMTRA Project is undertaken in terms of the general guidance document, "Guidance for UMTRA Project Surveillance

and Maintenance" (3). In addition, a site-specific surveillance and maintenance plan is prepared for each site. Currently, surveillance and maintenance activities on the UMTRA Project are in progress at the Canonsburg, Pennsylvania, and Shiprock, New Mexico, sites.

At Canonsburg, the surveillance and maintenance program led to the observation that rock was deteriorating at a rate greater than the design specifications and was therefore of unacceptable quality. This rock was replaced with suitable rock.

At Shiprock, the surveillance and maintenance program led to the observation of vegetative growth on the pile. Vegetation is not a planned part of the pile design, and accordingly the DOE undertook a special study of the growth of vegetation on piles (4). The observation of vegetation on the pile (and the publication of proposed groundwater protection standards by the EPA) led to a reevaluation of the design procedures for UMTRA Project piles.

## OTHER DOE SURVEILLANCE AND MAINTENANCE PROGRAMS

The working group report describes the surveillance and maintenance programs in operation at the FUSRAP sites, in particular that at Niagra Falls and the Colonie Interim Storage Site.

## THE GENERIC SURVEILLANCE AND MAINTENANCE GUIDANCE DOCUMENT

The working group prepared a Generic Draft Surveillance and Maintenance Guidance Document. It describes general approaches that may be adopted or modified for site-specific use by the DOE for implementing surveillance and maintenance activities at disposal sites remediated by the DOE. The scope of the document covers permanent sites. The document is intended to apply only to disposal facilities, the major part of which is a cell with the following features: is primarily above grade; has a soil or rock cover; completely encapsulates the contaminated materials; makes the maximum use of natural materials; has no leachate collection system; and has surrounding swales, channels, or topographic grading to control runoff or divert upgradient runoff.

The document addresses five primary activities:

- Definitions and characterization of final site conditions.
- Site inspection.
- Groundwater and unsaturated zone monitoring.
- Aerial photography.
- Custodial maintenance and contingency repair.

In the future, the document may be used as the basis for establishing acceptable surveillance and maintenance programs on all relevant and applicable DOE remedial action programs.

## DISPOSAL CELL DESIGN WORKING GROUP ACTIVITIES

The Disposal Cell Design working group, consisting of representatives from the DOE Headquarters, UMTRA Project, FUSRAP, SFMP, WSSRAP, and West Valley

Demonstration Project, met on three occasions. They compared the approach to the design of disposal cells on the referenced programs, and prepared a report that describes and compares the basis of the design on each program (5). Partly as a result of the definition of technical differences on the programs as identified by the working group (and also because of the publication of proposed groundwater protection standards by the EPA for the UMTRA Project), the DOE undertook a series of special studies and established a completely new approach to the design of disposal cells for facilities such as those found on UMTRA. This is discussed in subsequent sections.

## DOE SPECIAL STUDIES

When the UMTRA Project was first undertaken, a technology development program was organized. The results of the first technology development program were incorporated as standard practice on the UMTRA Project; see the Technical Approach Document (6). In order to deal with the findings of the surveillance and maintenance programs, in order to respond to the findings of the working group on disposal cell design, and in particular to achieve compliance with the proposed EPA groundwater protection standards, a new technology development program was undertaken. A number of special studies were completed. Detailed reports have been prepared on each study (4, 7, 8, 9, 10, 11). The following is a brief description of the important findings of some of the special studies:

Geomembranes: these cannot be used because they cannot be shown to last for the design life of the UMTRA Project, which is 1000 years.

Alternate Cover Materials: the only low permeability material that is both cost-effective and which has a design life of at least 1000 years is bentonite; it may be used in a cover either by mixing with other soils or by placing a commercial product named CLAYMAX$^{R}$.

Alternate Cover Designs: high permeability drains in the disposal cell cover are an effective way to increase precipitation runoff and hence compliance with the groundwater standards.

Freezing of Infiltration/Radon Barriers: freezing may affect the integrity of radon/infiltration barriers, and appropriate design procedures are needed to prevent damage.

Vegetated Covers: these may be beneficially used at site with suitable climates to inhibit infiltration to the disposal cell.

Radon/Infiltration Barrier Moisture Content: observation of in-place moisture contents of barriers at sites where construction has been complete for a number of years confirms that the barriers at sites in dry climates are likely to remain partially saturated, and hence the effective infiltration to the disposal cell will be very small.

## THE CHECKLIST DISPOSAL CELL DESIGN APPROACH

At the same time as the studies described above were in progress, alternate cell and cover designs were being formulated and evaluated. A

detailed report on disposal cell design procedures, technical approaches, and case history implementation of the methods has been prepared (12). Briefly, the checklist approach to the design of a disposal cell involves a checklist of possible perimeter dike details and top cover components, from which a design engineer selects the appropriate perimeter dike details and cover components for the site. Figure 1 shows the checklist perimeter dike details. The referenced design report provides a detailed discussion of why a particular detail may be adopted at a particular site. Figure 2 shows the checklist cover. All or a number of combinations of the components of the checklist cover may be used at a specific site. The referenced design report provides detailed criteria for the use or rejection of a particular cover component at a particular site.

## CASE HISTORIES OF THE USE OF THE CHECKLIST DISPOSAL CELL DESIGN APPROACH

Figures 3 and 4 show the disposal cell design for the remedial action facilities at the Grand Junction and Gunnison UMTRA Project sites in Colorado.

## REVISED SURVEILLANCE AND MAINTENANCE APPROACHES

As required by the proposed EPA groundwater protection standards, new and innovative approaches to surveillance and maintenance will have to be adopted. In particular, it will be necessary to install instruments in the disposal cell, including the cover and tailings and the subsurface soils and rocks, to provide data to confirm that the relevant site-specific groundwater protection standards are being complied with. A detailed report on appropriate cell instrumentation for future surveillance and maintenance has been compiled for the UMTRA Project.

## CONCLUSIONS

As a result of the efforts of the DOE working groups, and as a consequence of a series of special studies, the DOE's approach to disposal cell design and surveillance and maintenance has been significantly altered in the past year. Procedures have been adopted for disseminating ideas generated on one DOE program to other DOE programs likely to benefit from them.

## ACKNOWLEDGMENTS

The authors of this paper did not perform all the work described here. They were involved as managers and idea generators, and only in some areas were they the executors of the work. They would like to acknowledge the work done by their many colleagues and coworkers in the special studies, the working groups, and in the development of ideas for disposal cell design and surveillance and maintenance.

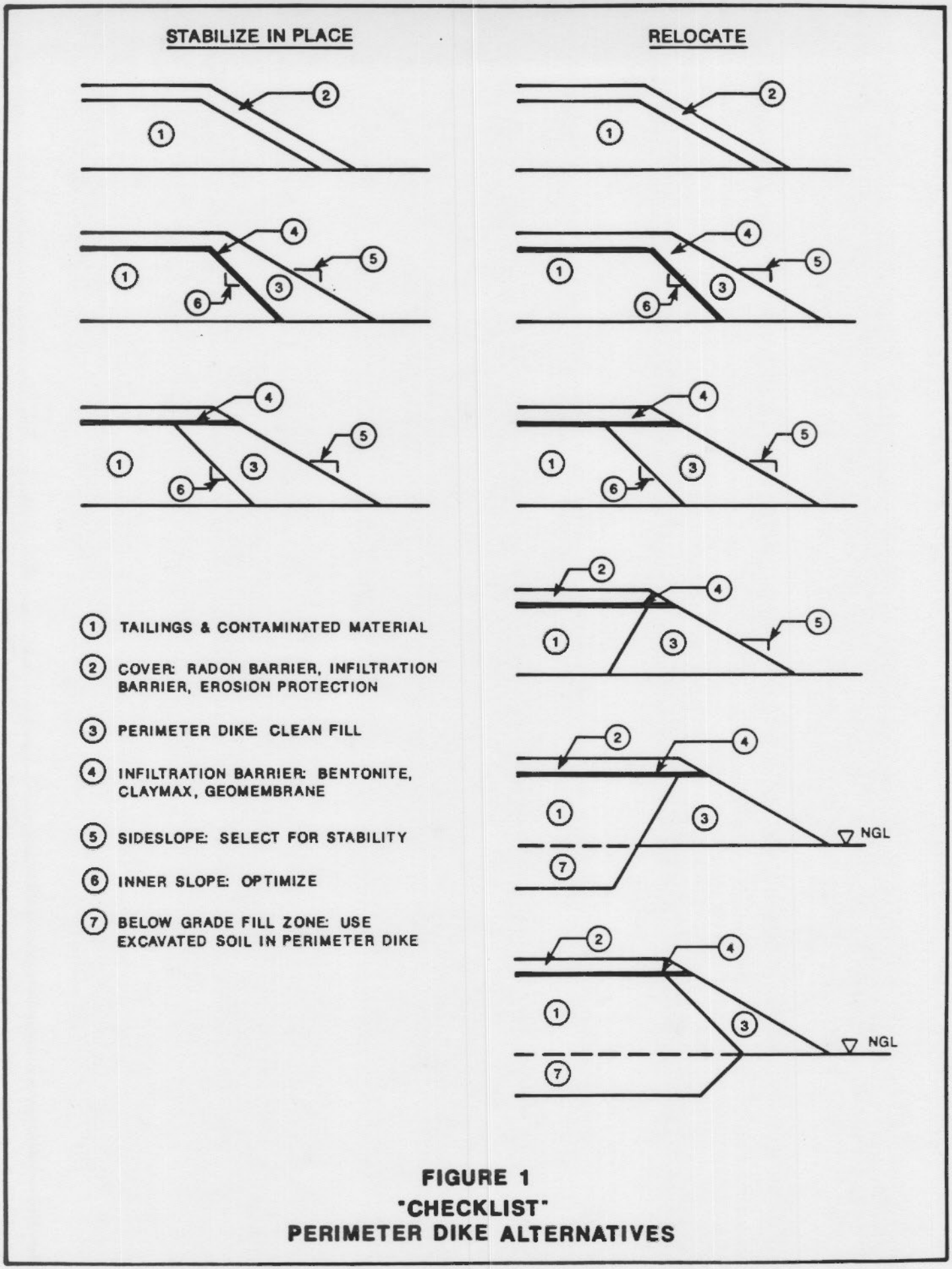
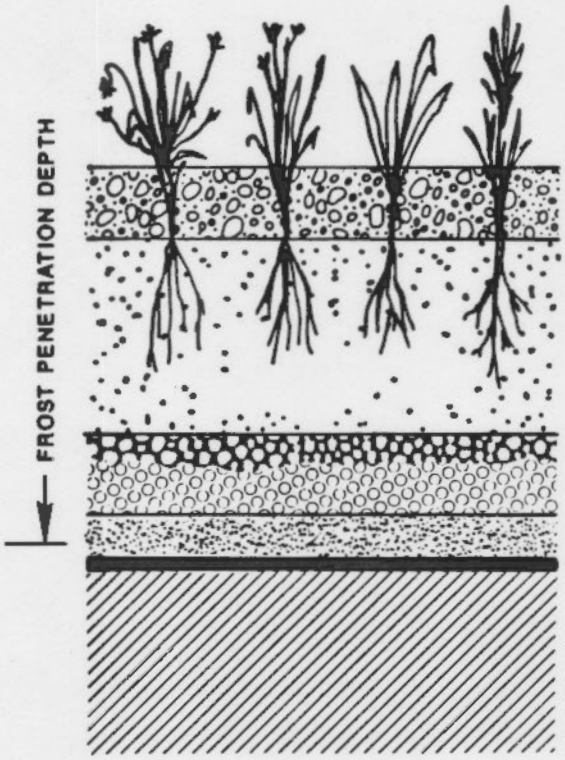



**FIGURE 1**
**"CHECKLIST"**
**PERIMETER DIKE ALTERNATIVES**




VEGETATION

0 – 1.0' ROCK MULCH

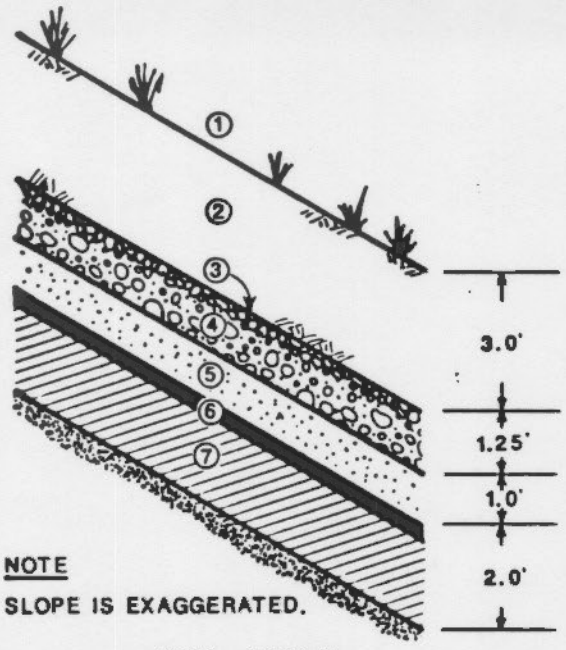
3.0' GROWTH MEDIUM & FROST PROTECTION

1.0' BIOBARRIER: COBBLES (TOP CHOKED OR FILTERED)

0.5' DRAIN: CLEAN SAND
INFILTRATION BARRIER: CLAYMAX

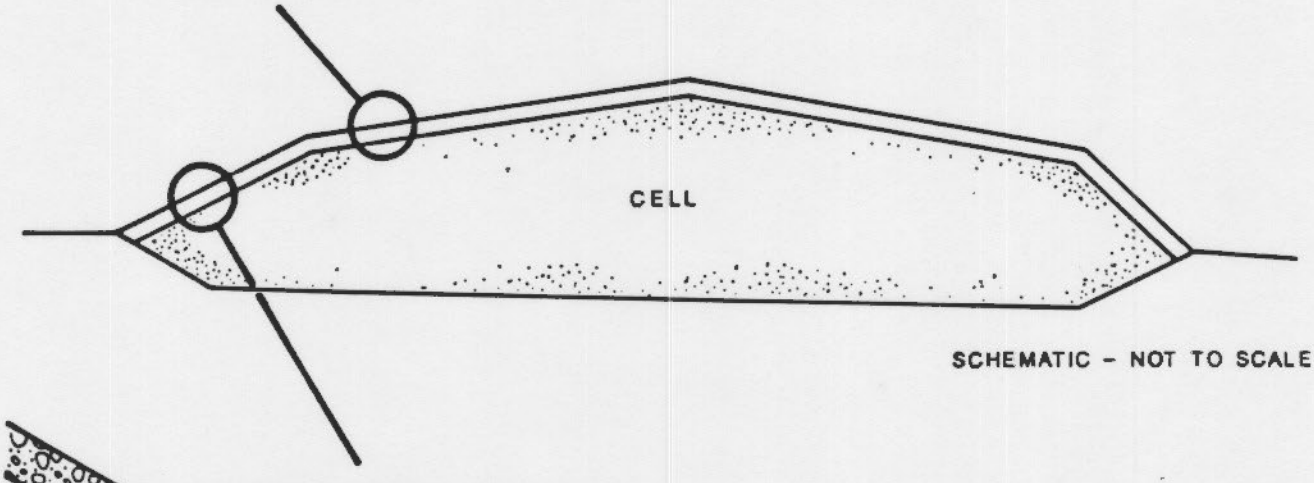
1.0' RADON BARRIER: CLAY/SILT

**FIGURE 2**
**"CHECKLIST"**
**TOP COVER**



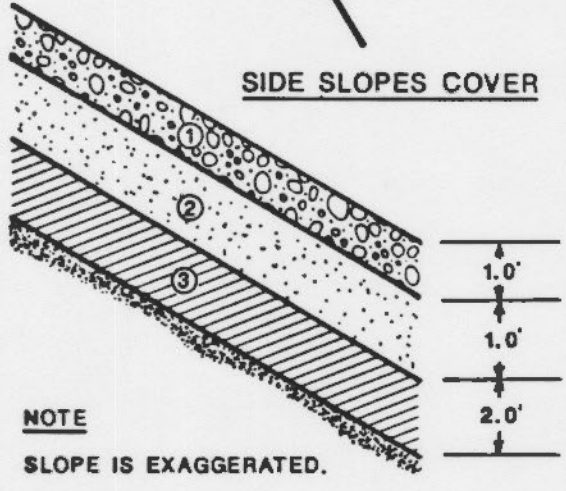

1. VEGETATION: SELF-SUSTAINING COMMUNITY
2. SOIL: NATURAL & AMENDED GROWTH MEDIUM
3. FILTER
4. BIOINTRUSION
5. DRAIN: CLEAN SAND
6. INFILTRATION BARRIER: CLAYMAX®
7. RADON BARRIER: LOW-PERMEABILITY CLAY

TOP COVER



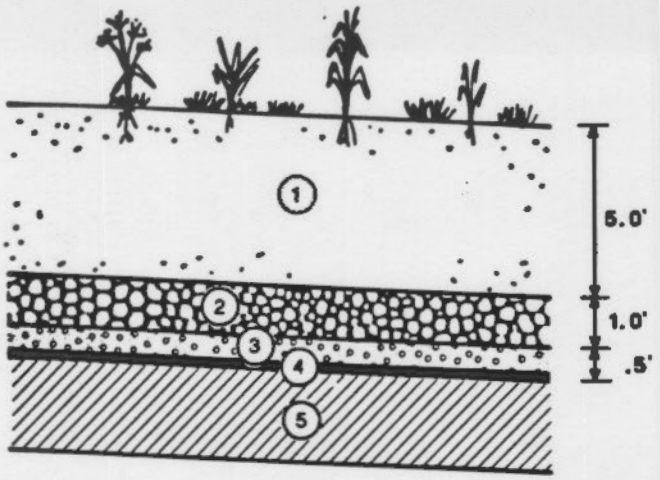

SCHEMATIC - NOT TO SCALE

SIDE SLOPES COVER




1. EROSION BARRIER: DURABLE ROCK
2. DRAIN: CLEAN SAND
3. INFILTRATION BARRIER & RADON BARRIER: LOW-PERMEABILITY CLAY

**FIGURE 3**
**GRAND JUNCTION PROPOSED COVER DESIGN**

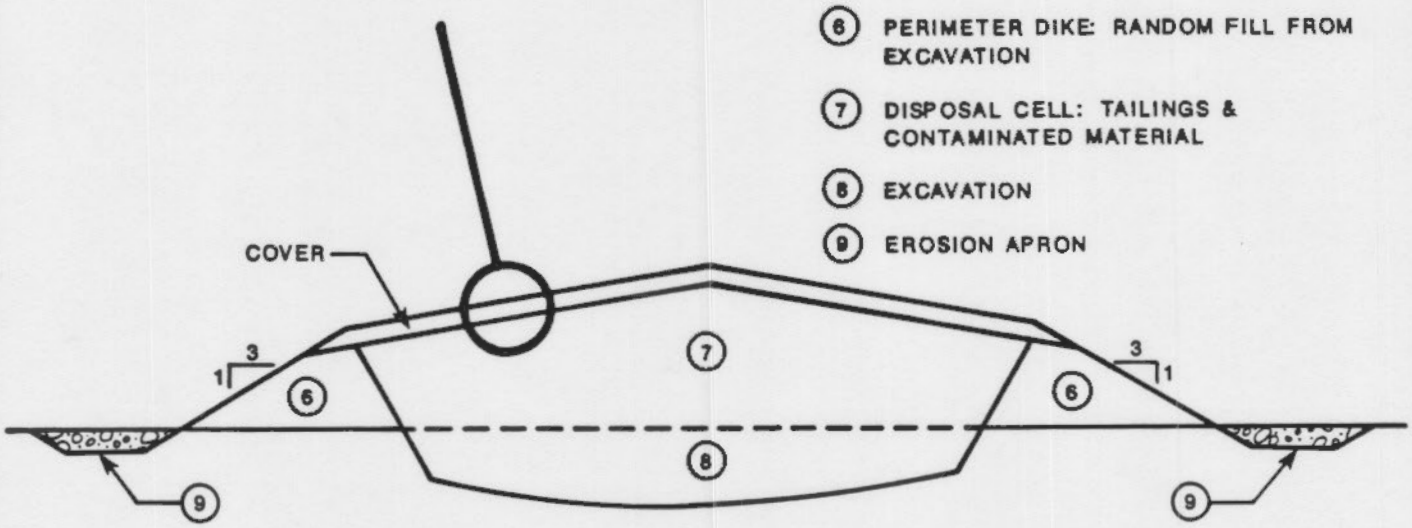



VEGETATION

1. FROST PROTECTION & GROWTH LAYER: RANDOM SOIL
2. BIOINTRUSION: COBBLES
3. DRAIN: SAND & GRAVEL
4. INFILTRATION BARRIER: CLAYMAX
5. RADON BARRIER: CLAY & SILT

TOP COVER DETAIL

6. PERIMETER DIKE: RANDOM FILL FROM EXCAVATION
7. DISPOSAL CELL: TAILINGS & CONTAMINATED MATERIAL
8. EXCAVATION
9. EROSION APRON




CROSS SECTION THROUGH DISPOSAL CELL

**FIGURE 4**
**DISPOSAL CELL DETAILS**
**LANDFILL**
**GUNNISON, COLORADO**

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