DEMONSTRATION OF A SUBSURFACE CONTAINMENT SYSTEM FOR INSTALLATION OF BARRIERS

Between 1952 and 1970, DOE buried mixed waste in pits and trenches that now have special cleanup needs. The disposal practices used decades ago left these landfills and other trenches, pits, and disposal sites filled with three million cubic meters of buried waste that is becoming harmful to human safety and health. Today's cleanup and waste removal is time-consuming and expensive, with some sites scheduled to complete cleanup by 2006 or later. Environmental remediation schedules are currently being met. RAHCO's proposed solution to the buried waste problem is to surround the waste with a geomembrane barrier and monitor the performance of the barrier over its lifetime. The installation of containment barriers will isolate buried waste and protect groundwater from pollutants until final remediations are completed.

The DOE has awarded a contract to RAHCO International, Inc., of Spokane, Washington, to design, develop, and test a novel barrier installation system to protect soil and groundwater from contamination and effectively meet environmental cleanup standards while reducing schedules, risks, and costs.

RAHCO International and IT Corporation, a company with offices near Oak Ridge and headquarters in Pittsburgh, will install test barriers around trenches to surround and encapsulate drums, chemicals, and other waste to prevent pollution from spreading into soil and groundwater until the area can be remediated.

The new system consists of underground barriers made of concrete and a special liner that forms a barrier to isolate underground waste, similar to the way a swimming pool holds water, without disrupting hazardous material that was buried decades ago.

The geomembrane barrier has several components: A vertical component located alongside the waste area that is made up of 80-mm-thick, high-density polyethylene material. A horizontal component located 2 ft beneath the waste area that is a geosynthetic clay-lined, high-density polyethylene material. There is also a horizontal-to-vertical component that is a premanufactured, high-density polyethylene material that slips under the horizontal barrier and over the vertical barrier and is welded at both points of contact.

The methodology for constructing the barriers uses a combination of conventional and specialized equipment. The excavation of the vertical barriers and the end barrier is performed with a conventional backhoe that has a reach of approximately 30 ft. The process of excavation begins by digging two trenches approximately 40-ft long alongside the buried waste. Following excavation of the side trench, an end trench is excavated outside and across the width of the buried waste trench. After the trenches are excavated, a shoring system made of H-beams and premanufactured steel panels is put into place.

The Slot Construction Unit (SCU), designed and manufactured by RAHCO, is placed in the end trench and aligned with the rails that are attached to the horizontal members of the shoring system. The SCU excavates the horizontal slot as well as places the horizontal barrier materials. Once excavation of the horizontal slot and placement of the horizontal barrier materials has begun, the backhoe excavation process continues along both sides of the buried waste trench. As the SCU completes its excavation and barrier placement process and moves forward along the trench, the areas of vertical trench behind the SCU are backfilled.

The Slot Construction Unit is operated from an operator's station and motor control center that are trailer-mounted and follow alongside the SCU. The SCU consists of a cutterhead mounted on a slot beam structure, a polyliner inserter, a floor block inserter, and cutterhead drive assemblies located on each end of the slot beam. The drive units each have 200-hp electric motors, gearboxes, and cable sheaves. The floor block inserter is a mechanical thruster with a magazine that contains 11, 2-ft by 3-ft concrete blocks. The polyliner inserter holds a roll of 30-in., 80-mm, high-density polyethylene (HDPE) which is enough material for one day of operation. Mounted horizontally in the SCU, the cutterhead traverses across the trench at a rate of up to 200 fpm. The cutters on the cutterhead are designed to handle materials with compressive strengths of up to 15,000 psi.

The construction materials used for this project include an inner wall barrier, that consists of both temporary shoring at the top portion of the barrier and permanent shoring at the bottom of the barrier below the horizontal slot area, and HDPE geomembrane mounted to the permanent shoring below the horizontal slot area. The outer wall barrier is comprised of temporary shoring, HDPE geomembrane, and a joint seal that unites the lower portion of the wall barrier with the upper portion. The floor barrier consists of temporary shoring on the outer barrier side, permanent shoring on the inner barrier side, and an engineered material that is poured in the bottom of the trench to act as support. The slot barrier material consists of interlocking concrete floor blocks, specially designed by RAHCO, and overlaid with the geosynthetic clay lining material.

Verification of the horizontal barrier placement will be made by sensors that are located within the slot cutter. They will detect a metallic strip on the geosynthetic clay lining material for lap joint position. There will be visual inspection of the perimeter barrier as well as wedge weld air pressure testing and extrusion weld vacuum testing. There will also be selective joint destructive testing.

The RAHCO system is designed to place barriers around and under waste areas. The envelope of operations for the waste trench geometry is up to 100-ft wide by 30-ft deep. We believe we have technology to provide a system wider than 100 ft, but it involves a different method of steering and thrusting of the slot cutter than the one we see on the present model.

Contractors will require approximately 20 ft of area around the perimeter of the waste and an access road approximately 16-ft wide to move construction material into place. The RAHCO specialized SCU equipment will handle unconsolidated soil as well as bedrock material. It can operate in dry as well as extremely wet materials. This system can advance at the rate of up to 10 ft/day.

The operating features of the RAHCO system are that it operates under broad field conditions. It operates without intrusion or disruption of waste material. The barrier materials are compatible with existing waste site chemical and physical conditions. The system provides for a continuous barrier without discontinuities, yet it hydraulically isolates the waste. It accommodates a joint between the barrier and an existing RCRA cap that generally exists at many DOE waste sites.

The specialized equipment is safe. The SCU is remotely operated. There are explosionproof equipment enclosures below grade. There are strategically located emergency stops as well as audio and visual alarms. The equipment operates at sound levels less than 85 dB. It has a positive means of preventing operation during maintenance. By reducing the number of workers involved and their contact with the equipment and waste materials, there is reduced risk of contamination. Similarly, this system greatly minimizes the potential for airborne release and groundwater contamination.

The equipment minimizes the use of fluids and greases and is electronically powered and controlled. The Subsurface Containment System incorporates design features including secondary containment to ensure against any leakage of operating fluids, a vacuum-type air cleaning system with HEPA filters, and surface water runoff and groundwater containment. The equipment and construction methods comply with applicable codes and federal regulations. It conforms to 10 CFR, Part 61, in particular; it minimizes the escape of hazardous waste to the ground or surface waters, or to the atmosphere. Barrier materials have appropriate properties that will prevent failure due to the pressure gradients. The polyliner is inspected during construction for uniformity; damage; and imperfections such as holes, cracks, thin spots, or foreign materials. The seams and joints are inspected to ensure the absence of tears, punctures, or blisters.

The measures of success for the system are safe operation, compliance with applicable environmental regulations, an effective barrier, construction rates of up to 10 ft/day, and a construction cost of less than $600/cu yd of waste contained.

Project objectives for Phase I, the Pilot-Scale Field Test, are to validate the subsurface containment system construction process, evaluate the subsurface containment system performance, validate the barrier constructability, and assess the barrier effectiveness. The objectives for Phase II, which is a full-scale demonstration of the system, is to perform a more extensive characterization of the test site, to demonstrate the equipment and the installation process under site-specific performance and regulatory requirements, to validate the operational performance of the equipment, and to perform long-term verification of the barrier using monitoring wells.

The project timeline calls for all the equipment and materials to be procured and factory-tested by the end of April 2001, moved onto the Oak Ridge test site by the end of May 2001, and field-tested by the end of Fiscal Year 2001.

In summary, the RAHCO technology was proven through proof-of-principle testing conducted at the RAHCO factory in Spokane, Washington, approximately three years ago. Equipment and components have been selected to minimize the risk of failure and to ensure success. The barrier installation system uses conventional equipment and proven construction techniques and materials. The system is highly mobile and rapidly deployable. It provides construction speeds to 10 lineal ft per single shift operation

with construction times that cannot be achieved by other methods. The current costs to remove, process, and store buried wastes are estimated at as much as $5000/cu yd, assuming a nominal 30-ft-wide by 20-ft-deep waste area, 1000 ft in length. The overall unit cost for the Subsurface Containment System barrier is estimated at less than $600/cu yd of waste volume. There has been significant progress towards the full-scale demonstration system. RAHCO will perform a pilot-scale field test at Oak Ridge at the end of Fiscal Year 2001. RAHCO's Subsurface Containment System provides an interim 50-year solution to DOE complex-wide buried waste problems and is a cost-effective method for containment of hazardous materials.

Demonstration of a Subsurface Containment System for Installation of Barriers

Industry Partnerships for Environmental Science and Technology Conference

17-19 October 2000

RAHCO International, Inc.
Spokane, Washington

Agenda

- & **PROBLEM/SOLUTION**
- & **SYSTEM OVERVIEW**
- & **SAFETY, HEALTH, & ENVIRONMENTAL FEATURES**
- & **PROJECT SCHEDULE**
- & **SUMMARY & CONCLUSION**

Problem Statement

SUBSURFACE CONTAMINANTS FOCUS AREA

2 **Between 1952 and 1970, DOE buried mixed waste in pits and trenches.**

- **Three million cubic meters of buried waste are becoming harmful to human safety and health.**

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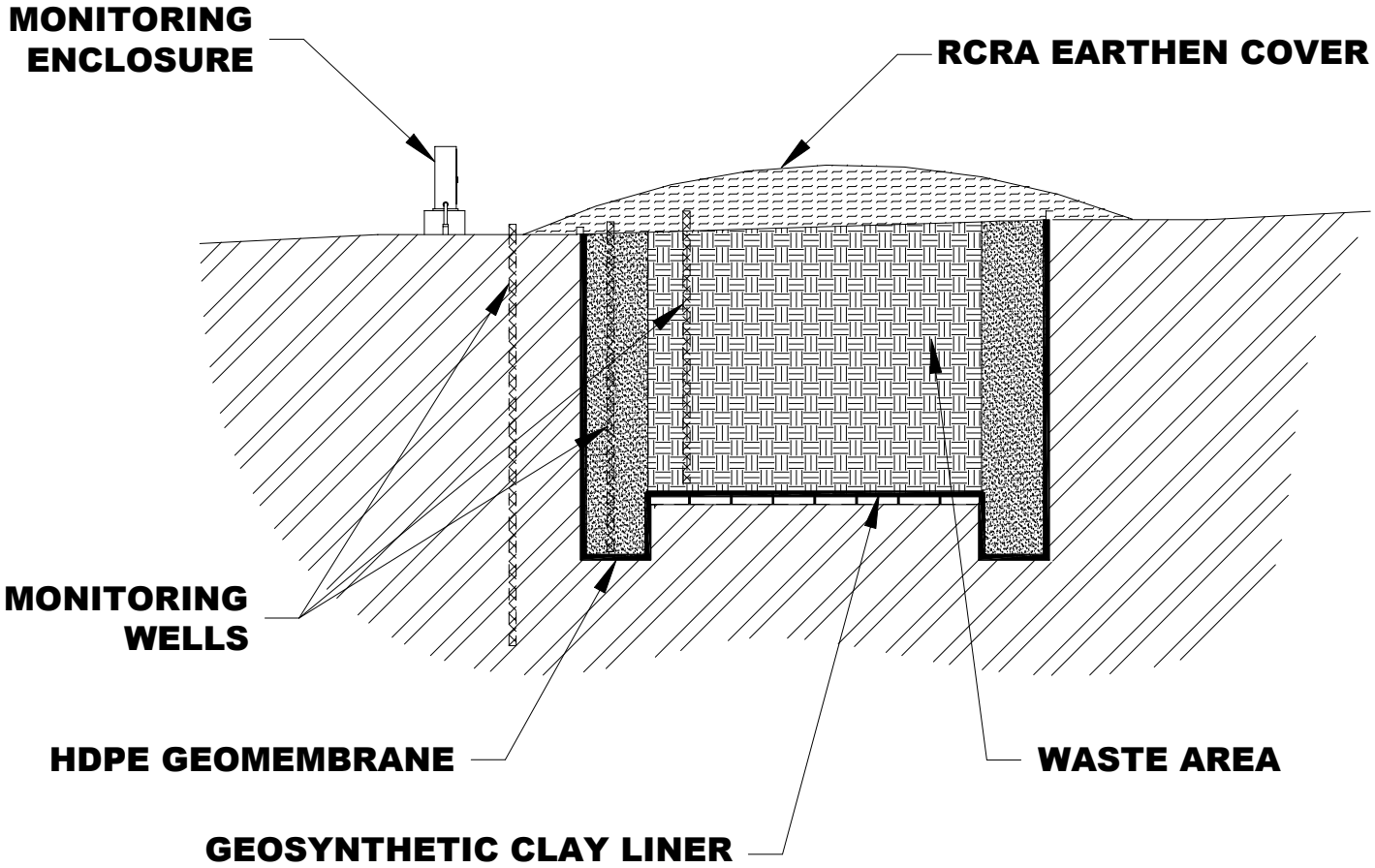
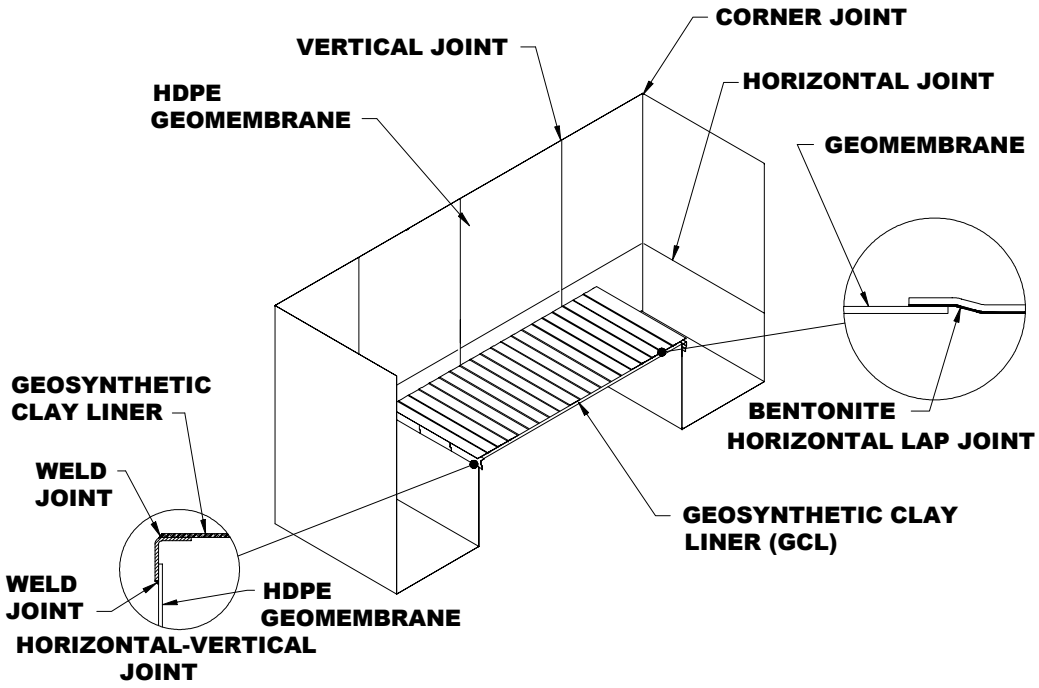
Proposed Solution

- **Surround the waste with a geomembrane barrier and monitor the performance of the barrier over its lifespan.**

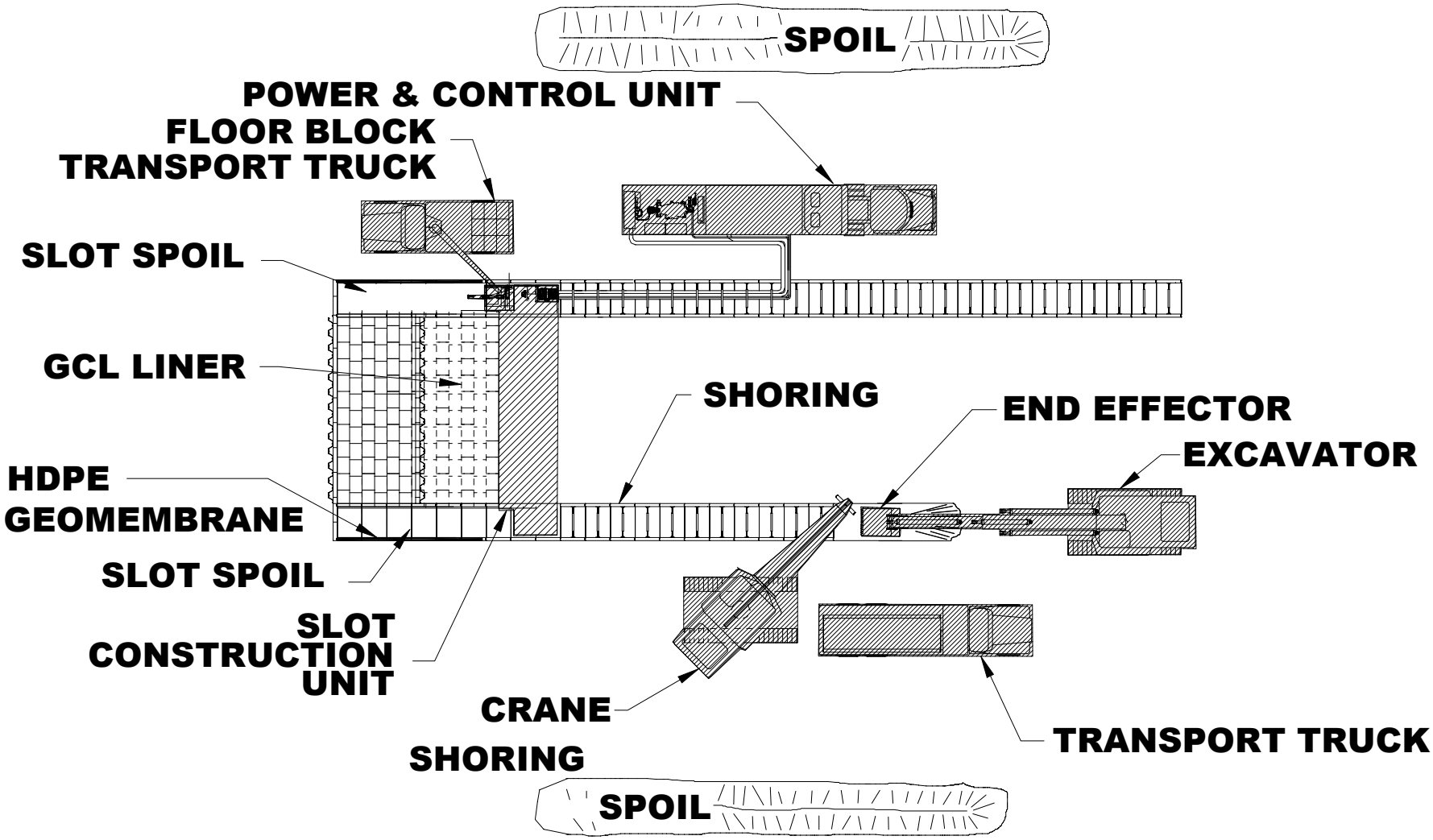


Geomembrane Barrier



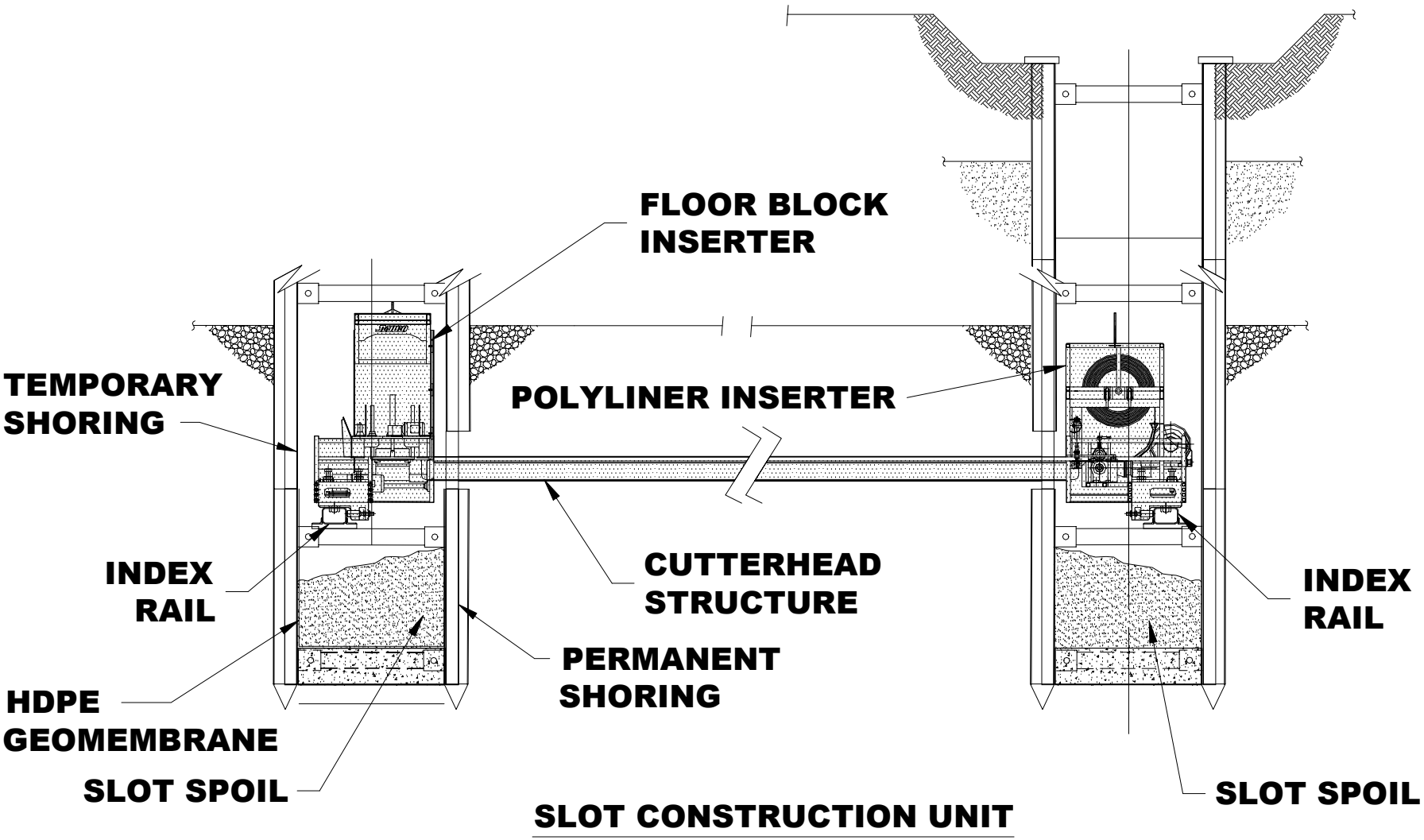
PROPERTIES	PERIMETER BARRIER	SLOT BARRIER
& Thickness (mils)	80	80
& Density (g/cc)	0.94	0.94
& Special Features		
Metallic Strip (in.)		3
Bentonite Coating (psf)		1

Construction Methodology



Construction Methodology (continued)

SUBSURFACE CONTAMINANTS FOCUS AREA



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Proof-of-Principle Testing

SUBSURFACE CONTAMINANTS FOCUS AREA

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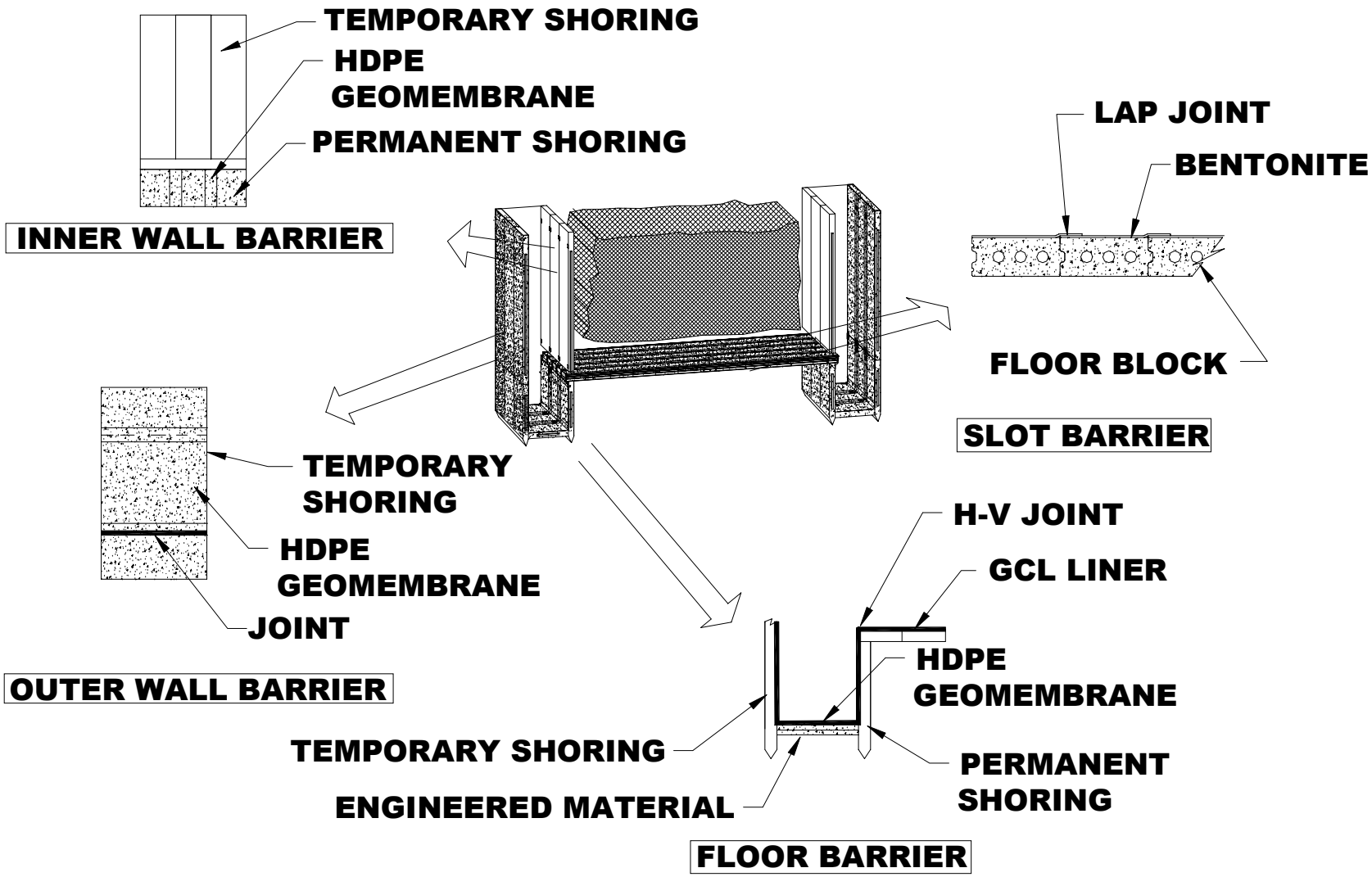
Construction Materials



Barrier Verification

SUBSURFACE CONTAMINANTS FOCUS AREA

- & **Lap Joint Position Verification**
- & **Visual Inspection of Perimeter Barrier**
- & **Wedge Weld Air Pressure Testing**
- & **Extrusion Weld Vacuum Testing**
- & **Selective Joint Destructive Testing**

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Envelope of Operations

- **Waste Geometry:** Up to 100-ft Wide by 30-ft Deep
- **Construction Geometry:** 20-ft Construction Area around the Perimeter of the Waste
- **Access:** 16-ft-wide Access Road
- **Material Type:** Unconsolidated Soil to Bedrock
- **Soil Conditions:** Vadose & Saturated Zone
- **Maximum Rate of Advance:** 10 ft/day

Operating Features

- Operates under broad field conditions.
- Operates without intrusion and/or disruption to the waste.
- Barrier compatible with existing waste site chemical and physical conditions.
- Constructs a continuous barrier without discontinuities.
- Hydraulically isolates the waste.
- Accommodates a joint between the barrier and an existing cap.

Safety Features

- Remote Operation of SCU
- Below-Grade, Explosion-Proof Equipment Enclosures
- Strategically Located Emergency Stops
- Audio & Visual Alarm Notification
- Sound Levels Less Than 85 dB
- Positive Means to Prevent Operation during Maintenance

- **Minimum Use of Fluids & Greases**
- **Conforms to 10 CFR Part 61 in Particular**
  - **Minimizes the escape of hazardous wastes to the ground or surface waters, or to the atmosphere.**
  - **Barrier materials have appropriate properties to prevent failure due to pressure gradients.**
  - **Polyliner inspected during construction for uniformity, damage, and imperfections (holes, cracks, thin spots, foreign materials).**
  - **Seams and joints inspected to ensure the absence of tears, punctures, or blisters.**

Measures of Success

SUBSURFACE CONTAMINANTS FOCUS AREA

- & **Safe Operation**
- & **Compliance with Applicable Environmental Regulations**
- & **Provide an Effective Barrier**
- & **Achieve Construction Rates to 10 ft/day**
- & **Achieve Construction Cost of Less than $600/cu yd of Waste Containment**

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Project Objectives

SUBSURFACE CONTAMINANTS FOCUS AREA

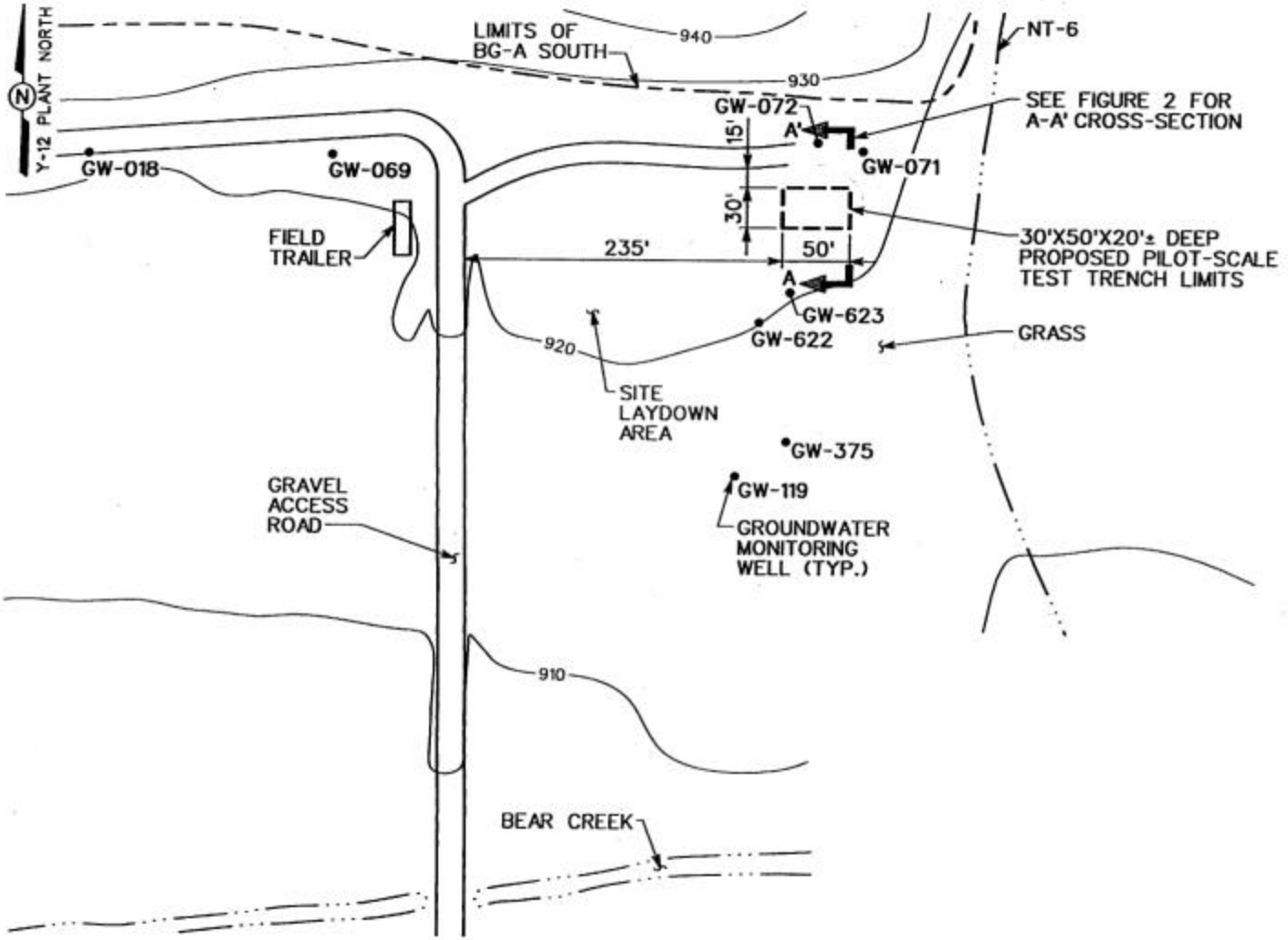
Phase I—Pilot-Scale Field Test:

- Validate the SCS construction process.
- Evaluate SCS performance.
- Validate barrier constructability.
- Assess barrier effectiveness.

Phase II—Full-Scale Demonstration:

- Characterize test site.
- Demonstrate the equipment and installation process under site-specific performance and regulatory requirements.
- Validate operational performance.
- Perform long-term verification of the barrier using monitoring wells.

Pilot-Scale Test Location



Project Schedule

9/99	10/99-12/00	1/01	2/01	3/01	4/01	5/01	6/01	7/01	8/01	9/01

1. Planning, Coordination, & Documentation

9/17/99 — 9/30/01

2. Equipment & Materials

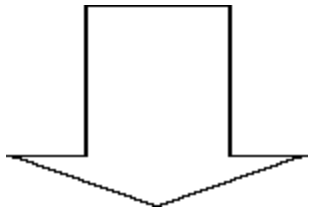
12/11/00 — 4/30/01

3. Pilot-Scale Field Test

5/24/01 — 8/31/01

Summary & Conclusions

- Technology Proven through Proof-of-Principle Tests
- Significant Progress toward a Full-Scale Demonstration System
- Pilot-Scale Field Test at Oak Ridge Reservation in FY 2001



- Interim Solution to DOE Complex-Wide Buried Waste
- Cost-Effective Containment of Hazardous Materials