PROTECTIVE BARRIER DEVELOPMENT: OVERVIEW

N. R. Wing[1] and G. W. Gee[2]

[1]Westinghouse Hanford Company, Richland, Washington

[2]Pacific Northwest Laboratory, Richland, Washington

Key Words: *Technology development, in situ disposal, barriers, caps*

ABSTRACT

Protective barrier and warning marker systems are being developed to isolate wastes disposed of near the earth's surface at the Hanford Site. The barrier is designed to function in an arid to semiarid climate, to limit infiltration and percolation of water through the waste zone to near-zero, to be maintenance free, and to last up to 10,000 yr. Natural materials (e.g., fine soil, sand, gravel, riprap, clay, asphalt) have been selected to optimize barrier performance and longevity and to create an integrated structure with redundant features. These materials isolate wastes by limiting water drainage; reducing the likelihood of plant, animal, and human intrusion; controlling emission of noxious gases; and minimizing erosion. Westinghouse Hanford Company and Pacific Northwest Laboratory efforts to assess the performance of various barrier and marker designs will be discussed.

INTRODUCTION

Protective barrier and warning marker systems are being developed to isolate certain types of wastes, disposed of near the earth's surface at the Hanford Site, from the environment. The barrier and warning marker systems use layers of natural materials to create an integrated structure with redundant protective features. The natural and manufactured materials (e.g., fine soil, sand, gravel, riprap, clay, asphalt) have been selected to optimize barrier performance and longevity. Current design objectives are to isolate wastes up to 10,000 yr by limiting water drainage; reducing the likelihood of plant, animal, and human intrusion; controlling emission of noxious gases; and minimizing erosion.

FUNCTIONAL PERFORMANCE OF PROTECTIVE BARRIERS

Protective barriers consist of various materials placed in layers to form an above-grade mound directly over the waste zone. A typical barrier (Figure 1) includes (layered from top to bottom) fine soil, sand/fine gravel, and coarse materials such as pitrun gravels or crushed basalt riprap. A layer of crushed basalt riprap may also be used on the shoulder, side slopes, and toe of the structure.

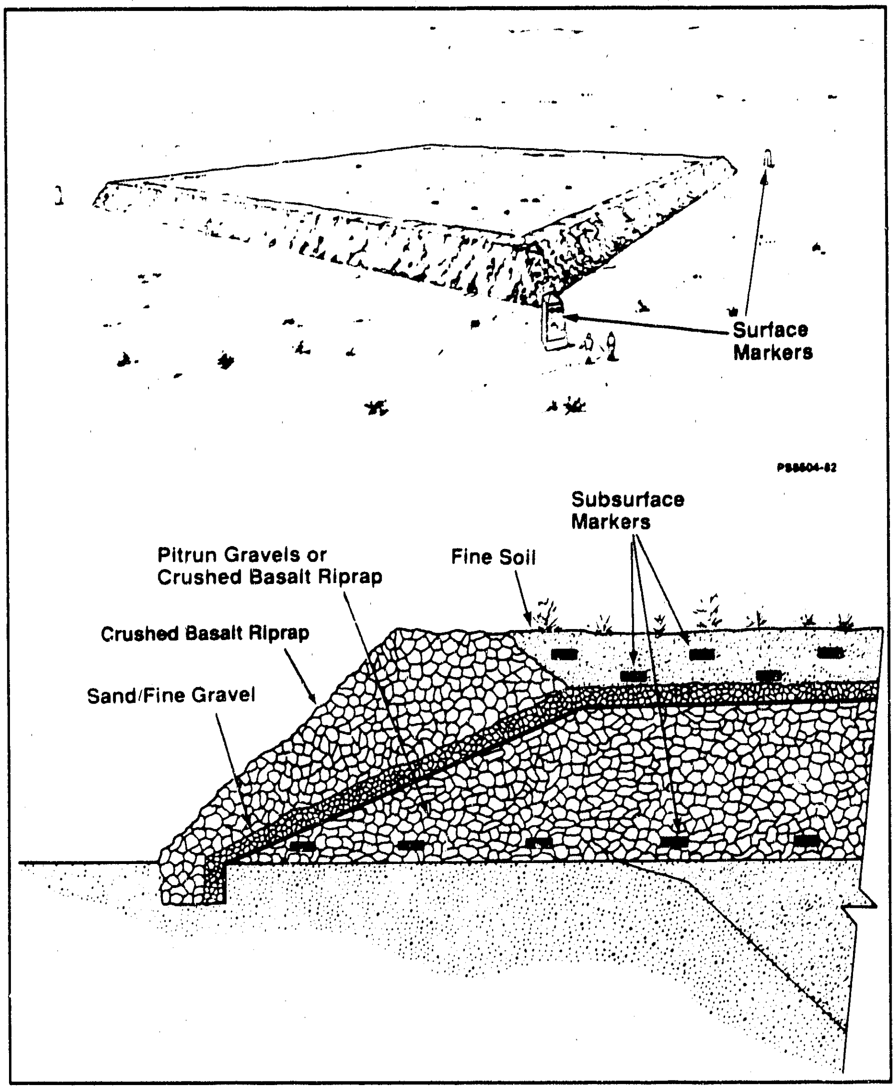

Figure 1. Typical protective barrier and warning marker system.

Each layer serves a distinct purpose (Figure 2). Fine soil stores moisture until evaporation and transpiration recycle the excess water back to the atmosphere. Fine soil also provides a substrate for plants that are necessary for transpiration. Gravels may be admixed into, or spread onto, the surface of the fine-soil layer to minimize wind and water erosion. The surface of the fine-soil layer can be designed to have a slight slope, or crown, to maximize runoff while further minimizing erosion.

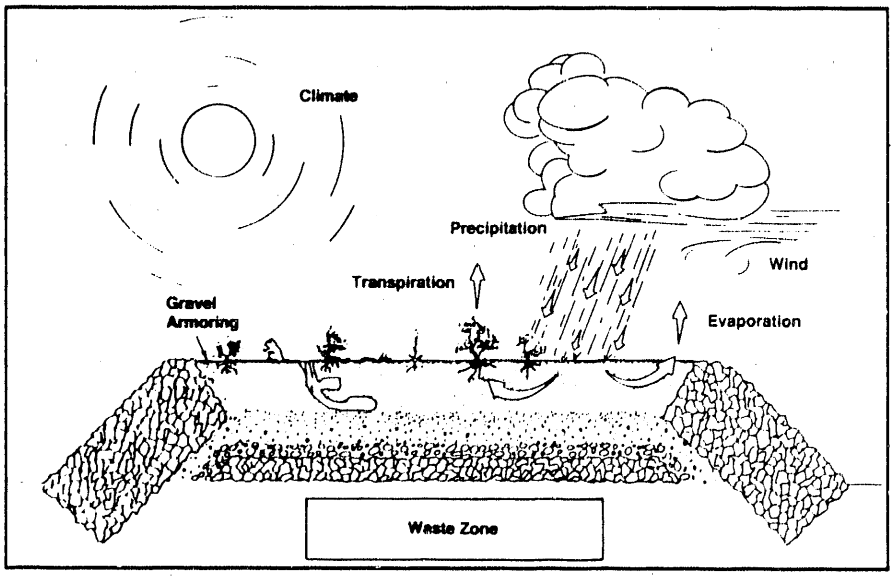

Figure 2. Functional performance of barriers.

The sand/fine-gravel layer serves a dual purpose. The textural difference at the interface between sand/fine gravel and fine soil creates a capillary break. The capillary break inhibits downward movement of moisture from the overlying unsaturated fine-soil layer. The sand/fine-gravel layer also functions as a filter to prevent fine soils from penetrating the void spaces of coarser materials below.

Coarse materials (e.g., pitrun gravels, crushed basalt riprap) are used to deter burrowing animals, deep-rooting plants, and human intruders from reaching the buried waste. Crushed basalt riprap is also used to protect against wind and water erosion of the barrier shoulder, side slope, and toe.

Low-permeability materials are also being considered for incorporation in the protective barrier design. During periods of unusually heavy or intense precipitation, the fine soil layer may not be able to completely retain and subsequently recycle all of the water to the atmosphere. Unless checked, the water would migrate through the protective barrier to the waste below. To restrict the percolating water, a low-permeability layer could be placed below the capillary break. This layer could be constructed of asphalt, clay, or chemical grout and would divert percolating water away from the waste zone. The layer would also help control emissions of noxious gases from certain wastes.

Surface markers, placed around the periphery of waste sites, will inform future generations of the nature and hazards of the buried wastes. In addition, subsurface markers, buried throughout the protective barrier, will warn people who inadvertently intrude into the barrier.

Because the barrier must perform for thousands of years without maintenance, natural materials (e.g., fine soil, sand, gravel, cobble, crushed basalt riprap, clay, asphalt) have been selected for use. Most of these materials exist in large quantities on the Hanford Site. In contrast to the natural construction materials, the ability of manmade construction materials to survive and function properly for thousands of years is not known. Because of this uncertainty, manmade construction materials are not used in protective barrier designs.

HANFORD SITE PROTECTIVE BARRIER DEVELOPMENT TEAM

Considerable development and evaluation must accompany the assessment of barrier and marker system performance. Thus, engineers and scientists from Westinghouse Hanford Company and the Pacific Northwest Laboratory formed the Hanford Site Protective Barrier Development Team in 1985. The team has overall responsibility for planning, directing, and executing development activities.

A Protective Barrier and Warning Marker System Development Plan (Adams and Wing, 1986) was prepared to organize and coordinate various activities associated with the development and testing of protective barrier and warning marker systems. Specific tasks were identified to resolve technical concerns and complete development and final design of the system (Figure 3). Test plans and detailed reports will describe future activities and results.

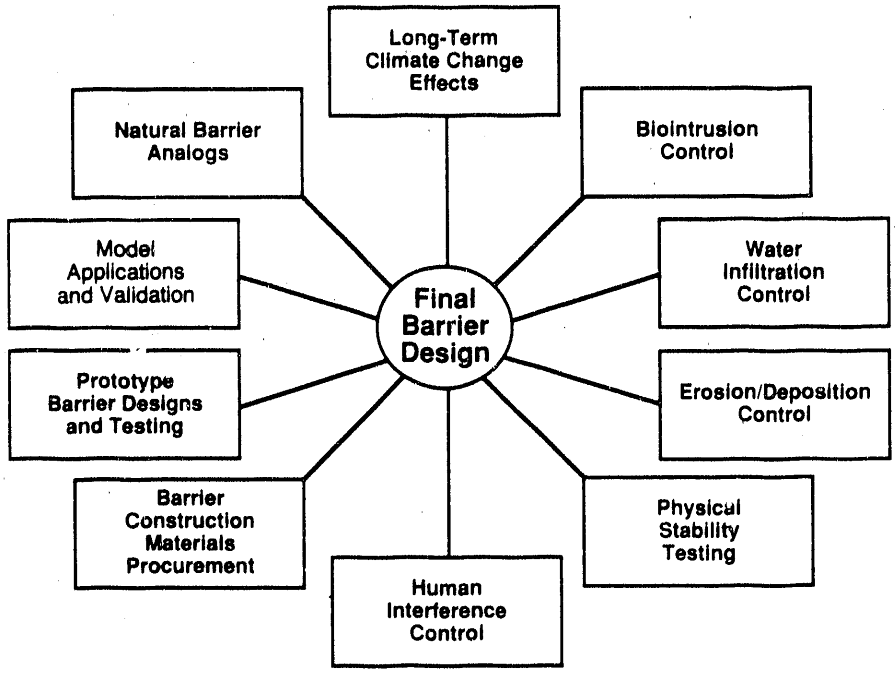

Figure 3. Hanford Site protective barrier and marker system development: Key tasks.

REFERENCE

Adams, M. R. and N. R. Wing. 1986. Protective Barrier and Warning Marker System Development Plan, RHO-RE-PL-35P. Rockwell Hanford Operations, Richland, WA.