The Screaming Eagle Road Landfill: Achieving Environmental Excellence

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The Screaming Eagle Road (SER) Landfill is located approximately thirteen miles northeast of the center of Columbia, South Carolina, and 1.5 miles east of Interstate Highway 20. From 1972 to 1987, the original fifty-two-acre landfill facility operated, similar to many old landfills, lacking many controls required for protecting the environment. However, since Chambers Richland County Landfill, Inc., a subsidiary of Waste Management, Inc. (WMI), purchased the SER Landfill from its original owners in 1986, many improvements to the design and operations of the landfill were implemented. WMI personnel were committed to comply with all regulations of the South Carolina Department of Health and Environmental Control (DHEC) and to convert the SER Landfill into a state-of-the-art facility with the best available technologies for environmental control. The story of how the SER Landfill was transformed from an old landfill with no or limited environmental control to a modern state-of-the-art facility is told in this article.

**How it was**

As permitted, the original SER Landfill consisted of five cells. Waste disposal was to occur directly on existing ground (i.e., without utilizing a liner system). A liner system consists of a combination of one or more drainage layers and low-permeability barrier layers (i.e., liners). Drainage layers consist of permeable soils or synthetic drainage materials (e.g., geonets). Liners include: (1) compacted clay liners (CCLs); (2) synthetic sheets of rubber or plastic material referred to as geomembranes (GMBs); and (3) geosynthetic clay liners (GCLs). The functions of the liners and drainage layers are complementary. The liner impedes the migration of leachate out of the landfill and improves the performance of any overlying drainage layer. The drainage layer limits the buildup of hydraulic head on the underlying liner and conveys the leachate that percolates into the layer to a leachate collection system (LCS). Leachate is liquid (mostly rainwater) that comes in contact with waste disposed of in the landfill. Depending on the type of waste, leachate may contain contaminants that are harmful to the environment and/or human health. Typically, an LCS consists of a perforated pipe, which is embedded in a trench and surrounded by gravel, that flows into a sump located at the lowest portion of the landfill cell. In most cases, leachate is pumped out of the sump via a forcemain to a leachate storage and/or treatment facility located on or off site. Because the original landfill did not include a liner system or an LCS, leachate generated in the landfill was not collected and treated.

The original landfill also had no ability to collect gas (mainly methane) generated from the decomposition of waste in the landfill. If landfill gases are left uncontrolled, they can contribute to air quality degradation in the region and cause odor problems at the landfill. Therefore, state-of-the-art landfills are equipped with a gas extraction system that collects the landfill gases and burns them in a flare. A gas extraction system typically consists of a network of gas extraction wells in which gas flows to the landfill surface. At the landfill surface, the gas flows into a network of lateral and header pipes and then into a gas flare station and/or blower. Because the original landfill did not include a gas extraction system, gases generated in the landfill were not collected and burned.

From the perspective of the 1990s, integration of liner, leachate collection, and gas extraction systems seems natural and prudent in a well-designed and operated landfill. In the 1970s and 1980s, however, few operating landfills across the United States had incorporated them. In short, at that time landfills without liner, leachate collection, and gas extraction systems were considered modern facilities.

**Solid Steps Towards Environmental Excellence**

When WMI purchased the SER Landfill in 1986, waste disposal was completed or active in parts of four of the five permitted cells. An approximately seven-acre permitted waste disposal cell was still undeveloped. Although legally permitted to continue unlined disposal over the undeveloped area, WMI recognized the need to convert the SER facility into a state-of-the-art landfill. Such a change was required to enable the company to market long-term, environmentally responsible waste disposal services to its customers. As a result, in 1990 WMI submitted a permit application to DHEC for vertical expansion over the existing landfill and for retrofitting the undeveloped seven-acre cell (Retrofit Area). Several design upgrades were proposed in the permit application including: (1) a liner system for the Retrofit Area; (2) an LCS for the Retrofit Area; (3) a synthetic cover system for the vertical expansion area; and (4) a gas management system for the entire landfill. This permit application was approved by DHEC in January 1991, making, at the time, the SER Landfill one of only a few South Carolina landfills permitted with liner systems.
Waste filling progressed in the original landfill until construction of the Retrofit Area was completed in 1994. Photo 1 shows liner system construction in progress in the Retrofit Area and shows the original unlined landfill. The liner system for the Retrofit Area consisted of, from top to bottom:
- a two-foot-thick protective soil layer;
- a geotextile filter;
- a high-density polyethylene (HDPE) geonet drainage layer;
- an HDPE geomembrane; and
- a two-foot-thick CCL.

In 1994, WMI constructed a leachate storage facility to handle leachate collected from the Retrofit Area and other lined areas to be constructed in the future. The leachate storage facility consisted of a 100,000-gallon glass-lined storage tank encapsulated by a concrete secondary containment area. Recently, WMI added another storage tank of equal capacity (Photo 2).

Although not required in the permit, in 1995 WMI designed and constructed a liner system that connects to the Retrofit Area liner system and extends over a several-acre area of the original unlined landfill. The purpose of this overlay liner system was to provide added environmental protection by separating new waste placed on the overlay liner system from the existing underlying waste. This design allowed for the collection and treatment of leachate and gas generated from the new waste.

WMI purchased five parcels of land adjacent to the original landfill, increasing the landfill site area to approximately 224 acres. In 1991, WMI submitted to DHEC a permit application for lateral expansion of the permitted SER Landfill. The lateral expansion permit application proposed the construction of six new cells, A through F, on the property adjacent to the existing landfill. The application also proposed to construct a new site entrance area that includes a gate, scale, scale house, tire wash area, and maintenance building. Two new sedimentation ponds (in addition to the existing pond) would be constructed to handle surface water runoff from the entire site.

Modern liner and leachate collection systems, similar to the systems constructed in the Retrofit Area, were proposed for the six new cells. A layover liner system was also proposed to be constructed on top of a portion of the existing original landfill. A geomembrane/CCL composite cover system and a gas extraction system were also proposed. DHEC approved this permit application on June 15, 1993.

On June 25, 1993, DHEC issued Solid Waste
Management Regulation R. 61–107.258, referred to herein as Chapter 61. The requirements set forth in the regulation reflect the design and siting criteria for municipal solid waste landfills promulgated in Title 40 of the Code of Federal Regulation (40 CFR & 258). Subtitle D. WMI modified the SER Landfill design to include several upgrade modifications to meet Chapter 61 regulations. Environmental Upgrade Plans were prepared and submitted to DHEC for review and approval, and in October 1994 WMI received a permit modification approval.

Since building the Retrofit Area in 1994, WMI has constructed approximately thirty additional acres of lined disposal area using a similar cross-section to that previously described, providing long-term, environmentally responsible waste disposal for the South Carolina midland region. Furthermore, WMI constructed a new site entrance facility and a sedimentation pond (Photo 3).

In addition, a gas extraction system was installed for the original landfill in 1997. This system consisted of gas extraction wells, lateral pipes, header pipes, a gas main, a condensate trap, and a flare station. The gas extraction well consists of perforated HDPE pipe, which is installed in the waste and surrounded by a gravel bedding material. The top nine feet of the pipe is nonperforated and the top six feet of the pipe is sealed with a cement/bentonite grout. A vacuum is applied at each well head, which extracts the gas from the waste. The gas flows to a four-inch-diameter HDPE lateral pipe and then to a gas collection header pipe. The gas main conducts the extracted gas to a flare station where the gas is burned (Photo 4). Condensate generated from the landfill gas flows by gravity through the lateral and header pipes to a condensate trap located at the low point of the piping network. The condensate trap is equipped with a pneumatic pump and liquid level controls. The condensate in the trap is pumped to a condensate forcemain and on to the existing leachate storage tank. In the future, the gas extraction system will be extended to handle gas generated from all completed phases of the landfill.

Also in 1997, WMI constructed a final cover system over unlined areas of the original landfill that reached final grades. This cover system consisted of a 1.5-foot thick compacted clay layer overlain by a two-foot thick vegetative soil layer. The final cover system was graded to promote quick collection and removal of surface water runoff through the use of drainage ditches and downdrain pipes.

Finally, substantial upgrades in environmental monitoring have also been implemented over the past few years. Currently, the SER Landfill is operated in accordance with DHEC-approved ground water monitoring and landfill gas monitoring plans that meet Chapter 61 regulations. The ground water monitoring network consists of two upgradient wells and eight downgradient wells that surround the landfill. These monitoring wells are used for the collection of samples of ground water for chemical analysis on a regular basis. Therefore, the monitoring wells enable early detection of chemical migration from the landfill, in the unlikely event a leak occurs from the landfill. The landfill gas monitoring network for the SER Landfill consists of one shallow and ten nested (i.e., one shallow and one deep) permanent probes. These probes are strategically located around the landfill to enable the detection of gas that may potentially migrate out of the landfill. In addition, gas monitoring is also conducted around and within site structures such as the scale house and the administrative building.

Closure
Since the 1970s, significant public interest has arisen within the United States regarding the environmental impacts associated with uncontrolled waste disposal practices of the past. As a response, in the 1980s extensive regulatory requirements were implemented at the state and federal level to address these concerns. Recognizing the need for such control, WMI is one of many private and public entities in South Carolina that have successfully converted old unlined landfills with limited or no environmental control into state-of-the-art facilities. The SER Landfill is an example of such a facility, currently boasting the latest in engineered liner, leachate collection, gas extraction, surface water management, and ground water and landfill gas monitoring systems. The story of the SER Landfill is not unique in South Carolina.

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