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May 9, 2006

U.S. Environmental Protection Agency
Region VII
901 N. 5th Street
Kansas City, Kansas 66101

ATTENTION: Mr. Dan Wall

SUBJECT: Feasibility Study Report
West Lake Landfill Operable Unit 1, Bridgeton, Missouri

Dear Mr. Wall,

On behalf of Cotter Corporation (N.S.L.), Laidlaw Waste Systems (Bridgeton), Inc., Rock Road Industries, Inc., and the United Sates Department of Energy (the "Respondents"), Engineering Management Support Inc. (EMSI) submits the attached Feasibility Study report for Operable Unit-1 at the West Lake Landfill Superfund Site. If you have any questions or desire additional information related to this report or any other aspect of the project, please do not hesitate to contact me.

Sincerely,
ENGINEERING MANAGEMENT SUPPORT, Inc.

Paul V. Rosasco, P.E.

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Feasibility Study

West Lake Landfill
Operable Unit 1

Prepared for:

West Lake Landfill OU-1 Respondents Group

Prepared by:

Engineering Management Support, Inc.
8125 West Grand Avenue, Suite 100
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May 8, 2006

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1 INTRODUCTION

Engineering Management Support Inc. (EMSI) has prepared this Feasibility Study (FS) for Operable Unit (OU) -1 at the West Lake Landfill located in Bridgeton, Missouri on behalf of Cotter Corporation (N.S.L.), Bridgeton Landfill, LLC (formerly known as Laidlaw Waste Systems [Bridgeton], Inc.), Rock Road Industries, Inc., and the United Sates Department of Energy (the "Respondents"), Respondents to an Administrative Order on Consent (AOC) [CERCLA Docket No. VII-93-F-005] with the United States Environmental Protection Agency (USEPA) to conduct a remedial investigation and feasibility study (RI/FS) at the West Lake Landfill site, OU-1. OU-1 includes conditions associated with two areas of radiological impacted materials, Radiological Area 1 (Area 1) and Radiological Area 2 (Area 2), at the West Lake Landfill. Investigation and evaluation of the occurrences of non-radioactive constituents in other parts of the landfill are being performed by Bridgeton Landfill, LLC under a separate operable unit (OU-2) RI/FS.

1.1 Purpose, Objectives and Scope of the FS

The purpose of an FS is to evaluate potential remedial options consistent with the procedures set forth in the National Contingency Plan (NCP) as further described in EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988a); guidance for "Conducting Remedial Investigation/ Feasibility Studies for CERCLA Municipal Landfill Sites" (USEPA, 1991); and guidance for "Presumptive Remedy for CERCLA Municipal Landfill Sites" (USEPA, 1993b). The primary objectives of an FS are to develop an appropriate range of waste management options that ensure the protection of human health and the environment and to assess each alternative in terms of the evaluation criteria prescribed by the NCP.

This FS for OU-1 at the West Lake Landfill has been prepared in accordance with the requirements of the AOC. Specifically, this report addresses the requirements of Sections 6.0 (Task V – Development and Screening of Remedial Alternatives) and 7.0 (Task VI – Detailed Analysis of Remedial Alternatives) of the Remedial Investigation/Feasibility Study (RI/FS) Statement of Work (SOW) to the AOC. The requirements of Sections 6.0 and 7.0 of the SOW were subsequently modified as set forth in letters from Mr. Paul Rosasco of EMSI to Mr. Steven Kinser of USEPA Region VII dated March 11, 1997 and May 16, 1997, and EPA's letter of April 7, 1997. Revision to the OU-1 FS requirements were also made consistent with EPA Region VII's determination that EPA's guidance on "Presumptive Remedy for CERCLA Municipal Landfill Sites" (USEPA, 1993b) should be considered for use in developing the FS for the West Lake Landfill. Use of the presumptive remedy approach for municipal landfill sites is discussed further in Section 4.4.2 of this report.

Based on EPA guidance and EPA Region VII decisions regarding the change in approach to completion of the FS, the requirements in Sections 6.0 and 7.0 of the SOW for a technical memorandum on Refined Remedial Action Objectives, a report on the Development and Screening of Remedial Alternatives, and a technical memorandum on the Comparison of Alternatives, along with the requirement for an initial screening of alternatives were deleted. Instead, the RAOs, the development and screening of alternatives and the comparison of alternatives are presented in this FS report. These revisions to the OU-1 FS requirements were developed to reflect EPA's presumptive remedy approach to CERCLA municipal landfill sites and in order to reduce the overall project schedule.

1.2 Feasibility Study Process Overview

According to the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988a), development of the FS should generally follow a prescribed methodology. Once a site has been adequately characterized through the RI process and risks to human health and the environment have been assessed through preparation of a baseline risk assessment (BRA), the FS serves as the mechanism for the development, screening, and detailed evaluation of alternative remedial actions to address issues and risks identified in the RI and BRA. The FS process typically occurs in three phases: the development of remedial alternatives, screening of the alternatives, and the detailed analysis of alternatives.

Alternatives for remedial action are developed by assembling combinations of technologies, and the media to which they would be applied, into alternatives that address contamination on a site-wide basis or for an identified OU. The alternatives development process consists of several general steps, which are briefly discussed as follows:

- Develop remedial action objectives (RAOs) specifying the contaminants, media of interest, and exposure pathways that permit a range of containment and treatment alternatives to be developed. The RAOs are developed based on chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and site-specific risk-related factors.

- Develop general response actions (GRAs) for each medium of interest such as institutional controls, containment, or other actions, singly or in combination that may be taken to satisfy the RAOs for the site or OU.

- Identify volumes or areas of media to which GRAs might be applied, taking into account the requirements for protectiveness as identified in the RAOs and the chemical and physical characterization of the site.

- Identify and screen the technologies applicable to each GRA to eliminate those that cannot be implemented technically at the site or OU (Note: This initial screening step is a medium-specific technology screening step conducted during development of alternatives, as opposed to the alternative screening step that is conducted subsequently to reduce the number of alternatives prior to the detailed analysis of alternatives). The GRAs are further defined to specify remedial technology types (e.g., the GRA of treatment can be further defined to include physical, chemical, or biological technology types).

- Evaluate technology process options to select a representative process for each technology type retained for consideration. Although specific processes are selected for alternative development and evaluation, these processes are intended to represent the broader range of process options within a general technology type.

- Assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations, as appropriate.

At many sites, a large number of alternatives are typically identified based on the results of the technology screening. In order to reduce the number of alternatives that are subjected to detailed evaluation and to focus the evaluation of alternatives, the list of alternatives developed based on the technology screening is often subjected to an initial screening based on the anticipated effectiveness, implementability and cost of the alternatives. As previously discussed, EPA Region VII previously agreed that the alternative screening step was not necessary for completion of the West Lake OU-1 FS, consistent with EPA's guidance on "Presumptive Remedy for CERCLA Municipal Landfill Sites" (USEPA, 1993b).

The potential remedial alternatives are then subjected to a detailed analysis using the nine criteria specified in the NCP. After completion of the detailed analysis of alternatives, the alternatives are subjected to a comparative analysis again using the nine criteria specified in the NCP.

1.3 Coordination with OU-2

OU-1 includes two separate sub areas within the overall area of the West Lake Landfill. These two areas, referred to as Area 1 and Area 2 contain radiologically impacted soil. The impacted soil is interspersed with and contained within an overall matrix of solid waste materials. Both Area 1 and 2 are part of larger areas of previously placed solid wastes which in turn are located within a 230 acre solid waste landfill and industrial use complex.

The radiologically impacted portions of Areas 1 and 2 represent only a portion of these areas, which in turn only represent a portion of the overall landfill area. Consequently, possible remedial actions for the radiologically impacted materials in Areas 1 and 2 cannot be implemented without consideration of ongoing activities at the landfill and possible future landfill operations, closure activities or remedial actions that may be implemented for other portions of the landfill. Evaluation of the need for and possible scope of potential remedial actions for other portions of the landfill are being evaluated as part of a separate operable unit, OU-2.

Selection and implementation of a remedy for OU-1 will necessarily involve coordination with the remedial action, if any, to be selected for OU-2. Such coordination may include but is not necessarily limited to issues related to the scope of the remedial actions for each OU, timing of implementation of potential remedy components, the compatibility of the remedial actions that may be selected for each OU, and the overall protectiveness of the combined remedial actions. Of particular interest will be coordination of any grading, landfill cover or drainage improvements that may be implemented for either of the OUs.

This FS only addresses the development and evaluation of potential remedial alternatives for OU-1. Where possible coordination issues may exist with remedial actions that may be implemented for OU-2, these issues are identified as part of the various alternative evaluations presented in this report.

As discussed later in this FS report, the remedy for OU-1 is likely to be focused on implementation of an upgraded landfill cover over the OU-1 area. The potential landfill cover improvements (grading, cover design, etc.) presented later in this FS report were developed with consideration of the configuration of the landfill areas outside of and adjacent to the OU-1 areas. Consequently, no technical compatibility issues are anticipated with implementation of any of cover designs presented later in this FS report. Implementation of these cover designs is also unlikely to limit options for OU-2.

1.4 Report Organization

Section 2 of the FS summarizes the surface and subsurface conditions at the Site, the nature and extent of contamination and potential risks associated with such contamination based on the results of the RI and BRA evaluations. Section 3 includes a preliminary identification of potential ARARs and development of RAOs. The identification of GRAs, identification and initial screening of technologies, evaluation of technologies and process options, and development into potential remedial alternatives are presented in Section 4. The potential remedial alternatives developed in Section 4 are then analyzed in detail in Section 5. Section 6 presents a summary comparison of the alternatives. A list of references is included in Section 7 of this report.

Appendix A contains copies of EPA's various guidance documents related to use of the presumptive remedy approach for CERCLA municipal landfill sites. Appendix B contains a detailed evaluation of potential "hot spots" and possible "hot spot" removal performed in accordance with EPA guidance (EPA, 1993b). The results of this evaluation are also summarized in Section 4.4.3 of this report. Appendix C contains copies of the existing land use covenants that have been implemented for the West Lake

Landfill and Radiological Areas 1 and 2. Detailed information regarding the estimated costs presented in Section 5 of the FS is contained in Appendix D.

2 SITE CONDITIONS

This section presents a summary of the surface and subsurface conditions at the West Lake Landfill based on the results of the RI evaluations (EMSI, 2000). This section also presents a conceptual model of the occurrence of radiologically impacted materials and the potential pathways through which radionuclides have or could migrate from Areas 1 and 2. A summary of the potential risks posed by both the radionuclides and the non-radiological parameters present in, and potentially migrating from, Areas 1 and 2 is also provided in this section.

2.1 Summary of Site Conditions

Surface and subsurface conditions at the West Lake Landfill, in particular as they relate to Radiological Areas 1 and 2 of OU-1, are summarized in this section.

2.1.1 Surface Conditions

The West Lake Landfill is situated on the eastern edge of the Missouri River floodplain approximately two miles east of the river (Figure 2-1), at the western edge of the City of Bridgeton. Immediately west, between the City of Bridgeton and the Missouri River is a primarily industrial area of unincorporated St. Louis County known as Earth City. The river is separated from Earth City by a levee system. The topography of the West Lake Landfill area has been significantly altered by quarry activities in the eastern portion of the landfill, and by placement of mine spoils and landfill materials in the eastern and western portion of the landfill.

Area 1 is situated on the north and western slopes of a topographic high within the landfill. Ground surface elevation in Area 1 varies from 490 feet on the south to 452 feet at the roadway near the landfill property entrance.

Area 2 is situated between a topographic high of landfilled materials on the south and east and the Buffer Zone and Crossroad properties (former Ford property) on the west. The highest topographic level in Area 2 is about 500 feet on the southwest side of Area 2 sloping to approximately 470 feet near the top of the landfill berm along the south side of the Ford property. The upper surface of the berm along the western edge of Area 2 is located approximately 20 to 30 feet above the adjacent Ford property and approximately 30 to 40 feet higher than the water surface in the flood control channel located to the southeast of Area 2. A berm on the northern portions of Area 2 controls runoff to the adjacent properties.

On the north side of Area 2 is the property referred to in the RI as the Ford Property. This property was previously owned by Ford Motor Credit, Inc. Prior to 1998, Ford subdivided and sold all of its property in this area. The majority of the Ford property was sold to Crossroad Properties LLC and has been developed into the Crossroad Industrial Park. Crossroad has developed all of their property with the exception of Lot 2A2, a 3.58 acre parcel located immediately north of the Buffer Zone. Ford retained the 1.78 acres immediately adjacent to the western portion of the northern boundary of Area 2, referred to as the Buffer Zone, the ownership of which was subsequently acquired by Rock Road Industries, Inc. (Rock Road) on behalf of the Respondents.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 29189C0039 H (FEMA, 1995) indicates that Areas 2 and the northern portion of Area 1 are in the Zone X flood area (Figure 2-2). The Zone X flood area includes areas of the 500-year floodplain, areas of 100-year flood with average depths of less than 1 foot or within drainage areas less than 1 square mile, or areas protected by levees from the 100-year flood. The map reflects the fact that at one time the surface elevation of Areas 1 and 2 were below the 100 year high water levels. Landfilling in this area has significantly raised the elevation of Areas 1 and 2 above the level of the floodplain. Specifically, according to FEMA's FIRM for this area, in the event of a 100 year flood, the water elevation would rise to between 453 to 454 feet within the levee system along the river (FIRM, St. Louis County, Panels 38 and 39, effective date August 2, 1995). The surface of the Area 2 berm is approximately 20 feet above the projected 100-year flood elevations within the levee system along the river. Flooding of areas adjacent to the landfill (i.e., areas outside of the levee system) would only occur as a result of a failure of the levee system. Spreading of floodwaters into areas outside of the levee system would result in lower flood elevations than those projected to occur within the levee system. Therefore, the actual elevations of any floodwaters that may extend into areas adjacent to the landfill are expected to be less than 453 feet. No flooding of the landfill or the adjacent Crossroad property was observed in 1993 and 1995 during the 500- and 300-year flood events that occurred in these years.

Surface runoff from Area 1 ultimately flows north to a drainage ditch along the south side of the landfill access road, east to the drainage ditch on the southwest side of St. Charles Rock Road and then north to a small pond located just north of the northwest corner of Area 2 (Figure 2-3). Runoff from Area 2 generally flows into an internal closed topographic depression within Area 2 (Figure 2-3). Some of the southern part of Area 2 drains into on-site drainage ditches that eventually route runoff to the drainage along the landfill access road and then to the drainage and pond along St. Charles Rock Road. During major storm events, a very small portion of Area 2 can potentially drain down the landfill berm onto the Ford property.

Three types of plant communities were identified in Areas 1 and 2. These include old field and hydrophilic plant communities identified in both Areas 1 and 2 and a forest plant community identified in Area 2 only. A fourth plant community, a maintained field community, was identified in areas adjacent to the landfill. The maintained field areas are subjected to mowing at frequency of at least once per year. No sensitive species or communities are known to occur on the landfill or in the surrounding area.

The West Lake Landfill is located in a predominantly industrial area. The entire landfill area, including the areas investigated under OU-1 and OU-2, has been the site of historic quarry operations to remove limestone, and historic and active landfill operations. The southernmost portion of the West Lake Landfill is permitted for active sanitary landfill operations (Permit No. 118912). Other activities conducted on the OU-2 portion of the property include concrete and asphalt batch plant operations and an auto repair facility (Figure 2-4).

The southern portion of the West Lake Landfill is zoned M-1 (manufacturing district, limited). Although the northern portion of the West Lake Landfill is zoned R-1 (one family dwelling district), this area has never been used for residential purposes, is bounded on all sides by industrial and commercial uses, and has been used for industrial purposes for more than fifty years. Moreover, the Missouri Court of Appeals affirmed in a trial court's finding that the "residential" zoning of the West Lake Quarry property directly south of the West Lake Landfill was unconstitutional, unreasonable and arbitrary. *West Lake Quarry and Material Company v. City of Bridgeton, 761 S.W. 2d 749 (Mo App 1988)*. The court specifically considered commercial-industrial land uses of the surrounding property, the high development costs for residential, noise from airplanes, and other evidence and concluded that property in this area is "totally inappropriate for residential development" and ordered the City to rezone the property M-2 (commercial-industrial) [*Id. at 752*]. Even though a portion of the Site is zoned residential, as a practical matter, the only reasonable future use of the Site is commercial-industrial, not residential.

Residential land use and groundwater use have been prohibited at the West Lake Landfill by restrictive covenants recorded by each of the property owners against their respective parcels. The covenant restrictions cannot be terminated without the written approval of the future owners, Missouri Department of Natural Resources (MDNR), and USEPA. Additional land use covenants have been recorded against Areas 1 and 2 to prevent construction of buildings or utility excavations in these areas.

Land use in the area surrounding the landfill is commercial and industrial. The property to the north of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. The Earth City industrial park is located adjacent to the landfill on the south and west, across Old St. Charles Rock Road. The nearest residential development, "Spanish Village", is located to the south of the landfill near the intersection of St. Charles Rock Road and I-270 approximately ¾ mile from Area 1 and 1 mile from Area 2. Mixed commercial, retail, manufacturing and single family residential uses are present to the southeast of the landfill. The land use zoning for the West Lake Landfill and surrounding area is shown on Figure 2-5.

2.1.2 Subsurface Conditions

The geology of the landfill area consists of Paleozoic age sedimentary rocks overlying Pre-Cambrian age igneous and metamorphic rocks. The Paleozoic bedrock is overlain by unconsolidated alluvial and loess deposits of recent (Holocene) age.

The uppermost bedrock units near the landfill consist of Mississippian age limestone and dolomite with inter-bedded shale and siltstone layers of the Kinderhookian, Osagean, and Meramecian Series. The Kinderhookian Series is an undifferentiated limestone, dolomitic limestone, shale and siltstone unit ranging in thickness from 0 to 122 feet in the St. Louis area. The Osagean Series consists of the Fern Glen Formation, a red limestone and shale, and the Burlington-Keokuk Formation, a cherty limestone. The Fern Glen Formation ranges in thickness from 0 to 105 feet and the Burlington-Keokuk Formation ranges from 0 to 240 feet thick in the St. Louis Area.

The Meramecian Series overlies the Osagean Series rocks. The Meramecian Series consists of several formations including the Warsaw Formation, the Salem Formation, the St. Louis Formation, and the St. Genevieve Formation. The St. Genevieve Formation is reportedly not present near the landfill (Golder, 1996).

Pennsylvanian-age Missourian, Desmoisian, and Atokan formations are present in some areas above the Mississippian-age rocks. The Pennsylvanian-age rocks consist primarily of shale, siltstone, and sandstone with silt and clay. These formations range in combined thickness from 0 to 375 feet in this area. The Atokan-Series Cheltenham Formation was identified as being present in the former landfill soil borrow area located to the southeast of the landfill.

Groundwater is present in both the bedrock units and the unconsolidated materials. The major bedrock aquifers of the St. Louis area include the Cambrian-age Potosi Dolomite and the Ordovician-age Gasconade Dolomite, Roubidoux Formation and St. Peter Sandstone.

Alluvial deposits of varying thickness are present beneath Areas 1 and 2. The landfill debris varies in thickness from 5 to 56 feet in Areas 1 and 2, with an average thickness of approximately 36 feet in Area 1 and approximately 30 feet in Area 2. The underlying alluvium increases in thickness from east to west beneath Area 1. The alluvial thickness beneath the southeastern portion of Area 1 is less than 5 feet (bottom elevation of 420 feet above mean sea level [AMSL]) while the thickness along the northwestern edge of Area 1 is approximately 80 feet (bottom elevation of 370 feet AMSL). The thickness of the alluvial deposits beneath Area 2 is fairly uniform at approximately 100 feet (bottom elevation of 335 feet AMSL).

During the RI investigations, groundwater was generally encountered in the underlying alluvium near or immediately below the base of the landfill debris. Isolated bodies of perched water were encountered in two of the 24 soil borings drilled in Area 1 and six of the 40 soil borings drilled in Area 2 as part of the RI field investigations. The perched water generally occurs in small isolated units at depths varying from five to 30 feet below ground surface.

Monthly groundwater levels measured in various landfill wells indicate that groundwater generally occurs only in the underlying alluvium at or below the base of the landfill materials with the exception of the localized perched water conditions encountered in isolated areas within the landfill. Groundwater elevations varied seasonally and were generally lowest during the fall and winter months (September through March) and highest during the spring and summer months (April through August).

The RI data indicate that only a very small amount of relief (less than one foot) exists in the water table surface beneath the landfill. Based on the water level data, the inferred direction of groundwater flow beneath Area 1 is to the south toward the active landfill. Water level elevations beneath Area 2 displayed areal differences of less than one foot making a site-specific determination of the direction of the hydraulic gradient impossible. The regional direction of groundwater flow is in a generally northerly direction within the Missouri River alluvial valley, parallel, or sub-parallel to the river alignment.

No public water supply wells that obtain water from the alluvial aquifer are present near the landfill. An inventory of private wells in the area of the landfill is presented in the RI report (EMSI, 2000). The results of this inventory indicated that the nearest private well reportedly used as a drinking water source is located one mile to the north of the landfill (Foth & Van Dyke, 1989). This well is the nearest downgradient well that may be used for drinking water purposes. Two additional wells that are not used for drinking water purposes are also located 5,100 ft to the northwest and 4,600 ft to north-northeast of the landfill (EMSI, 2000).

An updated well inventory was prepared as part of the RI for OU-2 (Herst & Associates, 2005). This evaluation included an inventory of both registered and unregistered wells located within approximately five miles of the West Lake Landfill. The closest registered well is located approximately one mile northeast of the landfill. This well was reportedly drilled to a depth of 245 ft which indicates a bedrock completion. Regional groundwater flow in the vicinity of the landfill is to the northwest, towards the Missouri River. Accordingly, the nearest registered well is not downgradient of the landfill. The closest registered well that appears to be completed in alluvium is approximately 2.5 miles south (upgradient) of the landfill.

Fifteen unregistered wells were reported to exist within five miles of the West Lake Landfill (Herst & Associates, 2005). Field reconnaissance was performed to verify the reported locations of the unregistered wells. Based on the field reconnaissance, only one of the fifteen reported unregistered wells was verified as present and the resident at this location stated that the well is no longer used because the property is serviced by municipal water.

2.2 Nature and Extent of Contamination

This section of the FS summarizes occurrences of radiological and non-radiological constituents detected in the soil borings completed in Areas 1 and 2.

2.2.1 Radiologically Impacted Materials

Radionuclides are present in a dispersed manner throughout the landfill deposits in Area 1 and Area 2. Radiological constituents occur in soil materials that are intermixed with and interspersed in the overall matrix of landfilled refuse, debris and fill materials and unimpacted soil. In some portions of Areas 1 and 2, radiologically impacted materials are present in the upper six inches; however, the majority of the radiological occurrences are present in the subsurface beneath these two areas.

In general, the primary radionuclides detected at levels above background concentrations at the West Lake Landfill are part of the uranium-238 and uranium-235 decay series. Thorium-232 and radium-224 isotopes from the thorium-232 decay series were also present above background levels but at a lesser frequency.

The discussions regarding the locations and extent of the radiologically impacted materials presented in the RI and summarized below were based in part on the concept of "reference levels". Reference levels were derived in the RI report based upon the EPA "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings" as set forth in Title 40, Part 192, Sections 12 and 41. These standards state that:

> The concentration of radium-226 (or radium-228) in land averaged over any area of 100 square meters shall not exceed the background level by more than - (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.

These standards are only applicable to uranium and thorium mill tailings sites designated under the Uranium Mill Tailings Radiation Control Act (UMTRCA). At the time the RI was prepared, no other numerical standards had been identified that could assist in characterizing the potential extent of the radiologically impacted materials at the West Lake Landfill. In the absence of any other established standards, values based upon the standards promulgated by EPA under 40 CFR 192 were included in the RI evaluations solely as a point of reference and as a means of easily and consistently identifying the radiologically impacted materials and assessing their extent. In referencing these standards, however, the RI states that risk-based levels that are considered to be protective of human health and the environment from radionuclide occurrences at the landfill would be based upon the results of the BRA, and that use of reference levels in the RI should not be construed as representing selection of the 40 CFR 192 standards as ARARs or selection of these standards as actual or potential remediation standards.

2.2.1.1 Radiological Area 1

Radionuclides are present in the upper 6 inches (15 cm) at levels above UMTRCA standard for surface soil (5 pCi/g over background) over approximately 50,700 square feet (1.16 acres) of Area 1 (Figure 2-6). Approximately 194,000 square feet (4.45 acres) of Area 1 have radionuclides present in the subsurface at depths ranging up to 7 feet, with localized intervals present to depths of 15 feet (Figure 2-7). Subsurface occurrences of radionuclides in Area 1 are present in soil material that is intermixed with the overall landfill matrix of refuse, debris and fill materials. The total volume of radiologically impacted materials and associated landfill materials in Area 1 is estimated to be approximately 24,400 cubic yards (EMSI, 2000).

2.2.1.2 Radiological Area 2

Radionuclides are present in the upper 6-inches (15 cm) over approximately 468,700 square feet (10.76 acres) of Area 2 (Figure 2-6). An additional 17,200 square feet in the northeastern portion of Area 2 contains soil/sediment eroded from the surface of Area 2. Radionuclide impacted materials are present in the subsurface beneath approximately 817,000 square feet (18.76 acres) of Area 2 at depths of up to approximately 12 feet, with some localized deeper intervals (Figure 2-7). Subsurface occurrences of radionuclides in Area 2 are present in soil material that is intermixed with the overall landfill matrix of refuse, debris, fill and non-impacted soil materials. The total volume of radiologically impacted materials and associated landfill materials in Area 2 is estimated to be approximately 118,000 cubic yards.

2.2.1.3 Radiological Occurrences on the Ford and Crossroad Properties

During the RI (EMSI, 2000), an additional 196,000 square feet of impacted surface materials were identified in the southern portion of what at that time was property owned by Ford Motor Credit (referred to as the Ford property) located immediately west of Area 2 (Figure 2-8). A portion of the Ford property was subsequently sold to Crossroad Properties, LLC (Crossroad) and a portion was retained by Ford (the buffer property). Reportedly, subsequent to completion of landfilling activities in Area 2, erosion of soil from the landfill berm occurred resulting in transport of radiologically impacted materials from Area 2 onto the adjacent Ford (now Buffer Zone and Crossroad) property (EMSI, 2000). The area has subsequently been revegetated by natural processes and no evidence of subsequent erosion or other failures have been identified. Occurrences of radionuclides were found in surficial (6 to 12 inches or less) soil at the toe and immediately adjacent to the landfill berm as a result of the historic erosion from Area 2.

Based on an areal extent of 196,000 square feet and a presumed 6-inch thickness, the volume of radiologically impacted materials located on the Ford property was estimated to be 3,600 cubic yards.

In November 1999, the vegetation and surface soil were scraped from the buffer property and a portion of the adjacent Crossroad property to a depth of approximately 2 to 6 inches. These activities were unauthorized and reportedly conducted by AAA Trailer, a neighboring property owner. The removed materials were piled in a berm along the southern boundary of the buffer property, adjacent to the northwestern boundary of the West Lake Landfill. A small amount of removed materials was also placed in a small pile on the Crossroad property.

EMSI prepared an Interim Measures Work Plan (EMSI, 1999) to address consolidation and stabilization of the soil piles and additional surface soil sampling. In February 2000, Herst & Associates at the request of EMSI on behalf of the Respondents collected additional surface soil samples from the disturbed area for laboratory testing. Only one sample (RC-02) obtained below and adjacent to the area of the former slope failure contained radionuclides (specifically thorium-230) above reference levels. The remainder of the samples contained either background levels of radionuclides or levels above background but below the reference levels.

The results of the additional soil sampling conducted in 2000 indicated that most of the radiologically impacted soil that had previously been present on the Buffer Zone and Lot 2A2 of the Crossroad property had been removed and was now located in the stockpiles. Evaluation of the soil sampling results obtained prior to and after the 1999 disturbance indicates that approximately one acre of the Buffer Zone may still contain some radionuclides above reference levels.

Inspection of the area in May 2000 indicated that native vegetation had been re-established over both the disturbed area and the stockpiled materials. The presence of native vegetation over these materials was determined to be sufficient to prevent windblown or rainwater runoff of these materials. Consequently, no additional interim measures were implemented.

A recent inspection of this area indicated that additional soil removal/regrading has been performed on the remaining portion of the Crossroad property and the adjacent Buffer Zone property by, or on the behalf of, AAA Trailer. These activities appear to have resulted in removal of the soil piles created during the previous regrading activity conducted by AAA Trailer, removal of the remaining soil on Lot 2A2 and the Buffer Zone that had not been excavated by AAA Trailer during the 1999 regrading it performed in this area, and placement of gravel over Lot 2A2 and the Buffer Zone. According to AAA Trailer, all of the soil removed during the July 1999 grading work and the May 2003 gravel layer installation, was placed in the northeastern corner of the Buffer Zone (terra technologies, 2004). Trailers associated with AAA Trailer's operations have been parked in this area although use of the Buffer Zone, which is owned by the Respondents, for this purpose, has not been authorized. As sampling has not been performed after the most recent grading work conducted by AAA Trailer (May 2003), the levels and extent of radionuclides, if any, that may remain in the soil in the Buffer Zone and Crossroad property after the more recent grading activities conducted by AAA Trailer are unknown at this time. Additional soil sampling to determine current conditions with respect to radionuclide occurrences in soil beneath the Crossroad property will be conducted as part of implementation of the selected remedy for this area.

2.2.1.4 Summary of Radiological Occurrences

The total estimated area underlain by radiologically impacted materials in Areas 1 and 2 is approximately 28 acres. The total estimated volume of radiologically impacted materials, including the refuse, debris, and fill materials and unimpacted soils that are present in the same depth interval and are co-mingled with the radiologically impacted materials, is estimated to be 146,000 cubic yards.

2.2.2 Non-radiologically Impacted Materials

As part of the investigation of radiological occurrences in Areas 1 and 2, investigations of occurrences of non-radiological occurrences were also performed. Occurrences of non-radiological constituents in Areas 1 and 2 are not associated with radiological occurrences.

2.3 Potential Migration Pathways

This section of the FS summarizes the potential migration pathways of radiological constituents from Areas 1 and 2 that were evaluated by the RI. The possible pathways by which radionuclides potentially could migrate from Areas 1 and 2 include:

- Airborne transport of radon gas, transport of radionuclides in fugitive dust, or subsurface migration of radon and volatile organic compounds (VOCs) with landfill gas;
- Rainwater runoff transport of radionuclides dissolved or suspended in on-site or offsite surface water or rainwater runoff;
- Erosion of Area 1 and 2 soils and transport of radionuclide impacted soils in sediment; and
- Leaching of radionuclides to perched water and discharge at the leachate seep or leaching of radionuclides into the underlying alluvial groundwater and groundwater transport to offsite areas.

The summary of potential migration pathways presented in the following sections reflects the current conditions at the site. Potential future changes in the use of the property or the physical integrity of Areas 1 and 2 could result in a deterioration over time that could potentially change the possible migration pathways if appropriate measures are not taken.

2.3.1 Airborne Transport

Radon flux measurements obtained during the RI indicated that the radon flux levels from Areas 1 and 2 did not exceed the standard of 20 pCi/m^2s (which is applied as an average to the entire area of interest) established pursuant to the UMTRCA for radon emissions from residual radioactive materials from inactive uranium processing sites (40 CFR 192.02(b)). The presence of radon emissions from OU-1 indicates that these emissions may be a migration pathway of concern; however, testing performed during the RI indicated that the overall radon emissions from the landfill are below the standard. Mixing of radon with landfill gases and lateral migration from Area 1 or 2 through the landfill materials does not appear to be a migration pathway of concern based upon measurements of radon concentrations in the landfill gas collection system.

Fugitive dust monitoring was conducted at one location in Area 1 and one location in Area 2 in accordance with the EPA approved RI/FS Work Plan (McLaren/Hart, 1994). Sampling for fugitive dust monitoring was performed at locations that contained the highest or some of the highest radionuclide concentrations in surface soil samples. Results of the fugitive dust monitoring indicated that although fugitive dust emissions may be a potential pathway at the landfill, the levels of radionuclides detected in the fugitive dust samples collected during the RI indicated that it is not a significant pathway for radionuclide migration from Areas 1 and 2 (EMSI, 2000). Fugitive dust is not considered a significant pathway for radionuclide migration under current conditions, primarily because the surfaces of Areas 1 and 2 are for the most part vegetated thereby reducing or preventing release of significant amounts fugitive dust. This pathway could become a concern in the future if the site conditions are not monitored and maintained.

Methane gas measurements were performed as part of the RI field investigations. During the RI, methane levels ranging from less than 1% to as much as 45% were observed in the various boreholes drilled for the RI. The highest levels of methane were observed in boreholes drilled in Area 1. Lower levels of methane were observed in Area 2; however, methane concentrations greater than 5% methane concentration by volume (the lower explosive limit or LEL for methane) were observed in both Area 1 and Area 2. The active portion of the West Lake Landfill has a methane gas collection and treatment system.

2.3.2 Runoff and Erosional Transport

Precipitation that falls on the surface of OU-1 has the potential to transport site constituents in the form of runoff water (water phase) or soil erosion associated with slope failures or mud flows (soil phase). As part of the RI, samples of rainwater runoff and sediment were obtained to assess the current potential for transport of radionuclides by these mechanisms. Rainwater runoff and sediment samples were obtained from various surface water diversion ditches, runoff control structures or erosional channels located both onsite and offsite within or adjacent to Areas 1 and 2 in accordance with the EPA-approved RI/FS Work Plan (McLaren/Hart, 1994).

As radionuclides are present in the surface soil in Areas 1 and 2, a potential for transport of radionuclides as suspended sediment or in dissolved phase exists in response to runoff of precipitation (rain or snow) that falls on the surface of Areas 1 and 2. The first subsection below (Section 2.3.2.1) summarizes the results of water sampling and evaluation of the potential for radionuclide transport by runoff water (either in the dissolved phase or as suspended sediment in water). This discussion is focused on review of the results of filtered (dissolved phase) and unfiltered (total phase) water samples to assess the potential for migration in the water phase. The second subsection below (Section 2.3.2.2) summarizes the results of soil and sediment sampling as they relate to the potential for soil erosion and transport of soil containing radionuclides from OU-1. This discussion is focused on review of the results of soil and sediment (solid phase) samples. As discussed previously (Section 2.2.1.3 and more fully in the RI [EMSI, 2000), erosion of soil from Area 2 after completion of landfilling in Area 2 resulted in transport of radionuclides onto the adjacent Ford (now Buffer Zone and Crossroad property) property indicating that at least historically, erosional transport either through slope failure or mudflow was a pathway for transport of radiologically impacted soil from the Site.

2.3.2.1 Rainwater Runoff Transport

This subsection addresses the potential for runoff water to contain and transport radionuclides from OU-1. Water samples were obtained during storm events to assess the potential for dissolved or suspended phase transport of site contaminants in precipitation runoff. Radionuclides were detected in some of the rainwater/runoff samples obtained as part of the RI.

As no standards or health-based criteria exist for rainwater/runoff, the results of the analyses of these samples were compared to the Maximum Contaminant Levels (MCLs) for drinking water systems; however, as there is no expectation that any potential receptor would actually drink rainwater/runoff, the MCLs are not an ARAR for rainwater/runoff. One of the rainwater/runoff samples obtained from an onsite area contained radionuclides at levels slightly above the radium MCL. The analysis of this sample indicated that the total of radium-226 and -228 isotopes in the unfiltered sample was twice the MCL;

however, the filtered sample contained radium levels far below the MCL. This indicates that the primary mechanism for rainwater runoff transport is transport of suspended sediment. Suspended sediment transport is limited to areas where sufficient water velocity occurs to keep the sediment in suspension. None of the surface water samples (either dissolved or total fractions) collected from the nearest offsite surface water bodies (surface water retention and detention basins and flood control channel located adjacent to the Site) contained radionuclides at levels above MCLs. The potential for radionuclide transport in either the dissolved phase or as suspended sediment in rainwater runoff during average storm events is likely limited by the presence of the existing vegetative cover. Therefore, dissolved phase transport in rainwater runoff does not appear to be a significant potential pathway for radionuclide migration. Suspended sediment transport in rainwater runoff is a potential pathway for radionuclide migration within and adjacent to Areas 1 and 2; however, based on the results of the offsite sampling, it does not appear to be a significant pathway for offsite migration of radionuclides.

2.3.2.2 Soil Erosion and Sediment Transport

This subsection addresses the potential for soil erosion during storm events to result in transport of radionuclides from OU-1. Sediment samples were collected from various surface water diversion ditches, runoff control structures or erosional channels located onsite and offsite. Some of the sediment samples collected on-site contained levels of radionuclides above background. One sediment sample collected at the landfill boundary on the southern side of the access road contained radium-226 at a level of approximately 5 pCi/g above background. The levels of radionuclides detected in offsite sediment samples were generally near or just slightly above background levels.

Previous erosional transport (slope failure or mudflow) from the western portion of Area 2 down the landfill berm resulted in transport of radionuclides onto the eastern portion of the buffer property and portions of the Crossroad property located adjacent to the base of the landfill slope on the northwestern boundary of Area 2. Soil samples obtained from five of the eleven locations on the Buffer Zone/Crossroad properties contained radionuclides at levels of 5 pCi/g or more above background. All of these samples were from the upper 3 to 6 inches of materials. Radionuclides were not detected above background levels in any of the soil samples obtained from the Buffer Zone/Crossroad properties at depths of one-foot or more. As previously discussed (Section 2.2.1.3), surface soil within this area was scraped and placed in stockpiles sometime during 1999. Subsequent testing did not detect the presence of any radionuclides above reference levels in any of the samples obtained from the Crossroad property and only one sample from the Buffer Zone contained radionuclides above reference levels.

Additional grading and placement of gravel occurred subsequent to the most recent soil sampling performed on Lot 2A2 and the Buffer Zone. The disposition of the soil piles created by the 1999 grading of this area is not precisely known; however, AAA Trailer has reported that the soil was pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use is still present beneath Lot 2A2 and the Buffer Zone.

Historic erosion of surface soil from Area 2 resulted in offsite transport of contaminated soil onto the adjacent Buffer Zone and Crossroad property. Based on this historic occurrence, erosional transport of soil in response to major storm events is considered to be a potential pathway. Based on the results of the sediment and offsite soil sample analyses, erosion of surface soil from Areas 1 and 2 and subsequent sediment transport has resulted in offsite migration of radionuclides from Areas 1 and 2. Soil erosion and sediment transport is also considered a potential pathway for future migration of radionuclides from Areas 1 and 2 during extreme precipitation events.

2.3.3 Leaching to Groundwater and Groundwater Transport

Perched water is present at isolated locations within the landfill materials in Areas 1 and 2. Radionuclides generally were not detected in the samples of perched water. The only radionuclides that were detected in perched water samples were at very low concentrations, approximately 1 to 2 pCi/l or less.

Groundwater monitoring was performed during 1995, 1996 and 1997 as part of the RI and during 2004 in conjunction with the FS. The results of the RI and the additional groundwater sampling indicated that radium is present in two OU-1 wells, D-3 and D-6 (Figure 2-9) at levels slightly greater than the MCL of 5 pCi/l for the total of Radium-226 and -228 isotopes. Benzene was detected in two OU-1 wells (I-2 and I-9) more than once at levels above the MCL (5 ug/l). Chlorobenzene was detected in well D-14 during the RI and in well D-85 during the additional sampling at levels above 100 ug/l. During the RI, arsenic was detected in three wells (MW-F3, S-10 and D-14) at levels above the MCL of 50 ug/l.

Missouri has promulgated a Maximum Contaminant Level (MCL) of 5 pCi/L for radium-226 and radium-228 combined (10 CSR 60-4.060 “Maximum Radionuclide Contaminant Levels and Monitoring Requirements”). Site data were compared to these standards to assess whether potential exposure to the measured concentrations is significant. The levels of radionuclides detected in groundwater beneath and adjacent to Areas 1 and 2 generally were below both background levels and the State of Missouri MCLs for drinking water systems.

Groundwater monitoring performed during the RI and FS did not identify any wells containing uranium at levels close to or above the MCL. Monitoring did identify several wells with total radium concentrations close to the MCL (e.g., I-2, I-9, I-11, D-13, and D-93) and two wells, D-3 and D-6, (Figure 2-9) with total radium levels above the Missouri State MCLs for drinking water systems. The measured concentrations in both wells were just slightly greater than the MCL. Well D-6 is located in the Buffer Zone immediately adjacent to the west side of Area 2. Based on all available data, it does not appear that the source of the radium occurrences in well D-6 is the result of either vertical migration from overlying soils or shallow groundwater, or lateral migration from upgradient groundwater. The RI concluded that the source of the radium levels in well D-6 was possibly the result of cross-contamination; that is dragging down of shallow impacted soil during drilling activities. Well D-3 is located in the western portion of Area 1. Radium was not detected in well D-3 at levels above the MCL during sampling performed for the RI; however, it was detected above the MCL during sampling performed in March and May of 2004 in conjunction with the FS. As radium was neither detected at levels above or even close to the MCL in wells (S-5 and I-4) completed at shallower depths at the same location as D-3 nor in any other wells in and around Area 1, the cause of the more recent reported occurrences of radium in well D-3 could not be identified.

Based on the monitoring data obtained during the RI leaching of radionuclides into groundwater and subsequent transport in groundwater to offsite areas is not currently considered to be a significant migration pathway. Although elevated levels of radionuclides and non-radionuclides have been detected in a few, isolated wells completed within or adjacent to OU-1 portions of the landfill, a plume or contiguous area of radionuclide or non-radionuclide constituent occurrences in groundwater at concentrations above regulatory standards or risk-based levels is not present at the West Lake Landfill. The lack of a plume of radionuclide contamination in groundwater at the Site is consistent with the relatively low solubility of most radionuclides in water and their affinity to adsorb onto the soil matrix. As radionuclides and non-radionuclide constituents have been detected in groundwater at levels slightly above MCLs and these constituents are present in the waste materials at the Site, leaching to groundwater is considered to be a potential future migration pathway that needs to be addressed as part of remedial action at the Site.

Uranium does possess a greater solubility than that of other radionuclides. Uranium isotopes (U-238 and U-234) have been detected in groundwater samples obtained from monitoring wells at the Site at levels of approximately 5 pCi/l or less. Uranium has also been detected in upgradient, background wells at levels up to approximately 2 pCi/l. EPA has established an MCL for uranium in public drinking water supplies (65 Fed Reg at 76708 [December 7, 2000]) of 30 ug/l (approximately 30 pCi/l) that became effective on December 8, 2003. The levels of uranium detected at the Site are below the 30 ug/l federal and Missouri (10 CSR 60-4.060) MCL for uranium.

Perched water discharges from the landfill surface in the western side of Area 2. Seepage that occurs in this area flows over the ground for a short distance prior to evaporating or infiltrating back into the underlying soil and waste. A sample of this leachate seep indicated that the radioisotopes present in the seep water were all below the Missouri State MCLs for drinking water supply systems. Based upon these results, the leachate seep is not a pathway for radionuclide migration. Furthermore, seepage discharge is not considered a pathway for offsite migration because the water from the seeps does not migrate offsite.

In accordance with the EPA-approved RI/FS Work Plan (McLaren/Hart, 1994), groundwater samples obtained from monitoring wells located within or near to Areas 1 and 2 were also analyzed for a wide range of chemicals including trace metals, petroleum hydrocarbon constituents, VOCs, semivolatile organic compounds, pesticides and polychlorinated biphenyls (PCBs). With the exception of the trace metals, which are naturally occurring, only isolated detections (i.e., these constituents were only detected in samples obtained from a single well or in a some instances in only a few wells) at low concentrations were found in wells sampled in or near Areas 1 and 2. Being naturally occurring, trace metals were detected in a greater number of wells, particularly in the unfiltered samples which contained suspended sediment. Arsenic was the most frequently detected trace metal and was found in approximately one-half of the wells sampled. The majority of arsenic results were either non-detect or found at levels similar to those found in the upgradient (background) well samples. Additional discussion of the groundwater sampling results for both the radionuclides and the non-radiological parameters can be found in the RI (EMSI, 2000). Overall these data confirm that a plume of contaminated groundwater is not present beneath or downgradient of the landfill indicating that leaching to groundwater currently is not a significant pathway for transport of radionuclides or non-radiological constituents.

It should be noted that the above discussion is based on a simple comparison of measured values to water quality standards and does not reflect detailed evaluation to determine whether these comparisons are statistically significant based on comparison of average values to drinking water standards taking into account the uncertainties associated with water quality measurements at levels near standards. Given the limited number of wells and limited number of chemicals with values potentially greater than drinking water standards, additional evaluations were not considered necessary for completion of the RI/FS. Statistical evaluation of groundwater quality data may be required as part of long-term monitoring to assess whether groundwater beneath the Site meets or exceeds standards and whether any long-term increasing or decreasing trends in groundwater quality are occurring at the Site.

In summary, groundwater monitoring to date has shown limited impact on groundwater quality. Partitioning calculations based on published distribution coefficients were presented in the RI (EMSI, 2000) and indicated that impacts to groundwater over time may be low. Although the RI evaluations indicated that the current and the projected future impacts to groundwater were low, the RI was neither designed to, nor considered all of the investigations and evaluations that would be required to support definitive conclusions about the potential for contaminants to leach to groundwater over time. Therefore, leaching of radionuclides and possibly other chemicals such as metals or VOCs, to groundwater is considered to be a potential pathway of concern.

2.3.4 Summary of Potential Migration Pathways

The results of the RI investigations indicate that the radiological and non-radiological contaminants present in the OU-1 waste materials may not be fully contained. Radionuclides have been detected in samples of storm water runoff, primarily in the form of suspended sediment. Large scale erosion of impacted soil in Area 2 in the form of a slope failure or mud flow previously resulted in offsite transport of radiological contaminants onto the adjacent property. While groundwater monitoring to date has shown only isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, the RI was not designed to develop definitive conclusions about the potential of contaminants to leach to groundwater over time. Therefore, leaching to groundwater represents a potential migration pathway to be address by the remedial actions that may be taken at the Site. The presence of landfill gas (methane) within OU-1 provides a potential mechanism for VOCs and radon within Areas 1 and 2 to be transported to areas outside of OU-1.

2.4 Baseline Risk Assessment

A BRA was performed for Areas 1 and 2 and the adjacent Buffer Zone/Crossroad property (Auxier & Associates, 2000). The BRA included both a quantitative human health risk assessment and a screening level ecological risk assessment. The results of the BRA are summarized below.

2.4.1 Human Health Risk Assessment

The BRA (Auxier & Associates, 2000) identified eight radionuclides (U-238, U-235, Th-232) and their associated daughter products (U-234, Th-230, Ra-226, Pb-210, and Pa-231) as Chemicals of Potential Concern (CoPCs) based on their relatively long half-lives. Based on a review of the site data and a toxicity screening, three trace metals (arsenic, lead, and uranium as a metal) and one polychlorinated biphenyl (Aroclor 1254) were also selected as CoPCs for the human health risk assessment. Based upon a comparison to EPA screening values, other trace metals and organic compounds detected in the soil samples obtained from Areas 1 and 2 were not selected as CoPCs as the maximum detected values of these constituents did not exceed the risk-based screening levels.

Several potential human receptors were identified and evaluated in the BRA including a groundskeeper currently working adjacent to Areas 1 and 2, a groundskeeper that may work on Areas 1 and 2 in the future, and a current or future groundskeeper working offsite on the buffer/Crossroad properties. Potential receptors associated with possible parking, open storage or other uses of Areas 1 and 2 ancillary to potential future commercial/industrial uses in areas adjacent to Areas 1 and 2 were also evaluated. The potential pathways by which these receptors could potentially be exposed to contaminants present in Areas 1 and 2 included exposure to external radiation, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, or incidental ingestion of soil containing radionuclides or other chemicals.

Although groundwater within the alluvial aquifer in the area of the Site may be potentially usable, potential exposure to radionuclides through consumption of groundwater is not considered to be viable pathway of concern. The nearest drinking water well is located a large distance from the Site. Furthermore, all of the businesses and residences in the area use municipal drinking water supplies. Therefore, there currently is no use of shallow groundwater in the area of the Site and none is any expected to occur in the future. In addition, as discussed above, groundwater monitoring to date has shown only isolated occurrences of chemical and radiological constituents at levels slightly above MCLs.

Table 2-1 presents a summary of the results of the risk assessment evaluations. Based upon an assessment of the carcinogenic potential and systemic toxic effects associated with each of the CoPCs, combined with the exposure assessment scenarios, potential risks were calculated for each potential receptor. These calculations indicated that the potential exposure to external radiation for the hypothetical groundskeeper that currently could work adjacent to Areas 1 and 2 resulted in a carcinogenic risk of 1 x 10^{-5} for Area 1 and 4 x 10^{-5} for Area 2. These calculated risks were within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. No adverse systemic (non-carcinogenic) effects to the groundskeeper were identified. The potential risks to a hypothetical groundskeeper working on the Buffer Zone/Crossroad properties adjacent to Area 2 resulted in a carcinogenic risk of 6 x 10^{-7}, which is also within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}.

The potential risks to the future onsite groundskeeper working in Areas 1 and 2 were calculated at 6 x 10^{-5} for Area 1 and 2 x 10^{-4} for Area 2. The calculated risk for a future onsite groundskeeper working in Area 2 is at the upper end of or slightly exceeds the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. As with the current exposure scenario, the calculated risk for a possible future exposure for a hypothetical offsite groundskeeper receptor (2 x 10^{-6}) was within EPA's accepted risk range.

Possible future uses of Areas 1 and 2 for parking lots, open storage, or employee recreation that may be ancillary to potential future commercial or industrial uses of portions of the landfill adjacent to Areas 1 and 2 were also addressed. The potential risks to a future user of a building that may be constructed adjacent to Area 1 or 2 (land use covenants prevent construction of a building on Area 1 or 2) were calculated at 1 x 10^{-5} for Area 1 and 4 x 10^{-5} for Area 2, both of which are within the accepted risk range of 10^{-4} to 10^{-6} used by EPA. The potential risks to future worker that may be involved in outdoor storage uses on Area 1 or 2 were calculated to be 1 x 10^{-4} for Area 1 and 4 x 10^{-4} for Area 2. The calculated risk for a future worker involved in outdoor storage in Area 2 is at the upper end of or slightly exceeds the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}.

Non-radiological CoPCs are not projected to cause unacceptable risks under either the current or future exposure scenarios. Uncertainties associated with the human health risk assessment were addressed through the use of conservative assumptions likely resulting in an overestimate of the actual risks that may occur.

Although the calculated potential risk levels, for the most part, are within the accepted risk range of 10^{-4} to 10^{-6} used by EPA, the calculated risks for some of the potential future exposure scenarios are at the upper end of, or slightly exceed the generally acceptable risk range used by EPA. In addition, uncertainties exist regarding the possible exposure frequency and duration associated with potential future workers at the Site. Therefore, the BRA did not necessarily evaluate the reasonable maximum exposure.

Consistent with the current and reasonably expected future uses of the property, industrial, commercial and recreational future uses were considered in the BRA. The calculated estimates of the potential risk were also based on exposure scenarios that were limited in part by existing restrictions on current and potential future land uses (institutional controls) at the Site. The evaluations of potential current and future risk were based on the assumption that the existing land use restrictions remain in place as these restrictions cannot be revoked or modified without the consent of EPA and MDNR. Consequently, the risk assessment reflects a No Further Action scenario rather than a No Action scenario. Unrestricted use of the Site, including possible future residential use, was not evaluated as part of the BRA due to the likely industrial and landfill uses of the Site, the presence of land use covenants limiting future use, and requirements associated with post-closure regulations for solid waste landfills. Consequently, the BRA did not evaluate all possible exposure scenarios but rather included reasonably anticipated future uses.

As the surface of Areas 1 and 2 is not currently covered by a landfill cover meeting the requirements of the MDNR solid waste regulations, infiltration into and erosion of these areas poses an overall potential risk to human health and the environment. Based on the BRA evaluations, the presence of radionuclides in OU-1 poses risks to potential future onsite workers that are at the upper end of or slightly exceeds the generally acceptable risk range used by EPA. In addition, the potential that the exposure duration and frequency for future onsite workers could be greater than those evaluated as part of the BRA suggests that risks to potential onsite workers could be greater than those calculated by the BRA. In addition, all possible future uses and exposures scenarios were not evaluated as part of the BRA. The presence of radionuclides and non-radiological contaminants in OU-1 poses an unacceptable risk to public health if institutional controls and the physical integrity of the disposal areas are not maintained or if future uses change.

2.4.2 Ecological Risk Assessment

The BRA included a screening level ecological risk assessment (ERA). There is a significant amount of uncertainty associated with the actual potential for ecological impacts. A screening level risk assessment deals with the uncertainty by using highly conservative assumptions when estimating potential risks, thus intentionally overestimating the potential risk significantly, sometimes by several orders of magnitude. Thus, while the screening level ERA indicates that a potential ecological risk may exist, the ERA also cautions that this does not mean that site-related chemicals are impacting ecological receptors.

After assessing the uncertainties, the ERA points out that Areas 1 and 2 currently support vegetative and animal communities with no observable impact to the plant communities. Vegetation in Areas 1 and 2 consists primarily of old field community (primarily grasses and herbaceous species with woody species present along the landfill berm in Area 2) interspersed with small areas of hydrophilic (herbaceous) vegetation within small depressions. Indications of the presence of deer, rabbits, coyotes and/or red foxes as well as various bird species were observed during the RI investigations. The ERA notes that the existing plant and animal communities are located within areas of landfill operations, and concludes that the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place.

The screening level risk assessment concluded that ecological receptors may be at risk from exposure to chemical contaminants, especially metals, in Areas 1 and 2. Small burrowing animals may be at risk from exposure to radioactive materials in Area 2. Metals present in soils may adversely affect plants and soil invertebrates. However, both Areas 1 and 2 currently support vegetative and animal communities and there is no observable impact to the health of the plant communities.

3 POTENTIAL ARARS AND REMEDIAL ACTION OBJECTIVES

This section of the FS describes potential ARARs associated with other environmental laws. This section also presents proposed RAOs for OU-1.

3.1 Potential Applicable or Relevant and Appropriate Requirements

CERCLA remedial actions must be analyzed for compliance with ARARs. This subsection identifies potential ARARs for the West Lake Landfill OU-1. Compliance with ARARs is one of the criteria used to evaluate potential remedial alternatives during the FS. The identification and evaluation of potential ARARs presented in this FS is intended to provide a basis for the development and detailed analysis of alternatives.

A requirement established under other environmental laws may be either "applicable" or "relevant and appropriate" to a remedial action, but not both. When determining the ARARs for a remedial action, a two-tier test may be applied. First, a determination of whether the regulation is applicable is made. Second, if the regulation is not applicable, then a determination of whether the regulation is nevertheless relevant and appropriate is made.

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site. Relevant requirements are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that do not directly and fully address site conditions but involve similar situations or problems to those encountered at a CERCLA site. Whether a requirement is appropriate (in addition to being relevant) varies depending on factors such as the duration of the response action, the form or concentration of the chemicals present, the nature of the release, the availability of other standards that more directly match the circumstances at the site, and other factors. Only the substantive portions of a regulation are considered potential ARARs. Administrative or procedural requirements such as permitting or record-keeping requirements are not potential ARARs.

In accordance with the NCP, only those requirements that are both relevant and appropriate are considered as ARARs for evaluation of remedial alternatives (40 CFR 300.430(e)(9)(iii)(B)).

The NCP [40 CFR § 300.400(g)(2)] requires the following comparisons shall be made, where pertinent, to determine relevance and appropriateness:

(i) The purpose of the requirement and the purpose of the CERCLA action;
(ii) The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
(iii) The substances regulated by the requirement and the substances found at the CERCLA site;
(iv) The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site;
(v) Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;
(vi) The type of place regulated and the type of place affected by the release or CERCLA action;
(vii) The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action;
(viii) Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site.

In the absence of promulgated laws and regulations, non-promulgated guidance or advisories can be considered when determining the level of cleanup to be achieved at a site. Such non-promulgated guidance or advisories are called "To Be Considered" (TBC) criteria. TBC criteria are advisories or guidance issued by the State or Federal government that are not legally binding requirements. Therefore, TBCs do not have the same status as potential ARARs, but TBCs are evaluated and considered for utilization where no ARARs exist. Examples of TBCs include peer reviewed health effects information, guidance documents, or policy documents. Although TBCs are not required to be achieved by law in the same manner as ARARs, compliance with TBCs may be required if necessary for the protection of human health or the environment. The determination of applicability, relevance and appropriateness, and compliance with TBCs is made on a case-by-case basis.

Clean-up actions must comply with the ARARs selected for a site unless a waiver is granted in the ROD based upon the statutory requirements of CERCLA Section 121(d)(4). Waiver requirements are summarized below:

- Interim remedy – Compliance with an ARAR can be waived if the remedial action is only a part of a total remedial action that will attain the ARAR when completed.

- Greater risk – Compliance with an ARAR can be waived if compliance with the ARAR would result in greater risk to human health and the environment than the alternative selected.

- Technical impracticability – Compliance with an ARAR can be waived if it is technically impracticable from the perspective of engineering design.

- Equivalent standard – Compliance with an ARAR can be waived if the remedy selected will attain an equal standard of performance through use of another approach.

- Inconsistent application of State requirements – Compliance with an ARAR can be waived if the State has not consistently applied the requirement (or demonstrated an intention to apply consistently) in similar circumstances at other remedial actions.

- Fund balancing – This waiver is for Superfund financed actions only. Compliance with an ARAR can be waived in order to provide a balance between the need for protection at the site, and the availability of fund monies to respond to other sites.

ARARs are divided into three categories:

- Chemical-specific ARARs;

- Location-specific ARARs; and

- Action-specific ARARs.

3.1.1 Potential Chemical-Specific ARARs

Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. These requirements are generally health- or risk-based contaminant concentration limits or discharge limitations for specific environmental media. If a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements should generally be applied. State standards for protection against ionizing radiation are an example of potential chemical-specific ARARs. Evaluations of potential chemical-specific ARARs for West Lake Landfill OU-1 are presented on Table 3-1 and are discussed further below.

3.1.1.1 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

The Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subpart B) relative to standards for cleanup of land and buildings contaminated with residual radioactive materials from an inactive uranium processing site were evaluated as potential chemical-specific ARARs. These standards are not applicable as the West Lake Landfill is not a designated UMTRCA uranium processing facility. The requirements in 40 C.F.R. Part 192 apply only to active and designated inactive uranium mill tailings sites and the West Lake Landfill is not (and never was) an active or designated inactive uranium mill processing site. The UMTRCA standards were developed for a different type of waste at different types of facilities than the low activity radioactive materials found in Areas 1 and 2. Although not applicable, the presence of radionuclides in OU-1 similar to those addressed by the UMTRA regulations suggests that portions of these regulations may be relevant and appropriate to potential remedial actions for OU-1.

The radiologically impacted material in Areas 1 and 2 represents only a very small portion of the total waste materials in these areas. Furthermore, the radiologically impacted materials are present within an overall matrix of municipal refuse, construction and demolition debris, and unimpacted soil. In addition, the uranium mill tailings standards are based on an unrestricted (i.e., potential residential) use of areas containing radium and/or thorium, not for solid waste disposal facilities such as the West Lake Landfill that have restricted use and have been and will continue to be used solely for commercial/industrial activities. Therefore, the waste materials in Areas 1 and 2 are not similar to uranium mill tailings or the situations addressed by the uranium mill tailings standards.

Certain aspects of these regulations may be potentially relevant and appropriate chemical-specific criteria for remedial action for OU-1. For example, the portion of these regulations addressing clean up levels for offsite impacted soil may be potentially relevant and appropriate criteria for remedial action, if any, involving excavation of radiologically impacted soil on the Buffer Zone/Crossroad properties. The portions of these regulations that establish standards of performance (radon emissions standards) for cover systems to be installed over radiologically impacted materials may potentially be relevant and appropriate chemical-specific criteria for the design of a cover system for Areas 1 and 2. Although not chemical-specific criteria, the portion of these regulations that established engineering design and performance standards for cover systems may potentially be relevant and appropriate action-specific criteria for remedial actions involving installation of an upgraded cover system over OU-1. Evaluation of the relevance and appropriateness of the chemical-specific requirements of the UMTRCA regulations to remedial action for OU-1 are discussed below. Evaluation of the relevance and appropriateness of the potential action-specific requirements of these regulations is presented in Section 3.1.3.1.

Three chemical-specific standards of 40 C.F.R. Part 192 may be potentially relevant and appropriate to potential remedial actions for OU-1. First, the UMTRCA standards state that control of residual radioactive materials and their listed constituents shall be designed to provide reasonable assurance that release of radon-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2s [40 C.F.R. § 192.02 (b)(1)]. For inactive sites, this standard can be satisfied alternatively by providing reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half picocuries per liter [40 C.F.R. § 192.02(b)(2)]. EPA also emphasized that averaging over the enormous piles was critical to the standard. It therefore explicitly stated that the average applies over the entire surface of the disposal site and over at least a one year period, which cannot exceed 100 years [40 C.F.R. §§ 192.02(b)(1) n.2, 192.32(b)(1)(ii) n.2]. According to EPA, it is the net radon from the entire pile that is of significance to health (48 Fed. Reg. at 45938). Therefore:

> daily and seasonal variations in radon emission are to be averaged over, since these are also not of significance to public health . . . this averaging may extend over longer periods to accommodate normal fluctuations in soil moisture content due to short-term climatic variations. Thus, the lowest recorded values of soil moisture content should not be used; rather, the average values are appropriate. Such averages should not, however, extend to times as long as the normal human life span, since that could result in a significant alteration in the level of protection of public health. Similarly, averaging performance over the entire period of longevity of the cover is not within the meaning of the standard.

EPA explicitly stated that events and processes that could significantly affect the <u>average</u> radon release rate from the entire disposal site should be considered [40 C.F.R. § 192.20(a)(1)]. Phenomena that are localized or temporary, such as local cracking or burrowing of rodents, need to be taken into account only if their cumulative effect would be significant in determining compliance with the standard [40 C.F.R. § 192.20(a)(1)].

The only monitoring requirement in these regulations applies during processing operations and prior to the end of the closure period. It does not apply to inactive sites. The licensee has to conduct monitoring using procedures described in 40 C.F.R. part 61, Appendix B, Method 115, or other methods at least as effective in demonstrating effectiveness of a permanent radon barrier in achieving compliance with the 20 pCi/m^2s flux standard [40 C.F.R. § 192.32(a)(4)(i)]. EPA does not intend continuous emissions monitoring (58 Fed. Reg. 60348). Rather, a single monitoring event may suffice to verify the design (*Id*). This monitoring requirement is not relevant and appropriate because Areas 1 and 2 are not large enough and because West Lake Landfill does not have the processing operations subject to the monitoring requirement. Radon monitoring was previously performed as part of the RI for OU-1. These results indicated that the overall radon emission from Areas 1 and 2 (21.8 pCi/m^2s based on the average of 50 test locations) slightly exceeded the 20 pCi/m^2s radon emission flux standard owing solely to the presence of three high values. The presence of radon at levels similar to the UMTRCA radon standard indicates that this standard may potentially be relevant and appropriate for OU-1. Remedial actions involving placement of additional cover material pursuant to EPA's presumptive remedy guidance (EPA, 1993b, see also Section 4.4.3 of this FS report) should meet the radon emission standard promulgated under UMTRCA.

Secondly, the concentration limits established under the groundwater protection standard of the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subparts A and B) present potentially relevant and appropriate standards for groundwater quality at the Site. The uranium concentrations observed in groundwater during the RI did not exceed or even come close to the standard of 30 pCi/l established by these regulations. With the exception of the total radium concentration in wells D-3 and D-6 (see previous discussion in section 2.3.3 of this FS), which slightly exceeded the standard of 5 pCi/l established by these regulations, the radium concentrations observed during the RI were also less than the standard established by these regulations. With the exception of arsenic levels in two wells, MW-F3 and S-84, dissolved concentrations of trace metals did not exceed the standards established by these regulations. There were some instances where the total (unfiltered) samples did exceed these standards; however, with the exception of the arsenic levels in the two wells identified above, analyses of the dissolved (filtered) fraction of these samples did not exceed the standards for any of the trace metals. Based on the presence of radioactive materials in OU-1 and the potential for leaching to groundwater, the groundwater protection standards (40 CFR 192.02(c)(3) and (4)) and monitoring requirements (40 CFR 192.03) of the UMTRCA regulations are potentially relevant and appropriate.

Third, the Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192 Subpart B) may potentially be relevant and appropriate requirements for the radiologically impacted soil that may be present on the Buffer Zone/Crossroad property. These regulations include standards for cleanup of land and buildings contaminated with residual radioactive materials from inactive uranium mills. As the West Lake Landfill is not and has never been an inactive uranium mill, these requirements are not applicable; however, as these regulations address the cleanup of soil contaminated with radium, they may be relevant and appropriate to any remedial actions that may be taken relative to the radiologically impacted soil on the Buffer Zone/Crossroad property. The surface (upper 15 cm) soil cleanup standard for radium-226 (no more than 5 pCi/g above background) and, in some cases, the subsurface standard (no more than 15 pCi/g above background) in 40 CFR 192 generally will be ARARs if excavation of soils contaminated with radium and thorium on the Buffer Zone/Crossroad properties is a component of the remediation alternative being considered. The standards in 10 CFR Part 40 Appendix A, I, Criterion 6(6) may also be considered relevant and appropriate to soil excavation from the Buffer Zone/Crossroad properties. In addition, EPA's guidance on the use of these soil standards for CERCLA cleanups are "to be considered" during evaluation and implementation of any soil remediation activities that may be performed based on a determination that the UMTRCA requirements are relevant and appropriate. Specifically, EPA's "Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites" (OSWER Directive 9200.4-25, February 12, 1998) [USEPA, 1998a] and "Remediation Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criteria in 10 CFR Part 40 Appendix A, I, Criterion 6(6)" (OSWER Directive 9200.4-35P, April 11, 2000) [USEPA, 2000a] should be considered during the design and implementation of any soil removal activities that may be performed in offsite areas adjacent to Areas 1 or 2.

3.1.1.2 National Emissions Standards for Hazardous Air Pollutants

The National Emissions Standards for Hazardous Air Pollutants (NESHAPs) include standards for radon-222 emissions to ambient air from designated uranium mill tailings piles that are no longer operational. Specifically, radon-222 emissions from inactive uranium mill tailings piles should not exceed 20 pCi/m^2s (40 CFR 61 Subpart T). As West Lake Landfill OU-1 is not a designated uranium mill tailings site, this requirement is not applicable. As a portion of the waste materials in West Lake Landfill OU-1 do emit radon, the radon-222 NESHAP is considered to be potentially relevant and appropriate. As discussed above and as summarized in Section 2.3.1 of this report and in more detail in the RI (EMSI, 2000), radon emissions from OU-1 slightly exceeded (21.8 pCi/m^2s based on the average of 50 test locations) the NESHAP standard of 20 pCi/m^2s.

3.1.1.3 Missouri Radiation Regulations for Protection Against Ionizing Radiation

The Missouri Radiation Regulations for Protection Against Ionizing Radiation (19 CSR 20-10.040) contain chemical-specific standards that under certain circumstances may be applicable or relevant and appropriate requirements for OU-1. The maximum permissible exposure limits standards for ionizing radiation are applicable to machines and materials that are sources of ionizing radiation and are not applicable to waste materials such as those found in OU-1. These regulations establish a maximum permissible dose for ionizing radiation of 5 mrem per year or 3 mrem per quarter to the entire body. As these regulations do provide standards for protection from radiation, they are potentially relevant and appropriate to the waste materials in OU-1.

Specifically, those portions of these regulations that address protection from radiation for persons inside of a controlled area may be relevant and appropriate to the protection of workers inside of Areas 1 and 2 during any remedial actions that may be undertaken. Similarly, those portions of these regulations that address protection from radiation for persons outside of a controlled area may be relevant and appropriate to the protection of other workers at the Site outside of Areas 1 and 2 and the general public during any remedial actions that may be undertaken.

These regulations also define maximum permissible exposure limits for occurrences of specific radionuclides in air at levels above background outside of controlled areas. These requirements are considered to be potentially applicable for protection of the public during implementation of any remedial action that may be undertaken. Specifically, these regulations would require perimeter air monitoring during implementation of any remedial action that may be undertaken at OU-1.

3.1.1.4 Missouri Maximum Contaminant Levels

EPA has established Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) pursuant to the Safe Drinking Water Act (40 CFR Part 141, Subparts F and G). Implementation of the requirements of the Safe Drinking Water Act in Missouri has been delegated to the State of Missouri and is the subject of regulations promulgated by the Missouri Department of Natural Resources (MDNR).

These regulations (10 CSR Division 60 Chapter 4) establish MCLs for public drinking water systems. As the West Lake Landfill does not operate a public drinking water system, these regulations are not applicable to the remedial actions under consideration for OU-1. As groundwater beneath the West Lake Landfill is part of a larger alluvial aquifer which could potentially be used for drinking water by private and/or public wells, these regulations are potentially relevant for remedial actions for OU-1. As these regulations identify maximum contaminant levels that are allowed in drinking water and some of the chemical constituents that are the subject of these regulations have been detected in one or more groundwater monitoring wells located within or adjacent to Areas 1 and 2, these regulations are potentially appropriate for remedial actions for OU-1. Specifically, the MCLs provide numerical standards against which the groundwater monitoring results obtained as part of the remedial action can be evaluated to assess the overall protectiveness of the remedy and the effectiveness of the various remedy components.

3.1.2 Potential Location-Specific ARARs

Location-specific ARARs are those requirements that relate to the geographical or physical location of the site or remedial action rather than the nature of the contaminants or the actions being taken. These requirements may limit the type of remedial actions that can be implemented, and may impose additional constraints on the remedial action. Floodplain restrictions and the protection of endangered species are examples of potential location-specific ARARs. Evaluations of potential location-specific ARARs are presented on Table 3-2.

In general, the potential location-specific ARARs are not considered to represent significant issues relative to the evaluation of potential remedial alternatives or the selection or implementation of potential remedial actions at the Site. The only identified location-specific ARARs of any significance are those related to floodplain management and proximity to airport runways.

The Buffer Zone and Crossroad property are located within the historic floodplain of the Missouri River. These areas are currently protected by levees that have been constructed along the river. Areas 1 and 2, the Buffer Zone and the Crossroad property are located within the extent of the floodplain identified by the FEMA. Specifically, these areas are located within the extent of the 500 year floodplain, portions of the 100 year floodplain that are expected to flood to depths of less than one foot, or portions of the 100 year floodplain that are protected by levees (Figure 2-2). To the extent that any regrading or excavation of soil containing radionuclides are considered for these areas, mitigative measures may need to be taken to minimize any adverse impacts to the floodplain associated with such activities.

The RCRA Subtitle D regulations (40 CFR Part 258, Subpart B) contain requirements for new or existing municipal solid waste landfills or lateral expansions that are located within 10,000 ft of any airport runway end used by turbojet aircraft or 5,000 ft of any airport runway end used by only piston-type aircraft. The landfills or expansions must demonstrate that the units are designed and operated so that the MSWLF unit does not pose a bird hazard to aircraft. MDNR regulations for solid waste management include a similar provision for sanitary landfills (10 CSR 80-3.010 (4)(B)(1)). The MDNR regulations do not include a similar provision for construction and demolition landfills.

Portions of the West Lake Landfill, including a portion of Area 1, are located within 10,000 ft of the end of the runway under construction as part of the expansion of the Lambert - St. Louis International Airport (Figure 3-1). The West Lake Landfill includes an operating landfill; however, Areas 1 and 2 are located in inactive closed portions of the landfill and therefore these requirements are not applicable. As the intent of the regulations is to control bird hazards, these requirements may potentially be relevant to remedial activities that could result in exposure of previously placed refuse that could attract birds and therefore present a potential hazard to aircraft. As discussed in Section 4 of this FS, there are several possible methods for construction of a new landfill cover over Areas 1 and 2, most of which entail placement of additional soil materials over the existing surface of the landfill. These regulations would not be appropriate requirements for this type of activity; however, one option to change the surface grades of Areas 1 and/or 2 entails cutting and filling of previously placed waste materials to achieve the necessary grades. The requirements of the RCRA Subtitle D regulations and MDNR regulations related to prevention of bird hazards may potentially be relevant and appropriate to alternatives that include regrading of existing waste materials if such materials present a potential to attract birds. Specifically, these requirements may potentially be relevant and appropriate if previously placed sanitary (putrescible) wastes are regraded but not if regrading is limited to construction and demolition debris.

3.1.3 Potential Action-Specific ARARs

Action-specific ARARs are technology-based requirements that define handling, treatment, disposal, and other procedures triggered by the type of remedial action under consideration. These requirements generally set performance or design standards for specific activities related to the management of wastes. These requirements are not triggered entirely by the specific chemicals at a site, but rather by the remedial activity selected to accomplish a remedy. For example, State regulations related to storage of radioactive materials are an example of potential action-specific ARARs that may be required to be met for a remedy involving temporary storage of radioactive materials. Evaluations of potential action-specific ARARs are presented on Table 3-3. Three of the more significant potential action-specific ARARs (UMTRCA Standards, RCRA Subtitle C standards and RCRA Subtitle D standards) are discussed further below.

3.1.3.1 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

Part 192 of Title 40 of the Code of Federal Regulations provides for Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings. Subpart A of these regulations contains Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites.

Portions of these regulations that provide for closure performance standards may potentially be relevant and appropriate to remedial actions for OU-1. Specifically, to address longevity considerations, 40 CFR 192.02(d) requires that each disposal site "shall be designed and stabilized in a manner that minimizes the need for future maintenance." In developing this requirement, EPA was concerned with long-term hazards relating to misuse by man or disruption by natural phenomena. While large volumes of uniform sand-like tailings piled on the ground or in impoundments may be of concern due to misuse by man (for example, use of tailings as construction or fill material) or disruption by natural phenomena, Areas 1 and 2 containing low activity radioactive materials in the subsurface mixed with garbage, construction and demolition debris, and other wastes do not present a concern of misuse by man. For UMTRCA tailings piles, the longevity consideration is typically addressed through placement of a rock armoring layer over the upper surface of the tailings pile capping system. Placement of a rock armoring layer over the top of a solid waste landfill cover system is inconsistent with the landfill cover design criteria contained in Subtitle D. Solid waste closure requirements are generally more appropriate than the UMTRCA requirements for the conditions associated with OU-1. To address longevity considerations for OU-1 and long-term hazards relating to disruption of the disposal site by natural phenomena, the development of remedial alternatives will include an alternative(s) that incorporates a concrete debris layer to restrict bio-intrusion and erosion into the underlying landfilled materials to increase the longevity of the landfill cover.

3.1.3.2 RCRA Subtitle C

The Resource Conservation and Recovery Act ("RCRA") Subtitle C regulations provide performance standards for the treatment, storage and disposal of RCRA-hazardous wastes. (42 U.S.C. Section 6921(a); 40 C.F.R. Part 264, *et. seq.*) A waste is considered to be hazardous if it is a solid waste that either exhibits the characteristics of hazardous waste (i.e. toxic, reactive, ignitable or corrosive) or it is a waste listed by EPA as being hazardous. (40 C.F.R. Section 261.3.) As the portions of the West Lake Landfill containing OU-1 were closed prior to the November 1980 effective date of RCRA Subtitle C, these requirements are not applicable.

EPA comments to the Draft Feasibility Study for OU-1 requested a site specific analysis of potential relevant and appropriate construction, maintenance and monitoring requirements applicable to final cover under the RCRA Subtitle C landfill closure regulations. While the RCRA Subtitle C landfill closure regulations appear to have potential relevance in that they contain requirements for capping undisturbed contaminated soil in place, none of the regulations are well-suited to OU-1 and as such should not be considered ARARs for OU-1.

The RCRA Subtitle C landfill closure regulations of 40 C.F.R. Part 264 provide as follows:

> Section 264.310 Closure and post-closure care.
>
> (a) At final closure of the landfill or upon closure of any cell, the owner or operator must cover the landfill or cell with a final cover designed and constructed to:
>
> (1) Provide long-term minimization of migration of liquids through the closed landfill;
> (2) Function with minimum maintenance;
> (3) Promote drainage and minimize erosion or abrasion of the cover;
> (4) Accommodate settling and subsidence so that the cover's integrity is maintained; and
> (5) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. (40 C.F.R. 264.310(a).)[1]

The RCRA Subtitle C landfill closure regulations are designed to: a) control and mitigate significant risk to human health and the environment presented by hazardous wastes; b) control hazardous waste leachate migration, post-closure and off-site releases by requiring a liner, cover and leachate monitoring system; and c) close active landfills which have not yet settled or had major subsidence. These regulations are intended to apply to operational hazardous waste landfills and require the owner/operator to pre-select closure methods via an approved closure plan, which addresses the risks germane to hazardous wastes. In fact, Congress' primary goal in adopting RCRA was

[1] EPA authored a technical guidance document to implement the final cover requirements of 40 C.F.R. Part 264. *(EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments*, July 1989, EPA 530-SW-89-047 hereinafter, "Final Cover Guidance".) This guidance document calls for a stringent final cover design of at least three final cover layers: a) 60 cm of soil as a top layer, either vegetated or armored at the surface, b) granular or geosynthetic drainage layer with a hydraulic transmissivity of no less than 3×10^{-5} cm^2/sec., and c) a two-component low permeability layer comprised of one flexible membrane liner installed directly on a compacted soil component with an hydraulic conductivity no greater than 1×10^{-7} cm/sec.

"prospective" rather than directed at already-disposed waste within a land disposal unit (51 Fed Reg. 40577 (November 7, 1986).)[2]

EPA has indicated that it may be unnecessary to require compliance with the RCRA Subtitle C final cover requirements at a CERCLA site. EPA has specifically stated that "if the waste is generally of low toxicity and the contamination is dispersed over a large area that bears little resemblance to the discrete units regulated under RCRA Subtitle C", use of RCRA closure and Subtitle C covers may not be appropriate (53 Fed. Reg. 51447 [December 21, 1988]; see also 55 Fed. Reg. 8760 [March 8, 1990]).

In comparison, the constituents, landfill conditions, project scope, landfill size and historical background under consideration for OU-1 substantially differ from the RCRA Subtitle C closure goals for an active, hazardous waste landfill. (40 C.F.R. Section 300.400(g)(2).) These differences are analyzed below:

1. The BRA indicated risks for hypothetical exposures at the upper end or slightly exceeding the acceptable risk range.

The primary concerns addressed by the RCRA Subtitle C landfill closure regulations are the risks posed by handling and managing hazardous wastes. By definition a hazardous waste is,

> a solid waste or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may -
>
> (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or
>
> (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. (42 U.S.C. Section 6903(5).)

As such, the RCRA Subtitle C landfill closure regulations seek to minimize the risks unique to hazardous wastes such as "fires, explosions, production of toxic fumes and similar problems resulting from the improper management of ignitable, reactive, and incompatible wastes." (45 Fed. Reg. 33210 (May 19, 1980).) To address these concerns, the owner/operator of a hazardous waste landfill must develop a closure plan during the landfill's active life setting forward precise plans as to how the wastes will be managed, treated, removed, stored and/or monitored at closure. (40 C.F.R. Section

[2]For example, Missouri regulation specifically provides that state regulations apply to the owner/operator of a "permitted" hazardous waste treatment, storage or disposal facility. (10 CSR 25-7.264)(2).)

264.112.) The closure plan is then incorporated into the permit as a permit condition. (40 C.F.R. Section 264.112 (a).)

However, in the case of an unregulated landfill being addressed under CERCLA, the proposed remedial actions are developed based on the NCP. Among the tools used in the NCP process, the responsible parties develop a BRA in accordance with EPA guidance for human health and ecological risk assessments and identify the risks presented by the contaminated materials discovered at the subject site. (40 C.F.R. Section 300.430(d)(4).)

In this case, the risk assessment for OU-1 assessed and quantified risk for current and future exposure conditions using probable, hypothetical receptor populations. The BRA evaluated radiocarcinogenic and chemocarcinogenic risk by media type for each receptor. The BRA also identified potential exposure routes at OU-1, including external radiation, inhalation of dust and gas, dermal contact and incidental ingestion of soil (Auxier & Associates, 2000).

At OU-1, the BRA indicated risks for the future hypothetical exposure at the upper end or slightly exceeding the acceptable risk range. On a constituent-comparison basis, the materials contained at OU-1 do not present the same level of risk inherent in managing hazardous wastes. It is therefore inappropriate to consider the RCRA Subtitle C landfill closure requirements as ARARs since they are significantly more stringent than necessary to address the risks present at OU-1.

2. The RI was not designed to provide definitive conclusions about potential for contaminants to leach to groundwater over time.

The other major concern which the RCRA Subtitle C landfill closure regulations are designed to address is the risk presented by leachate formation, leachate migration, post-closure escape of hazardous waste, hazardous constituents, leachate contaminated run-off, and decomposition of hazardous waste products to the ground or surface waters (See e.g., 40 C.F.R. 264.111.) The hazardous waste regulations and the Final Cover Guidance contain EPA's two-part RCRA liquids management strategy, e.g., a) minimize leachate generation by keeping liquids out of the unit; and b) detect, collect and remove leachate within the unit (EPA, 1989). The cornerstone of the strategy is keeping water out of the landfill and the final cover requirements are designed to be sufficiently stringent to altogether prevent the infiltration of liquid.

The presumptive remedy for municipal landfills assumes a Subtitle D landfill cap will be installed and maintained over landfill sites. For OU-1, the Subtitle D cap will be protective against the potential for leaching in light of the limited impact shown by groundwater monitoring to date.

3. OU-1 is a large, pre-regulation landfill and has likely experienced all major settling and subsidence.

The RCRA Final Cover Guidance for hazardous waste sites provides for specific sloping requirements, a venting system and if necessary, an interim closure period to allow for major settling to occur which may result from drums rupturing and causing subsidence, or biodegradation of organic matter. These provisions are designed to ensure the integrity and structure of the landfill closure system. These requirements are not relevant and appropriate for the same reasons articulated in the additional evaluation of the RCRA Subtitle D and Missouri Solid Waste requirements.

As applied to OU-1, the landfill is large (the total parcel is approximately 200 acres) and is over 50 years old. No drums were identified as part of the RI that could potentially rupture and cause subsidence. Due to the landfill's age, it is likely that all major settling and subsidence has already taken place.

3.1.3.3 RCRA Subtitle D

As discussed in Section 4 of this FS report, the West Lake Landfill is a municipal solid waste landfill that is being evaluated for potential remedial actions pursuant to EPA's "Presumptive Remedy for CERCLA Municipal Landfill Sites" guidance (EPA, 1993b). As the primary focus of the presumptive remedy approach for solid waste landfills is source containment, the RCRA Subtitle D requirements (or MDNR equivalent requirements) represent the primary standards for design and implementation of the containment remedy. Specifically, the landfill cover design, gas control measures, maintenance, groundwater monitoring, and corrective action criteria of these regulations are potentially relevant and appropriate.

Pursuant to Subtitle D of the Resource Conservation and Recovery Act (RCRA), EPA promulgated minimum criteria, including capping requirements, upon closure of a landfill that apply to new landfills. The EPA's rule only applies to new facilities or expansions, it does not apply to existing units [56 Fed. Reg. 50978-51007 (Oct. 9, 1991)]. Therefore, the Subtitle D requirements are not applicable to OU-1 but as they address waste materials and situations similar to those found in OU-1, the requirements of these regulations may in part be relevant and appropriate for remedial actions for OU-1 as discussed further below.

Under RCRA Subtitle D, a state may promulgate more stringent regulations for landfills in that state, provided that the EPA approves of the state's regulations. Missouri is an approved state for providing regulations for landfills. Missouri promulgated its regulations in 1997 [22 Mo Reg 1008, (June 2, 1997)] and they became effective July 1, 1997. The Missouri landfill requirements establish closure requirements for existing sanitary landfills that close after October 9, 1991. In response to a comment made at the time Missouri proposed its closure requirements, MDNR stated that "[m]any of the changes in this amendment are not applicable to existing facilities that have existing permits and have already been constructed. It is not the intent of the department to impose the requirements of the revised rule on existing facilities in an unreasonable manner." [22 Mo. Reg. 1008, 1008 (June 2, 1997) (Order of Rulemaking)]. The portion of the West Lake Landfill that includes OU-1 closed circa 1974. Therefore, the Missouri closure requirements are not applicable requirements for remedial action under CERCLA since they only apply to closure and post-closure plans for active landfills at the time the regulation was promulgated.

Although the RCRA Subtitle D requirements and the Missouri landfill closure requirements are not applicable to remedial action of OU-1, the NCP requires that an evaluation be made as to whether such requirements are, nevertheless relevant and appropriate. "For action-specific requirements, generally the test for relevance is whether the action contemplated at the CERCLA site is similar." [53 Fed. Reg. 51394-51436 (Dec. 21, 1988)].

The closure requirements of the Missouri landfill regulations specify final slope grades and cover requirements to minimize infiltration and erosion. Therefore, these requirements are considered to be potentially relevant and appropriate for remedial actions for OU-1.

The MDNR regulations require cover to be applied to minimize fire hazards, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance [10 CSR 80-3.010(17)(A)]. The MDNR regulations require that as each phase of a sanitary landfill is completed, a final cover system shall be installed at portions of existing sanitary landfills without composite liners. This final cover shall consist of at least two feet (2') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less overlaid by at least one foot (1') of soil capable of sustaining vegetative growth [10 CSR 80-3.010(17)(C)(4)]. Placement of soil cover addresses the requirements for minimization of fire hazards, odors, blowing litter, control of gas venting and scavenging. Placement of clay meeting the permeability requirement addresses the requirement for minimization of infiltration of precipitation. Placement of soil and establishment of a vegetative cover meets the requirement of providing for a pleasing appearance.

The MDNR landfill regulations also contain minimum and maximum slope requirements. Specifically, these regulations require the final slope of the top of the sanitary landfill shall have a minimum slope of five percent (5%) [10 CSR 80-3.010(17)(B)(7)]. MDNR regulations also require that the maximum slopes be less than 25% unless it has been demonstrated in a detailed slope stability analysis that the slopes can be constructed and maintained throughout the entire operational life and post-closure period of the landfill. Even with such a demonstration, no active, intermediate or final slope shall exceed $33^1/_3$%. The purpose of this requirement is to prevent slope stability or erosional failure of the landfill side slopes.

Portions of Area 1 and much of Area 2 contain slope angles of less than 5% and in some portions of Area 1 and much of Area 2 less than 2%. Portions of the landfill berm located along the northern boundary of Area 1 and the western boundary of Area 2 contain slopes greater than 25%. Portions of the landfill berm on the west side of Area 2 also exceed $33^1/_3$%. In the early 1970's, a slope failure consisting of erosion and washout occurred in the central portion of the landfill berm on the west side of Area 2. This slope failure resulted in erosion, transport and deposition of radioactively impacted soil from Area 2 onto the adjacent Buffer Zone property.

As disposal activities in the OU-1 portions of the West Lake Landfill were completed over 25 years ago, future differential settlement of the surface of the landfill would appear not to be a concern based on the results of the evaluations described in the referenced article. However, as the MDNR regulations address slope angles of cover systems over solid waste landfills necessary for minimization of infiltration and erosion and OU-1 is part of a solid waste landfill, these requirements may potentially be appropriate for design of a new landfill cover for OU-1.

Correction of past erosional failure of a portion of the landfill side slopes is included in the scope of the potential CERCLA remedial action. Remedial alternatives have been developed to include regrading to increase the slope of the surface of OU-1 to 2% or 5% and to reduce the steeper portions of the existing landfill surface in OU-1 to 25% or less where possible. Remedial action alternatives that include a concrete rubble layer which would provide additional erosion protection, protection against biointrusion, as well as providing a marker layer for future identification of the Site as a disposal facility, have also been developed and evaluated in the FS.

The MDNR regulations are intended to regulate active landfill operations. The radionuclide occurrences in OU-1 of the West Lake Landfill are present in portions of the landfill that were closed circa 1974. As the MDNR regulations address active landfills and not retrofitting of closed landfills, it is reasonable to conclude that these regulations anticipate achieving the 5% slope requirement using refuse that is placed during operation of the landfill and not placement of significant thicknesses (5 to 10 ft or more) of soil across an entire landfill area after conclusion of the active landfill operations. Therefore, these requirements are not relevant to remedial action for OU-1. As the MDNR regulations address slope angles of cover systems over solid waste landfills necessary for minimization of infiltration and erosion and OU-1 is part of a solid waste landfill, these requirements are potentially appropriate for OU-1.

The MDNR requirements for cover design and minimum slope angle are potentially relevant and appropriate for construction of a new landfill cover. These regulations would address issues associated with potential pathways of concern to OU-1 (erosional transport, infiltration and leaching to groundwater) and therefore are related to the purpose of the potential CERCLA remedial actions and address media and substances similar to those addressed by the potential CERCLA actions. Although the purpose of these requirements was not intended to address radioactive emissions (e.g., gamma radiation) associated with OU-1, installation of an upgraded landfill cover would provide protection from radioactive emissions from OU-1.

The MDNR regulations are intended to address the design, operation and closure of active or new sanitary or construction demolition landfills and were not intended as standards for retrofitting previously closed landfills. However, the cover design, minimum slope angle requirements, and the maximum slope angle requirements of the MDNR regulations are intended to prevent slope stability or erosional failure of landfill slopes. The potential CERCLA remedial actions are intended in part to correct a previous erosional failure of a portion of the landfill slope and to limit infiltration and subsequent leaching of contaminants. Consequently, the minimum and maximum slope angle and cover design requirements under the MDNR regulations may be potentially relevant to the potential CERCLA actions. As the purpose of a landfill cover is to prevent infiltration and erosion, the cover design criteria are also potentially appropriate.

The MDNR landfill regulations refer to a minimum slope of five percent (5%) [10 CSR 80-3.010(17)(B)(7)]. During conversations between Mr. Evan Randall of Spencer Fane Britt & Browne, LLP and Mr. Frank Dolan of MDNR, Mr. Dolan indicated that the purpose of the minimum slope of 5% is to address potential settlement of a landfill over time and the creation of depressions in the landfill surface that would collect precipitation runoff and become areas of increased infiltration of precipitation. Mr. Dolan further indicated that MDNR previously required a 2% slope on the surface but based on "common observations" of settlement of closed landfills MDNR subsequently determined that this slope angle was not great enough to prevent ponding of water due to differential settlement. Mr. Dolan referenced an article by Dean K. Wall and Chris Zeiss in the Journal of Environmental Engineering (Vol. 121, No. 3, March 1995) as the only formal document that MDNR used to select the 5% slope. In this article, the authors state that the process of differential settlement will take place within a 20 to 30 year period after a landfill is closed. The article does not address what the slope angle should be on the final surface of the landfill after settling. Based on the fact that landfilling of the portions of the West Lake Landfill in which Areas 1 and 2 are located was completed approximately 30 years ago, differential settlement is not a concern because the majority of the differential settlement and compaction of the refuse has already occurred. Therefore, a 2% minimum slope should be sufficient to promote drainage and reduce infiltration of precipitation. As the 5% minimum final slope requirement was intended to be applied to active landfills and not retroactively applied to closed landfills, and given that the 2% slope is considered sufficient to promote drainage thereby reducing infiltration, the 5% final grade is not necessarily considered to be appropriate requirement. Furthermore, use of a 2% slope should result in a lower potential for erosion, increasing the life of the cover and overall longevity of the remedy compared to a 5% slope which would be subject to greater erosion potential.

3.1.3.4 MDNR CALM (DRAFT – September 1, 2001)

The MDNR draft Cleanup Action Levels for Missouri (September 1, 2001) (CALM) guidance document outlines a process for determining cleanup goals at Missouri sites with known or suspected hazardous substance contamination. The CALM process was developed for hazardous substance contamination which is to be remediated under Missouri's Voluntary Cleanup Program (VCP) laws and regulations (10 CSR 25-15.010), as administered by MDNR's Hazardous Waste Program. This guidance has not been finalized by MDNR and therefore cannot be considered an ARAR for West Lake Landfill OU-1. Further, because West Lake Landfill OU-1 is a Federal Superfund site and is not being addressed under Missouri's VCP program, the CALM guidance document should not be regarded as a TBC criteria.

The CALM guidelines' Appendix E provides a format for implementing proprietary use controls at contaminated sites. Although CALM is not a legally binding requirement because it is (and may remain) a draft state regulation and not an approved and promulgated state regulation, the CALM Appendix E may provide a useful format for implementing use restrictions at the West Lake Landfill site.

3.2 Remedial Action Objectives

As part of the development of the Presumptive Remedy approach to CERCLA Municipal Landfills, EPA identified typical RAOs for the presumptive remedy (EPA, 1993b). The RAOs identified by EPA for the municipal landfill presumptive remedy include the following:

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from the source area; and
- Controlling and treating landfill gas.

The RAOs identified by EPA in the presumptive remedy guidance (EPA, 1993b) address the potential migration pathways and exposures identified in Section 2.3 for OU-1. The first objective of preventing direct contact with landfill contents addresses direct exposure to contaminated soil or waste materials. This objective will also include prevention of exposure to gamma radiation. The second and third objectives identified in the presumptive remedy guidance are directly applicable to OU-1. As a plume of contaminated groundwater does not exist beneath or downgradient of OU-1, the fourth objective is not applicable to OU-1; however, as limited occurrences of radionuclides have been detected in shallow groundwater beneath OU-1, groundwater monitoring may be a required component of any remedy that may be selected for the OU-1. As landfill gas (methane or methane plus VOCs) plus radon have been identified as potential issue for OU-1, the fifth objective of controlling and treating landfill gas, including radon emissions from OU-1 is applicable to OU-1.

Based on application of the presumptive remedy guidance, the following RAOs have been identified for OU-1:

1. Prevent direct contact with landfill contents and exposure to radiation;

2. Minimize infiltration and any resulting contaminant leaching to groundwater;

3. Control surface water runoff and erosion and decrease the potential for erosion and subsequent transport of radiologically impacted materials; and

4. Control radon and landfill gas emissions.

4 TECHNOLOGY SCREENING AND ALTERNATIVES DEVELOPMENT

The beginning of this section of the FS describes the process used to screen technologies that are then used as components of potential OU-wide remedial alternatives. Potential OU-wide remedial alternatives are developed at the end of this section.

The process of identifying OU-wide remedial alternatives begins with identification of the potential scope of any remedial action. General response actions (GRAs) that may be applicable to the OU based on the results of the site characterization (Section 2) and the RAOs established in Section 3 are then identified. Potential remedial action technologies associated with each GRA that may be applicable to OU-1 and the RAOs are first identified and screened based on technical implementability. The resultant technologies are then evaluated based on anticipated effectiveness, implementability and relative cost to identify the most applicable technologies. These technologies are then combined to develop remedial action alternatives for OU-1 for the West Lake Landfill. In Section 5 of this FS, the remedial action alternatives are subjected to detailed analysis for the various factors required for evaluation in accordance with the NCP (EPA, 1990).

4.1 Technology Identification

Each GRA is identified in this section based on site conditions and the established RAOs. These GRAs are then used to identify potentially applicable technologies. The criteria for identifying potentially applicable technologies are provided in EPA guidance (EPA, 1988a) and in the NCP. A strong statutory preference for remedies that are reliable and provide long-term protection is identified in Section 121 of CERCLA, as amended. The primary requirements for a final remedy are that it be both protective of human health and the environment and cost effective. Hence, technology screening focuses on these two factors.

Media-specific GRAs are developed to address the RAOs established for a site or OU. Given the environmental setting and the nature and extent of contamination described in Section 2 and the RAOs and potential ARARs discussed in Section 3, a list of GRAs that may be applicable to OU-1 at the West Lake Landfill was assembled and is as follows:

- No action;
- Institutional controls;
- Monitoring;
- In-situ containment;

- Physical treatment/pretreatment in-situ;
- Chemical treatment/pretreatment in-situ;
- Removal (of soil from the buffer and Crossroad properties or of radiologically-impacted material within Areas 1 or 2);
- Physical treatment/pretreatment following Removal (subject to Removal being retained as a GRA);
- Chemical treatment/pretreatment following Removal (subject to Removal being retained as a GRA);
- Disposal (subject to Removal being retained as a GRA).

For each GRA, broad technology groups and specific process options that could be used to implement these actions are identified. Technologies refer to general types of actions (e.g., capping and covers). Process options refer to the specific processes within each technology type (e.g., soil cover). Information from the literature, including applicability, performance, removal efficiencies, operation and maintenance (O&M) requirements, implementability, and the relative cost of candidate technologies was considered in preparing the list of technologies and process options provided on Figure 4-1. USEPA's Presumptive Remedy for CERCLA Municipal Landfill Sites guidance (EPA, 1993b) was also used to identify technologies and process options. As discussed later in this section, No Action is included to provide a reference as a basis for comparison with the other alternatives that are developed.

4.2 Screening and Evaluation of Potentially Applicable Technologies

In this section, the universe of technologies and process options identified for each GRA is initially screened. The number of remaining technologies and process options is then further reduced through an evaluation process. Surviving technologies and process options are described at the end of this section.

4.2.1 Screening of Potentially Applicable Technologies

The universe of potentially applicable technology types and process options applicable to each GRA is initially reduced through screening based on technical implementability. The results from this initial screening based on technical implementability are also included on Figure 4-1. The following technologies and process options were eliminated because of various implementability issues discussed under the screening comments on Figure 4-1: advisories as institutional controls; all physical treatment/pretreatment in-situ (dewatering/drying, nonthermal extraction, and thermal destruction); all chemical treatment/pretreatment in-situ (soil flushing and stabilization/solidification [S/S]); all physical treatment/pretreatment following removal; and contact extraction and S/S under the GRA of chemical treatment/pretreatment following removal.

4.2.2 Evaluation of Potentially Applicable Technologies

Technologies and process options considered technically implementable are evaluated in detail based on effectiveness, implementability (both technical and administrative), and relative cost as defined by the following factors:

- Effectiveness - in terms of protecting human health and the environment in both the short term and the long term;

- Implementability - in terms of technical feasibility, resource availability, and administrative feasibility; and

- Cost - in a comparative manner (i.e., lower, moderate, or higher relative to other technologies within the same GRA) for technologies of similar performance and implementability.

Technologies and process options that are not effective in protecting human health and the environment, that cannot be implemented because of the physical characteristics of the site or materials of concern, or that have a cost that is an order of magnitude greater than a similar technology, are eliminated during this phase. In accordance with EPA guidance (EPA, 1988a), effectiveness is the major emphasis of this evaluation. Less weight is provided to implementability and cost. The results of the evaluation of potentially applicable technologies are shown on Figure 4-2.

4.3 Potentially Applicable Technologies

The technologies and process options that were retained after the effectiveness, implementability, and cost evaluation shown on Figure 4-2 were assembled into combined OU-wide alternatives identified in Section 4.4. These potential technology types and process options are described and discussed in the following subsections.

4.3.1 Institutional Controls

EPA defines institutional controls as non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. Human exposure to radiologically-impacted materials in OU-1 could potentially occur from direct exposure to the landfilled materials, exposure to impacted media or exposure to radiation from the radiologically-impacted materials. Activities that could potentially affect the integrity of any remedy implemented at the Site could include drilling, excavation or other surface disturbances or subsurface intrusions that could degrade the integrity of the existing or upgraded landfill cover or changes in surface water runoff patterns, intensity, flow or drainage system that could result in erosion of the existing or upgraded landfill cover.

Institutional controls will also provide the mechanism for insuring access to the landfill and as needed adjacent properties for purposes of performing operations, monitoring and maintenance activities for the remedy. Such controls will also provide a mechanism for EPA and/or MDNR access to the Site to inspect and monitor compliance with the remedy requirements and the overall effectiveness of the remedy.

In accordance with the NCP, institutional controls are generally used in conjunction with, rather than in lieu of, engineering remedies. Where the opportunity exists, institutional controls should be "layered" (i.e., use multiple institutional controls) or implemented in a series to provide overlapping assurances.

EPA recognizes four categories of IC mechanisms:

1. Proprietary Controls - these controls are based on state property law with the most common examples being easements and covenants;

2. Governmental Controls - these controls use the authority of an existing unit of government such as zoning and building codes;

3. Enforcement and Permit Tools - these legal tools include orders, permits and consent decrees; and

4. Informational Devices - these devices include deed notices and State registries or advisories.

Institutional controls are measures that minimize public exposure by limiting access to or use of contaminated areas. Institutional controls are effective as informational devices and can constitute an enforceable property interest, but institutional controls do not preclude access to or use of property. Institutional controls do not reduce contaminant toxicity, mobility, or volume, but they can reduce the potential for exposure to contaminated material. Institutional controls, such as land use covenants, and limitations on groundwater use, are used as appropriate to supplement engineering controls such as fencing or containment to prevent or limit exposure to affected environmental media and/or to ensure the effectiveness of other response actions. Institutional controls can include both on-site and off-site institutional controls.

Property use restrictions at the West Lake Landfill Site will be implemented through the placement of institutional controls. The specific institutional control design and implementation strategy will be a component of the remedial design planning process following release of the OU-1 Record of Decision by EPA. Where appropriate, multiple mechanisms, or a "layered" approach, will be used to enhance the effectiveness of the institutional control strategy. See above for the general categories of institutional control mechanisms.

At the West Lake Landfill Site, the affected properties are privately owned and the use restrictions must be maintained for a long period of time. Therefore, proprietary controls should be considered because they generally run with the land and are enforceable. The primary examples of proprietary controls, covenants and easements, are based in real property law and generally create legal property interests. This involves placing a legal instrument in the chain of title of the property. A property interest may be conveyed from the property owner (grantor) to a second party (grantee) for the purpose of restricting land or resource use. These types of controls can be binding on subsequent purchasers of property giving them a measure of long-term reliability.

Covenants under common law are typically promises to do something (affirmative) or not to do something (negative) with regard to the land. In case of a breach of the covenant, contract law usually applies. This means that the available remedies in case of a breach of the covenant would generally be limited to monetary damages.

Restrictive covenants may be an effective tool for implementing and enforcing the use restrictions established as part of the remedy for the West Lake Landfill Site. Easements, allowing the easement holder to enter or use property for a stated purpose, could be useful for adjacent property, e.g., the Crossroad property, to secure access rights for any long-term monitoring or maintenance needs.

The institutional control component (Appendix E) of the MDNR CALM draft regulations consists primarily of a restrictive covenant with an easement provision that allows MDNR access to a site for the duration of the restrictive covenant for the purpose of conducting periodic inspections. As grantee, MDNR has the authority to enforce the restrictive covenant. CALM Appendix E requires that the restrictive covenant state the intention of the property owner to make the covenant and the easement effective in perpetuity or until the MDNR determines that they are no longer necessary. This type of language ensures that a court will interpret the restrictive covenant and easement to run with the land and be binding on a current owner and all subsequent owners of the property, regardless of any case law that might support a different conclusion. As such, the CALM Appendix E language provides a useful format for implementing use restrictions at the West Lake Landfill site, including the requirement that a property owner sign and record the restrictive covenant with the Recorder's Office in the county in which the property is located.

In addition to the above proprietary controls, the MDNR has promulgated regulations pertaining to the location and construction of water wells. The Well Construction Code (10 C.S.R. 23-3.010) prohibits the placement of a well within 300 feet of a landfill.

These rules should provide an additional layer of protection against the placement of wells on or near the West Lake Landfill.

Also, the West Lake Landfill site has been listed by MDNR on the State's Registry of Confirmed, Abandoned, or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Registry). The Registry is maintained by the MDNR pursuant to the Missouri Hazardous Waste Management Law, Mo.Rev.Stat. Section 260.440. Sites listed on the Registry appear on a publicly available list. A notice is filed with the County Recorder of Deeds and notice must be provided by the seller to any potential buyers of the property. The remedial design Work Plan will contain an institutional control design and implementation plan specifying the institutional controls and identifying the steps necessary to implement proprietary controls. At a minimum, the controls will provide detailed descriptions of the types and locations of the residual contaminants, the parties involved, provisions for third party enforcement, the parties' rights, the resource/use restrictions, language to assure that the institutional controls are binding on subsequent purchasers, and specific notice and approval requirements for modifying or terminating a control. Title documentation also generally will be required.

The Operation and Maintenance (O&M) Plan will contain procedures for surveillance, monitoring and maintenance of the institutional controls. The O&M Plan will provide for notice to EPA and/or the state of any institutional control violations, planned or actual land use changes, and any planned or actual transfers, sales or leases of property subject to the use restrictions.

The use restrictions or institutional controls objectives described below apply to all cap alternatives meeting the Subtitle D cover system requirements (*i.e.*, L4, L5, and L6). These restrictions must be maintained until the remaining hazardous substances at the Site are sampled at levels allowing for unlimited use and unrestricted exposure. These use restrictions do not apply to activities related to the implementation, maintenance, monitoring or repair of the remedy.

These use restrictions should apply within the boundary of the cover system(s) for Area 1 and Area 2, including all bordering buffer areas (OU 1 Area).

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Prevent development and use for industrial or commercial purposes, such as manufacturing, offices, storage units, parking lots or other facilities, that are incompatible with the function or maintenance of the landfill cover.

3. Prevent construction activities involving drilling, boring, digging, or other use of heavy equipment that could disturb vegetation, disrupt grading or drainage patterns, cause erosion or otherwise compromise the integrity of the landfill cover, or manage these activities such that any damage to the cover is avoided or repaired.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

The use restrictions for adjacent disposal areas will be identified under the West Lake Landfill OU 2 Feasibility Study or as part of implementation of post-closure regulations for the permitted portions of the landfill. Coordination across operable units will ensure that use restrictions are complementary.

The following use restrictions should apply to the non-disposal areas of the West Lake Landfill site.

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Any new or existing structures for human occupancy should be assessed for gas accumulation, and mitigating engineering measures, such as foundation venting, should be employed as necessary.

3. Manage any construction activities, such as drilling, boring, digging, or other use of heavy equipment to avoid disturbance of the OU 1 Area.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas. Under this scenario, the use restrictions listed under letter A, above, will encompass the impacted area of the Ford property and no additional use restrictions will be necessary to address this property. Soil sampling will be undertaken to support the remedial design and confirm these assumptions.

4.3.2 Access Restrictions

Access restrictions generally involve physical barriers to entry such as fences and guards. These barriers are intended to prevent access to controlled areas. They serve to minimize the potential for deliberate or inadvertent trespass into controlled areas. The entire landfill site is fenced to control access to the Site. Maintenance of the existing fencing is considered an integral part of the remedial actions developed for OU-1. Additional fencing around Areas 1 and 2 is considered a potential additional measure to further control access to these areas.

4.3.3 Monitoring

Monitoring is a process option that is expected to be a component of each remedial alternative discussed in Section 4.4, except the No Action alternative. Monitoring may serve the purpose of evaluating contaminant levels and migration and, depending on the remedial action selected, to evaluate the performance and effectiveness of any remedial action technology or process option employed.

4.3.4 In-Situ Containment

In-situ containment consists of technologies that confine contaminated media at their current locations. These technologies reduce contaminant mobility and the associated potential for exposure, but they do not reduce contaminant toxicity or volume. In-situ containment technologies include surface controls/diversions, surface water/sediment control barriers, dust controls, and caps and covers.

Surface controls/diversions are used to divert surface runoff around contaminated areas to minimize potential for contact of surface water runoff with impacted soils or for contaminant re-suspension. Graded contours, swales, and berms can effectively control surface water runon and runoff and can limit the mobility of contaminants. Sedimentation basins could also be used in conjunction with surface controls/diversions for surface water control. These measures would not, however, be effective for any off-site surface waters that are hydrologically connected to each other and to the local groundwater system.

A contaminated area can be encapsulated by placing low permeability surface seal barriers such as caps and covers on top of the area. Capping of soil and sediment could effectively limit airborne emissions and reduce precipitation-enhanced percolation, infiltration, and leaching. A variety of materials can be used in the construction of caps and covers depending on the design considerations for the cap or cover including soils, admixtures, and synthetic membranes. Factors influencing the selection of materials and design include the desired functions of cover materials, waste characteristics, climate, hydrogeology, projected land use, and availability and costs of cover materials.

For Areas 1 and 2 of OU-1 at the West Lake Landfill, asphalt or concrete covers were screened-out because of potential cost and maintenance requirements and are inconsistent with the cover design requirements of the Subtitle D regulations. Synthetic membrane and multilayer/multimedia material covers were also screened-out because they are inconsistent with the existing landfill cover and cover requirements. Soil, clay, and vegetation layer covers were retained. In addition for Areas 1 and 2, surface preparation such as filling of surface depressions may be required prior to any cap or cover placement.

4.3.5 Excavation

Excavation of radiologically-impacted material can limit contaminant mobility and volume at the affected area of concern and can facilitate treatment and disposal that could reduce contaminant toxicity, mobility, and volume. Excavation can be applied to affected media at the site, and the appropriate technology and process option is a function of the physical properties of the medium.

Excavation with conventional earth-moving equipment (e.g., bulldozers, backhoes, scrapers, and front-end loaders) can effectively remove bulk material such as radiologically-impacted surface soil on the buffer/Crossroad properties. In addition, consideration must be given to the type and composition of material to be excavated, which can affect the size of the excavation and the ability to separate the radiologically impacted soil from other fill material.

Excavation of radiologically-impacted materials within Areas 1 and 2 is generally not considered feasible as the radiologically impacted soils are contained within an overall matrix of municipal solid waste, debris and other fill material. Physical removal of radiologically-impacted soils would require excavation of large volumes of solid waste to remove small volumes of affected soil. Such activities could result in strong odor emissions. Furthermore, separation of soil (both impacted and non-impacted) from solid waste materials would necessitate screening of the excavated materials. Screening of refuse is a very labor intensive activity due to the need to physically remove plastic and other debris that fouls the shaker screen. Cleaning of the screen could expose workers to gamma radiation under conditions that would be difficult to provide adequate protection.

Although wholesale excavation of the radiologically-impacted materials within Areas 1 and 2 is generally not considered feasible, this FS includes selective excavation of radiologically impacted materials containing higher levels of radionuclides as a potential remedial technology. Excavation of radiologically impacted soil that may still remain on the Buffer Zone and Crossroad property, if any, and consolidation of that excavated soil in Area 2 is also considered. Excavation of Buffer Zone and Crossroad property soil could be performed using standard construction equipment and techniques including a bulldozer and loader to scrape and load the soil into trucks that would subsequently transport the excavated soil to Area 2. Alternatively, scrapers could be used to excavate, transport and stockpile the soil.

4.3.6 Disposal

If the selected remedy were to include excavation of portions of Area 1 or 2 for offsite disposal, the radiologically-impacted material removed from the Site would be transported to a permitted off-site facility for disposal. Disposal of commercial (non-Department of Defense) low-level radioactive waste is governed by the Low-Level Radioactive Waste Policy Act of 1980 (Public Law 96-573) and the Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240) which gave the states responsibility for disposal of their low-level radioactive waste. The Act encouraged the states to enter into compacts that would allow them to dispose of waste at a common disposal facility. Most states have entered into compacts; however, no new disposal facilities have been built since the Act was passed.

Missouri, along with the states of Indiana, Iowa, Minnesota, Ohio, and Wisconsin, is a member of the Midwest Interstate Low-Level Radioactive Waste Compact. There are no permitted low-level radioactive waste disposal sites within any of the member states of the Midwest Interstate Low-Level Radioactive Waste Compact. Consequently, disposal of low-level radioactive waste generated within the compact states must be disposed outside of the compact.

Only four active, licensed low-level radioactive waste disposal facilities exist in the United States. These include the Chem Nuclear facility in Barnwell, South Carolina, the Envirocare of Utah facility near Clive, Utah, the Envirosafe facility in Idaho, and the Hanford Low-Level Radioactive Waste facility operated by U.S. Ecology. The Chem Nuclear site accepts waste from all U.S. generators except those in the Rocky Mountain and Northwest compacts. Beginning in 2008, this facility will only accept waste from the Atlantic Compact states (Connecticut, New Jersey, and South Carolina). The Envirocare and Envirosafe facilities accept wastes from all regions of the United States. The Hanford site only accepts wastes from the Northwest and Rocky Mountain compacts. Consequently, only three licensed commercial waste disposal facilities, Chem Nuclear, Envirosafe, and Envirocare, could currently accept radiologically impacted material that may be excavated from the West Lake Landfill for offsite disposal.

Several former uranium mills, such as International Uranium (USA) Corporations White Mesa Mill near Blanding, Utah, accept low-level radioactive wastes that can be reprocessed for recovery of uranium. The radiologically impacted materials at the West Lake Landfill contain uranium in addition to thorium and radium and therefore may be suitable for acceptance for re-processing at an uranium mill; however, the presence of refuse and other solid wastes within which the radionuclides are present make these materials unsuitable for re-processing at an uranium mill.

4.4 Development of Alternatives

In this section, technologies and process options retained in Section 4.3 are assembled into remedial alternatives. This section describes the statutory requirements related to remedial alternative development, EPA's presumptive remedy approach to CERCLA municipal landfill sites such as the West Lake Landfill, an evaluation of potential "hot spot" remediation, and the remedial alternatives for OU-1.

4.4.1 NCP Requirements for Remedial Alternatives

For source control actions, the NCP (EPA, 1990) requires the following types of alternatives to be developed as appropriate:

- A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element;

- Other alternatives which, at a minimum, treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed;

- One or more alternatives that involve little or no treatment, but provide protection of human health and the environment primarily by preventing or controlling exposure to hazardous substances, pollutants, or contaminants, through engineering controls, for example, containment, and, as necessary, institutional controls to protect human health and the environment and to assure continued effectiveness of the response action;

- One or more innovative treatment technologies for further consideration, if those technologies offer the potential for comparable or superior performance or implementability, fewer or less adverse impacts than other available approaches, or lower costs for levels of performance similar to that of demonstrated treatment technologies; and

- A no-action alternative.

4.4.2 Presumptive Remedy Approach for CERCLA Municipal Landfills

Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment is usually impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites.

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedy approach is to use the Superfund program's past experience to streamline site investigation and accelerate selection of cleanup actions. EPA has issued guidance that establishes containment as the presumptive remedy for CERCLA municipal landfills (EPA, 1993b); data collection and preparation of RI/FS for CERCLA municipal landfill sites (EPA, 1991 and 1995); application of the CERCLA municipal landfill presumptive remedy approach to military landfills including those that contain radioactive wastes (EPA, 1996b); reuse of CERCLA municipal landfill sites (EPA, 1999); and other aspects of the presumptive remedy approach to CERCLA municipal landfill sites (EPA, 1992, 1993a, and 1997c). Copies of these guidance documents are included as Appendix A to this FS.

Areas 1 and 2 are part of larger areas previously used for solid waste landfill disposal as part of historic operations at the West Lake Landfill. As Areas 1 and 2 are part of a solid waste landfill, they meet the primary criteria for use of EPA's presumptive remedy for CERCLA Municipal Landfill sites. Areas 1 and 2 contain municipal solid waste and construction and demolition debris that are intermixed with soil that was used for daily, intermediate, and final cover. Some of the soil used for cover material contained radionuclides. Consequently, the volume of waste materials (municipal solid waste, construction and demolition debris, and radiologically-impacted soil) represents a large volume or relatively low concentration waste thereby meeting the criteria established by EPA in the National Contingency Plan and the Presumptive Remedy Guidance for CERCLA Municipal Landfill sites for use of containment remedies. The overall volume and heterogeneity of the waste materials in Areas 1 and 2 combined with their contiguity with other areas of solid waste disposal at the West Lake Landfill, make treatment of these wastes impractical and therefore use of containment technologies is appropriate for OU-1.

Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris and other, non-impacted soil materials. Consequently, excavation of the radiologically impacted materials for possible ex situ treatment techniques or possible offsite disposal is impracticable. Due to the heterogeneous nature of the solid waste materials and the dispersed nature of the radionuclide occurrences within the overall solid waste matrix, in situ treatment techniques involving subsurface delivery of reagents or other substances to immobilize, react with, or otherwise treat the radionuclide occurrences are not practicable. Due to the presence of the radionuclide materials within the overall combustible matrix of solid waste, the presence of potentially explosive levels of landfill (methane) gas, the overall low silica content of the refuse and lack of a continuous matrix for heating, application of in situ thermal treatment techniques is impracticable. Therefore, containment technologies and use of the presumptive remedy approach for municipal landfills is appropriate for OU-1.

EPA expects to use presumptive remedies at all appropriate sites except under unusual site-specific circumstances. The presence of radionuclides in a municipal landfill was not specifically addressed by EPA in the development of the presumptive remedy for CERCLA municipal landfill sites; however, EPA did address the presence of low level radionuclides in landfills as part of the development of the presumptive remedy approach for CERCLA military landfill sites. EPA has established that the presumptive remedy approach for CERCLA municipal landfill sites should also be used for appropriate military landfills (EPA, 1996). EPA has indicated that although waste types may differ between municipal and military landfills, these differences do not preclude the use of source containment as the primary remedy at appropriate military landfills, including those that contain low-level radioactive wastes (EPA, 1996). In addition, EPA has used the containment presumptive remedy at other CERCLA municipal landfill sites that contained radionuclides (EPA, 1994). Therefore, the presence of radionuclides does not negate use of the CERCLA municipal landfill presumptive remedy at the West Lake Landfill.

The presumptive remedy guidance requires the EPA (or State) site manager to make the initial decision of whether a particular municipal landfill site is suitable for the presumptive remedy. EPA's Remedial Project Manager (RPM) has indicated that use of the presumptive remedy for CERCLA municipal landfills should be considered for use in the development and evaluation of potential remedial alternatives for the West Lake Landfill.

Based upon their experiences at numerous CERCLA municipal landfill sites and as a result of the initiatives undertaken as part of the Superfund Accelerated Cleanup Model, EPA has initiated use of and developed presumptive remedies for specific types of sites, contaminants, or both, including CERCLA municipal landfill sites. The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected groundwater at the perimeter of the landfill, and/or upgradient groundwater that are causing saturation of the landfill mass may be implemented as part of the presumptive remedy.

Based upon their experience, EPA has identified the following components for consideration in applying the presumptive remedy approach for source area containment at CERCLA municipal landfills:

- Landfill cap;
- Source area groundwater control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment; and/or
- Institutional controls to supplement engineering controls.

Of these, the landfill cap, landfill gas collection and treatment and institutional control actions are considered applicable to Areas 1 and 2.

Construction of an upgraded landfill cap would achieve the following objectives:

- Prevent direct contact with landfill contents and exposure to radiation;
- Minimize infiltration and any resulting contaminant leaching to groundwater;
- Control surface water runoff and erosion and decrease the potential for erosion and subsequent transport of radiologically impacted materials; and
- Control radon and landfill gas emissions.

Therefore, implementation of an upgraded landfill cap, consistent with the presumptive remedy approach, is well suited to the waste materials and site conditions in OU-1.

As there is no plume of groundwater contamination associated with Areas 1 and 2, source area groundwater control is not applicable or required for Areas 1 and 2. With the possible exception of the seep located in the southwestern portion of Area 2, no leachate discharge has been identified from Areas 1 and 2. Therefore, leachate collection and treatment is not a required component of potential remedial actions for OU-1.

Based on the results of the radon monitoring conducted during the RI, collection or control of radon gas is not considered necessary. Radon testing performed during the RI indicated that the overall average radon emission from Areas 1 and 2 is close to the EPA standard of 20 pCi/m^2s. Installation of an upgraded landfill cover should result in a reduction in radon emissions.

Methane gas measurements were performed as part of the RI field investigations. During the RI, methane levels ranging from less than 1% to as much as 45% were observed in the various boreholes drilled for the RI. The highest levels of methane were observed in boreholes drilled in Area 1. Lower levels of methane were observed in Area 2; however, methane concentrations greater than 5% methane concentration by volume (the lower explosive limit or LEL for methane) were observed in both Area 1 and Area 2. Methane gas generation and accumulation has been observed in other areas of the West Lake Landfill. The active portion of the West Lake Landfill has a methane gas collection and treatment system. There is a continuing potential for methane gas accumulations within Area 1 or 2 as a result of waste materials disposed within or adjacent to Areas 1 and 2 and therefore methane gas, monitoring, collection and/or treatment may need to be considered potential components of any remedial actions that may be taken for OU-1.

Institutional and access controls have previously been implemented for the West Lake Landfill overall and Areas 1 and 2. These are discussed under the No Action (L1) and Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring (L2) alternatives in Sections 4.4.4.1.1 and 4.4.4.1.2 below. Some of the existing institutional and access controls reference the consent order for the RI/FS, which will not be the operative remediation document once the remedy implementation phase begins. Accordingly, additional or revised institutional controls may be determined to be necessary to restrict land uses or site development that could result in changes in potential exposure to radionuclides or other constituents contained in the radiologically-impacted materials or other wastes at the landfill. Additional institutional controls may also be necessary to protect the integrity of any remedial actions implemented at the Site. These institutional and access controls, along with any future additions to the existing institutional and access controls, will also serve to prevent future land uses that could potentially disrupt or otherwise affect the integrity of any remedial actions that may be taken at the Site.

As discussed above, the potential exposure scenarios, possible hazards associated with OU-1, and the RAOs for OU-1 are addressed by the various remedy components associated with EPA’s presumptive remedy for CERCLA municipal landfill Sites. The presence of radionuclides does not restrict or otherwise affect the applicability of the presumptive remedy approach to OU-1. Therefore, this FS report, in particular the development of remedial alternatives for OU-1, has been performed consistent with the approach set forth in EPA's presumptive remedy guidance (Appendix A).

4.4.3 Remediation of “Hot Spots”

EPA’s guidance for presumptive remedies at CERCLA municipal landfill sites also describes issues to be addressed related to the characterization and possible treatment of “hot spots”. Hot spots consist of highly toxic and/or highly mobile material that may present a potential principal threat to human health or the environment. This section presents a summary of the evaluation of potential “hot spot” occurrences and possible “hot spot” remediation at the West Lake Landfill. A more detailed evaluation is presented in Appendix B.

Excavation or treatment of hot spots is generally practicable where the waste type or mixture of wastes is in a discrete, accessible location of a landfill. A hot spot should be large enough that its remediation would significantly reduce the risk posed by the overall site, but small enough that it is reasonable to consider removal or treatment.

EPA guidance identifies four questions to be addressed to determine whether characterization and/or treatment of hot spots are warranted. All four of these questions must be answered in the affirmative to support a decision to characterize and treat hot spots. These four questions are as follows:

- Does evidence exist to indicate the presence and approximate location of waste?
- Is the hot spot known to be principal threat waste?
- Is the waste in a discrete accessible part of the landfill?
- Is the hot spot known to be large enough that its remediation will significantly reduce the threat posed by the overall site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

With respect to the first question, reliable historic information regarding the location of the radionuclide materials does not exist. Surveys and sampling conducted as part of the RI have identified the general locations of the occurrences of the radiologically impacted materials within Areas 1 and 2. Results of the RI investigations indicate that the radiologically impacted soil material is dispersed both laterally and vertically throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and unimpacted soil cover material. Therefore, the exact location, boundaries and extent of the radiologically impacted materials cannot be precisely located and can only be approximately estimated, and the answer to the first question is no.

As to the second question, principal threat wastes addressed by the presumptive remedy guidance for which hot spot remediation is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile material. Occurrences of radiologically impacted materials at the West Lake Landfill are present in soil material, not liquids. Variations in the levels of radionuclides do occur and a few areas with higher levels of radionuclides (e.g., near soil borings WL-209, WL-210, WL-216, and WL-234) have been identified. The properties of radionuclides and the presence of the radionuclides in soil material results in the radionuclide occurrences at the West Lake Landfill being generally immobile, and do not qualify as principal threat wastes as defined in the presumptive remedy guidance.

As far as the third question is concerned, the radionuclides are not present in a discrete area, unit, or zone of the landfill. The radiologically impacted materials are present in soil material contained within the overall matrix of municipal refuse, construction and demolition debris and unimpacted soil, making retrieval of the impacted materials impracticable.

With respect to the fourth question, removal of the majority of the radioactively impacted materials would require excavation of over 250,000 cubic yards of soil and refuse which exceeds the 100,000 cubic yards threshold value identified in the guidance. Excavation of a smaller volume of radioactively impacted material would not significantly reduce the threat posed by the overall site beyond the protections afforded by the presumptive remedy. Therefore, the answer to the fourth question is no.

Based upon the evaluation of the four factors identified by EPA, implementation of "hot spot" removal as part of the remedial actions that may be undertaken for OU-1 at the West Lake Landfill does not meet the criteria established in the presumptive remedy guidance.

Although there are no areas within OU-1 that meet EPA's "hot spot" criteria, limited excavation and offsite disposal of the more accessible portions of the landfill material containing relatively higher concentration of radiologically impacted soils could offer some limited advantage in the event that institutional and engineering controls fail. Accordingly, excavation of a portion of radiologically impacted materials in OU-1 will be retained as a potential remedial alternative during the development of potential remedial alternatives for OU-1 and will be analyzed using the nine criteria specified by the NCP to provide assurance that application of the presumptive remedy approach is appropriate.

4.4.4 Remedial Alternatives for OU-1

Remedial alternatives were developed for OU-1 of the West Lake Landfill based upon EPA's presumptive remedy approach to CERCLA municipal landfills, the technologies and representative process options retained by the screening and evaluation discussed in Sections 4.2 and 4.3 and the potential RAOs for OU-1 (Section 3.2). Remedial alternatives were developed for containment of the wastes (landfill alternatives) and to address radiologically impacted soil on the Buffer Zone/Crossroad property (former Ford property).

<u>Areas 1 and 2 Landfill Alternatives</u>

- Alternative L1 – No Action

- Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

- Alternative L3 – Soil cover to address gamma exposure and erosion potential

- Alternative L4 –Regrading of Areas 1 and 2 (minimum slope of 2%) and installation of a Subtitle D cover system

- Alternative L5 – Regrading of Areas 1 and 2 (minimum slope of 5%) and installation of a Subtitle D cover system

- Alternative L6 – Excavation of material with higher levels of radioactivity from Area 2 and regrading and installation of a Subtitle D cover system

Historic erosion of the landfill berm along the north side of Area 2 resulted in deposition of radiologically impacted soil on the surface of the Buffer Zone and Crossroad property (formerly termed the Ford property). The following remedial alternatives for the soil in this area will be evaluated as part of the development of potential remedial alternatives for West Lake Landfill OU-1:

<u>Buffer Zone / Crossroad Property (Ford property) Alternatives</u>

- Alternative F1 – No Action

- Alternative F2 – Institutional and Access Controls

- Alternative F3 – Capping and Institutional and Access Controls

- Alternative F4 – Soil Excavation and Consolidation in Area 2

The following sections describe each of the alternatives. Additional information is provided in Section 5 as part of the evaluation of each alternative against the NCP criteria.

There are various components of all of the remedies described above that either have already been implemented at the Site (e.g., access and institutional controls) or that are components of all of the alternatives (e.g., groundwater monitoring). The various remedy components that are common to all of the alternatives are described as part of the No Action (Alternative L1) or the Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls and Monitoring (Alternative L2) alternatives.

As under all of the alternatives described above, waste materials will remain on site, OU-1 is subject to ongoing review by EPA to assess the protectiveness and the effectiveness of the remedial actions that may be implemented at the Site. By law, these reviews must be performed at a minimum of every five years and hence have come to be termed "Five Year Reviews". EPA has established guidance regarding the content and format of Five-Year Reviews (EPA, 2001) that details the specific evaluations that must be performed in a Five Year Review to assess the ongoing protectiveness of a remedy performed pursuant to CERCLA. A description of the Five Year Review process and the estimated costs associated with such reviews is included as part of the No Action alternative and is carried forward as part of all of the remedial alternatives being considered for OU-1.

The detailed description and conceptual design of each of the alternatives described below was based upon the results of the RI (EMSI, 2000) and the BRA (Auxier & Associates, 2000). The detailed descriptions and conceptual designs included in this section are FS-level evaluations that provide an adequate basis for evaluation of alternatives and are not intended as final descriptions or designs for any remedial action that may be selected by EPA. Additional evaluations and development of more detailed designs for any remedial action that may be selected by EPA will be conducted as part of any remedial design activities.

4.4.4.1 Area 1 and 2 Landfill Alternatives

Six potential remedial alternatives have been identified for the portions of the West Lake Landfill that contain radiological Areas 1 and 2. These six alternatives are described below.

4.4.4.1.1 Alternative L1 – No Action

Alternative 1 (No Action) is included as required by the NCP to serve as a baseline for comparison of the other alternatives. Under this alternative, no engineering measures will be implemented to reduce potential exposures or control potential migration from Areas 1 and 2. Similarly, no additional institutional controls and no additional fencing will be implemented to control land use, access or potential future exposures to Areas 1 and 2. No monitoring will be conducted to identify or evaluate any potential changes that may occur to conditions at Areas 1 and 2 or to contaminant levels or occurrences.

As previously discussed (Section 4.3.1), institutional controls are measures that preclude or minimize public exposure by limiting use of contaminated areas. Under this alternative, the existing institutional controls at the Site would remain in effect but no onsite engineered measures would be implemented.

The existing institutional controls consist of a covenant implemented and recorded in June 1997 against the deeds for the entire landfill prohibiting residential use and groundwater use. An additional covenant was recorded in January 1998 restricting construction of buildings and underground utilities and pipes within Areas 1 and 2. These covenants automatically renew fifty years from the date first recorded and every twenty five years thereafter. The covenants grant EPA, the MDNR, and the owners the right to enforce their restrictions and these restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA. Therefore, the existing institutional controls will remain in effect as part of the No Action alternative. Copies of these land use covenants are included in Appendix C to this report. Implementation of these institutional controls requires ongoing monitoring, maintenance and enforcement to be effective.

Under the No Action Alternative, the existing institutional controls along with the existing landfill fencing would continue to control and restrict access to or inappropriate development of Areas 1 and 2. Although the existing institutional and access controls would continue in place to control current and future use of the landfill area and of Areas 1 and 2 in particular, for purposes of the No Action alternative, it is assumed that monitoring, maintenance and enforcement of the existing institutional controls will not be performed. Without monitoring, maintenance and enforcement, the existing institutional and access controls would not be effective at limiting exposure.

As under the No Action alternative, and indeed for all of the alternatives being evaluated for OU-1, waste materials will remain on site, the No Action and other alternatives are subject to ongoing Five Year Reviews by EPA as required by Section 121 of CERCLA and the NCP. The specific questions to be address by each Five Year Review include the following:

1. Is the remedy functioning as intended by the decision documents?

2. Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

3. Has any other information come to light that could call into question the protectiveness of the remedy?

EPA or the State, with or without assistance of one of their contractors, will perform a Five Year Review at a minimum of every five years after completion of the Record of Decision for the Site or, if determined by EPA to be necessary, at more frequent intervals.

4.4.4.1.2 Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

Under Alternative L2, the existing landfill cover in Areas 1 and 2 would be inspected, repaired as necessary and maintained as part of the overall maintenance of the West Lake Landfill in conjunction with ongoing operations at the landfill. Maintenance of the landfill cover would include regular inspection and repair, as necessary, of the existing landfill cover over Areas 1 and 2. Inspection, maintenance and repair would include brush-hogging adjacent to fences to remove vegetation that would affect the integrity of the fence, repair and replacement of the fence as necessary, repair of erosional channels, elimination of depressions and areas of ponded water through placement of additional soil to establish or maintain vegetative cover.

Based on a visual inspection, approximately 20% of the surface of Areas 1 and 2 do not currently contain sufficient vegetative cover to prevent or reduce the potential for windblown dust, erosion and infiltration. Therefore, it is assumed for purposes of the feasibility study that approximately 20% of the existing landfill cover over Areas 1 and 2 (total area of 45.2 acres) will require initial repair in the form of placement of additional soil and re-vegetation to eliminate ponding in low areas or fill, regrade and re-cover areas where the cover has previously been eroded. For purposes of estimating the costs of future maintenance activities, it is assumed that approximately one acre of the total area will require repair and reseeding every five years.

Besides the activities associated with operation of the landfill, portions of the West Lake Landfill property are currently used for other industrial activities including for example a concrete batch plant, asphalt plant, and outdoor storage of roll-off containers. Additional uses anticipated in the near future include use of a portion of the Site for a solid waste transfer facility. Currently, the anticipated future use of the property is continued use for waste management facilities (solid waste and/or construction and demolition waste disposal, waste transfer station, outdoor storage of roll-off containers, etc.) and industrial facilities (concrete and asphalt plants). Potential future uses of the West Lake Landfill Site that can reasonably be expected to occur after completion of landfilling activities and construction of remedial actions include continued commercial/industrial uses such as the concrete/asphalt plants, additional commercial/industrial uses such as the waste transfer station and outdoor storage, and/or maintenance of private open space. Although not currently anticipated, other possible future uses could include additional commercial facilities possibly including office space and associated parking or additional outdoor storage uses or possibly recreational facilities (ball fields, golf course, etc.).

Future use of Areas 1 and 2 could result in exposure to radionuclide or non-radionuclide constituents, could result in enhance migration of these constituents, and could impact the effectiveness of the existing or future engineered controls that may be implemented at the Site. As noted in Section 4.3.1, above, certain types of land uses could potentially result in exposure to waste materials or hazardous constituents, could result in dispersal or increased migration of such constituents or could affect the stability and integrity of the waste materials and existing engineered barriers.

To address potentially unacceptable land use, the use restrictions or institutional controls objectives described below would apply to all cap alternatives. These restrictions must be maintained until the remaining hazardous substances at the Site are sampled at levels allowing for unlimited use and unrestricted exposure. These use restrictions do not apply to activities related to the implementation, maintenance, monitoring or repair of the remedy.

These use restrictions should apply within the boundary of the cover system(s) for Area 1 and Area 2, including all bordering buffer areas (OU 1 Area).

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Prevent development and use for industrial or commercial purposes, such as manufacturing, offices, storage units, parking lots or other facilities, that are incompatible with the function or maintenance of the landfill cover.

3. Prevent construction activities involving drilling, boring, digging, or other use of heavy equipment that could disturb vegetation, disrupt grading or drainage patterns, cause erosion or otherwise compromise the integrity of the landfill cover, or manage these activities such that any damage to the cover is avoided or repaired.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

The use restrictions for adjacent disposal areas will be identified under the West Lake Landfill OU 2 Feasibility Study or as part of implementation of post-closure regulations for the permitted portions of the landfill. Coordination across operable units will ensure that use restrictions are complementary.

The following use restrictions would apply to the non-disposal areas of the West Lake Landfill site.

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Any new or existing structures for human occupancy should be assessed for gas accumulation, and mitigating engineering measures, such as foundation venting, should be employed as necessary.

3. Manage any construction activities, such as drilling, boring, digging, or other use of heavy equipment to avoid disturbance of the OU 1 Area.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

At the West Lake Landfill Site, the affected properties are privately owned and the use restrictions must be maintained for a long period of time. Therefore, proprietary controls should be considered because they generally run with the land and are enforceable. The primary examples of proprietary controls, covenants and easements, are based in real property law and generally create legal property interests. This involves placing a legal instrument in the chain of title of the property. A property interest may be conveyed from the property owner (grantor) to a second party (grantee) for the purpose of restricting land or resource use. These types of controls can be binding on subsequent purchasers of property giving them a measure of long-term reliability.

Covenants under common law are typically promises to do something (affirmative) or not to do something (negative) with regard to the land. In case of a breach of the covenant, contract law usually applies. This means that the available remedies in case of a breach of the covenant would generally be limited to monetary damages.

Restrictive covenants may be an effective tool for implementing and enforcing the use restrictions established as part of the remedy for the West Lake Landfill Site. Easements, allowing the easement holder to enter or use property for a stated purpose, could be useful for adjacent property, e.g., the Crossroad property, to secure access rights for any long-term monitoring or maintenance needs.

The institutional control component (Appendix E) of the MDNR CALM draft regulations consists primarily of a restrictive covenant with an easement provision that allows MDNR access to a site for the duration of the restrictive covenant for the purpose of conducting periodic inspections. The CALM Appendix E language provides a useful format for implementing use restrictions at the West Lake Landfill site, including the requirement that a property owner sign and record the restrictive covenant with the Recorder's Office in the county in which the property is located.

In addition to the above proprietary controls, the MDNR has promulgated regulations pertaining to the location and construction of water wells. The Well Construction Code (10 C.S.R. 23-3.010) prohibits the placement of a well within 300 feet of a landfill. These rules should provide an additional layer of protection against the placement of wells on or near the West Lake Landfill.

Also, the West Lake Landfill site has been listed by MDNR on the State's Registry of Confirmed, Abandoned, or Uncontrolled Hazardous Waste Disposal Sites in Missouri (Uncontrolled Sites Registry). The Registry is maintained by the MDNR pursuant to the Missouri Hazardous Waste Management Law, Mo.Rev.Stat. Section 260.440. Sites listed on the Registry appear on a publicly available list. A notice is filed with the County Recorder of Deeds and notice must be provided by the seller to any potential buyers of the property.

The remedial design Work Plan will contain an institutional control design and implementation plan specifying the institutional controls and identifying the steps necessary to implement proprietary controls. At a minimum, the controls will provide detailed descriptions of the types and locations of the residual contaminants, the parties involved, provisions for third party enforcement, the parties' rights, the resource/use restrictions, language to assure that the institutional controls are binding on subsequent purchasers, and specific notice and approval requirements for modifying or terminating a control. Title documentation also generally will be required.

The Operation and Maintenance (O&M) Plan will contain procedures for surveillance, monitoring and maintenance of the institutional controls. The O&M Plan will provide for notice to EPA and/or the state of any institutional control violations, planned or actual land use changes, and any planned or actual transfers, sales or leases of property subject to the use restrictions.

Based on the above considerations, proprietary controls consisting of deed restrictions, environmental covenants, and other land use restrictions that "run with the land" are preferred institutional control mechanisms for the West Lake Landfill Site to supplement the Well Construction Code and Uncontrolled Sites Registry use prohibitions.
Existing proprietary controls in place for OU-1 of the West Lake Landfill Site consist of a deed covenant implemented and recorded in June 1997 in the chain of title for the entire landfill. This covenant runs with the land and against current and future property owners, and prohibits residential use and groundwater use of the entirety of the West Lake Landfill site. An additional deed covenant was recorded in January 1998 restricting construction of buildings and underground utilities and pipes within Areas 1 and 2 of the OU-1 portion of the landfill. These covenants automatically renew fifty years from the date first recorded and every twenty five years thereafter. The covenants grant EPA, the MDNR, and the property owners the right to enforce the use restrictions, and these restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA.

These 1997 and 1998 deed covenant institutional controls will remain operative for any remedial alternative selected for the Site. Copies of these land use covenants are included in Appendix C to this report. Implementation of these institutional controls require ongoing monitoring, maintenance and enforcement to be effective.

Another proprietary institutional control is in place at Areas 1 and 2 of OU-1. Construction work and commercial and industrial uses are precluded on Areas 1 and 2 pursuant to a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc. (the owner of record of the parcels containing Areas 1 and 2) prohibiting the placement of buildings and restricting installation of underground utilities, pipes and/or excavation in these areas. These land use covenants automatically renew fifty years from the date first recorded and every twenty five years thereafter. The land use covenants grant EPA, the MDNR, and any current property owners the right to enforce their restrictions and these restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA. Copies of these land use covenants are included in Appendix C.

The intended future use of Areas 1 and 2 is as private open space. Review of the existing institutional controls indicates that although structures cannot be built and excavation cannot be performed in Areas 1 and 2, a potential exists for future use of Areas 1 and 2 in conjunction with allowable uses in other portions of the landfill area. For example, construction of office buildings or other commercial or industrial structures could be performed in areas adjacent to Areas 1 and 2 in the future. As part of this type of development, there may be an expectation of using Areas 1 and 2 for ancillary uses such as landscaping, parking lots, or open storage.

Additional institutional controls must be implemented as necessary to further limit future uses and to insure that the remedy implemented at the Site remains protective of human health and the environment and that possible future uses do not impact the effectiveness or integrity of the remedial actions. As part of this alternative, additional institutional controls in the form of additional restrictive covenants would be implemented to prevent or control potential future uses of Areas 1 and 2 not currently expressly restricted. Under this alternative, the current property owners will be required to record additional deed restrictions or proscriptive covenants in the property chain of title to prevent future use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2. In addition, proscriptive deed restrictions will be required providing that any future construction on the property must also repair any excavations such that the integrity of the landfill cover or other remedy components is maintained, supply continued access to and allowance for maintenance of the landfill cover, runon and runoff control structures, landfill gas collection and treatment systems, if any, and groundwater monitoring wells, and landfill gas monitoring points.

Although access to the entire West Lake Landfill property is controlled by a perimeter fence, access to Areas 1 and 2 within the West Lake site is currently not controlled by fencing. To restrict access to Areas 1 and 2, additional fencing would be installed along those portions of the boundaries of Areas 1 and 2 that are not currently fenced (generally the internal boundaries of Areas 1 and 2).

Because of the potential for radon, as well as methane gas, accumulation in any structures that may be built on the landfill in the vicinity of Areas 1 and 2 or elsewhere on the landfill, an additional land use covenant may need to be enacted to require testing and installation of foundation venting and/or vapor barrier systems as necessary as part of any new building construction at the site. These types of controls are commonly used in areas where soils with naturally high levels of radon exist. Implementation of foundation venting or vapor barriers is actually an engineering measure to control radon and landfill gas migration into structures. However, under this alternative, these measures would only be implemented for any new occupied structures that may be constructed in the future at the site. Therefore, their implementation will be addressed through imposition of a land use covenant on new construction at the Site.

Several construction techniques may be used to prevent radon or other vapor migration into basements or through foundation slabs to eliminate the accumulation of radon or landfill gas in indoor air. These construction techniques (EPA, 1993d) include active soil depressurization (ASD); pressurizing a building using the heating, ventilating, and air conditioning (HVAC) system; and sealing major vapor entry routes. These vapor accumulation prevention features are very effective and can be installed relatively easily and inexpensively during new building construction.

An ASD system prevents vapor entry by creating a negative-pressure zone beneath building basements or slabs. The lower air pressure in a building compared with the surrounding soil draws radon or other vapors into a building. The ASD system reverses the pressure difference, so that the sub slab (or subbasement) pressure is lower than the indoor pressure. A vapor suction pit is installed in the aggregate under the slab to create the negative-pressure zone. The sub slab pit is then connected to a vent pipe that runs from the pit to the outdoors. A suction fan is connected to the pipe outside of the building to produce the negative-pressure zone beneath the slab.

A building HVAC system may be designed and operated to reduce vapor entry and radon accumulation by building pressurization and dilution. The HVAC system can be used to produce a slightly positive air pressure inside all areas of the building. Pressurization is accomplished by drawing more outdoor air into the building than is removed. Excess air that is not removed by the exhaust system is forced out of the building through cracks and unsealed openings in the building shell, thereby preventing vapor entry through the same cracks and unsealed openings. The outdoor air also increases building ventilation and dilutes radon concentrations in vapors that may enter the building.

Vapor entry and radon accumulation may also be minimized by sealing cracks and openings in the building slab or substructure. However, it is difficult to seal every crack and penetration. Therefore, sealing vapor entry routes or constructing physical barriers as stand-alone approaches are not currently recommended (EPA, 1993d). However, sealing major vapor entry routes will help reduce radon accumulation and increase the effectiveness of the other vapor prevention techniques. For example, sealing increases the effectiveness of ASD by improving or extending the negative-pressure field beneath the slab or basement. Sealing also helps achieve building pressurization by minimizing air leakage. As an alternative to sealing the foundation of a building, a vapor barrier, consisting of an HDPE liner or other suitable low permeability material can be installed below a new building foundation to prevent upward migration of radon from the subsurface to the area adjacent to the building foundation.

Alternative L2 would also include a provision for groundwater monitoring. The general requirements for the long-term groundwater monitoring component of the selected remedy are anticipated to be described in the Record of Decision. The exact scope and requirements for the long-term groundwater monitoring component of the selected remedy will be set forth in the remedial design documents. Design and implementation of a long-term groundwater monitoring program is expected to meet the substantive requirements of the UMTRCA groundwater protection and monitoring requirements and the MDNR post-closure regulations for closed solid waste landfills.

A point of compliance for groundwater monitoring will be defined by EPA in the Record of Decision. For purposes of this FS it is anticipated to consist of those portions of the boundaries of Areas 1 and 2 that are coincident with the boundary of the West Lake Landfill. Specifically, this would include the northeastern boundary of Area 1 and the northeastern, northern, northwestern and western boundaries of Area 2. The point of compliance used for this FS does not include the other boundaries of Areas 1 and 2 as these boundaries are located internal to and within the overall boundary of the landfill and therefore are adjacent to areas containing other landfill wastes making compliance monitoring along these boundaries impractical.

For purposes of the evaluation of potential remedial alternatives, it is assumed that 11 existing monitoring wells located in three clusters along the northern and western (presumed downgradient) boundary of Area 2 and wells PZ-114-AS and PZ-115-SS adjacent to Area 1 would be monitored (Figure 4-3). These 11 wells were selected, as they would provide both lateral and vertical coverage of groundwater conditions downgradient of Areas 1 and 2 and/or along the site boundaries. Wells S-8, I-62 and D-83 are located at the northern boundary of Area 2 and may no longer exist as a result of development of the adjacent Crossroad property. As part of this alternative, these wells will need to be replaced. As part of remedial design activities, the status of all of the wells proposed for inclusion in the long-term groundwater monitoring program will need to be assessed and any wells that are damaged or no longer exist at that time may need to be replaced as part of implementation of remedial actions at the Site consistent with the requirements of the groundwater monitoring network contained in the EPA-approved remedial design documents.

For purposes of the FS evaluation of alternatives and in particular to develop a cost estimate, it is assumed that these wells would be sampled quarterly for three years to characterize baseline conditions. After the first three years of baseline monitoring, it is assumed that the groundwater monitoring would be conducted semiannually on a biannual basis to identify any changes that may occur in the future.

For purposes of preparing this FS, it is assumed that groundwater samples will be analyzed for gross alpha and beta, uranium and radium isotopes, VOCs, and select trace metals as required by the UMTRCA groundwater protection standards and the MDNR regulations (Table 4-1). As these wells would only be sampled infrequently and the goal of the monitoring program would be to identify changes in water quality over time, not to simulate drinking water conditions, the samples would be filtered in the field and the analyses would reflect the dissolved fraction only. Filtering and performance of dissolved analyses will eliminate uncertainties and large statistical variances associated with varying levels of suspended solids entrainment in the samples. Water level data and field parameters (pH, specific conductance, turbidity and temperature) would be obtained as part of the groundwater monitoring activities.

As with any alternative, the exact number and locations of the wells to be monitored, the parameters for which they would be monitored, and the frequency at which they would be monitored would be determined as part of the remedial design activities if this alternative was selected. The description of the wells to be monitored, analyte list, and monitoring frequency presented above is intended solely to provide a basis for describing the alternative and to develop an estimated cost for this activity.

In addition to the groundwater monitoring component of this alternative, a landfill gas monitoring program would also be developed and implemented as part of the remedial actions for OU-1. Similar to the groundwater monitoring component, the need for and scope of the landfill gas monitoring program will be specified by EPA in the Record of Decision. The exact number and locations of gas monitoring points and measurement frequency will be determined in EPA-approved remedial design documents for OU-1. For purposes of this FS report, it has been assumed that approximately 12 gas monitoring probes will be installed along those portions of Areas 1 and 2 that are coincident with the boundaries of the West Lake Landfill property, specifically the northeastern boundary of Area 1 and the northeastern, northern, northwestern and western boundaries of Area 2. Methane gas and radon monitoring will be performed on a quarterly basis for three years to characterize baseline conditions. After the first three years of baseline monitoring, it is assumed that the landfill gas monitoring would be conducted semiannually on a biannual basis to identify any changes that may occur in the future. In the event that landfill gas (methane) or radon is detected along the site boundaries at levels above regulatory thresholds (e.g., 5% of the LEL for methane), a contingent corrective action of gas extraction and treatment could be implemented.

Alternative L2 would also include performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.1.3 Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential

Alternative L3 would consist of placement of an 30-inch thick soil cover over Areas 1 and 2 to reduce the potential gamma exposure to workers that may enter these areas in the future. Placement of additional soil cover would also reduce the potential for windblown or water erosion of surface soil containing radionuclides.

Auxier & Associates has calculated the current gamma exposure rates for Areas 1 and 2 to be approximately 1.5 rems/year (1500 mrems/year). This calculation is based on use of the 95% upper confidence interval for the mean values for the activities of the radionuclides present in Areas 1 and 2. Therefore, the current condition at the landfill would meet the Missouri occupational exposure standards for protection against ionizing radiation in a controlled area (5 rems or 5,000 millirems [mrems]/year). As discussed above, access to the landfill property by the general public is controlled; however, access to Areas 1 and 2 is not currently controlled. In addition, although based on use of the 95% upper confidence interval, the levels of radiation in Areas 1 and 2 would meet the Missouri occupational exposure standards, there are some smaller areas within Areas 1 and 2 in which these standards could be exceeded.

The BRA (Auxier & Associates, 2000) also examined potential risks that may be posed by Areas 1 and 2, including risks to groundskeepers, possible trespassers, or others not directly employed at the landfill that might enter Areas 1 and 2. The risk assessment determined that due to the potential frequency and duration of possible exposure, the greatest potential risk would occur for a potential future groundskeeper. The potential frequency and duration of possible exposure for a groundskeeper were greater than those anticipated to occur for an occasional trespasser and therefore, the potential risks for the groundskeeper exposure scenario were evaluated. A potential future groundskeeper is anticipated to be present in Areas 1 and 2 approximately 8 hours per day, one day per week for 26 weeks per year for a total duration of 208 hours/year (Auxier & Associates, 2000). The calculated risks associated with this exposure are approximately 1500 mrem/yr or a potential carcinogenic risk of approximately 6 x 10^{-5} and 2 x 10^{-4} for Areas 1 and 2 respectively. These levels are less than the Missouri maximum permissible limit for exposure to ionizing radiation of 5 rems (5,000 mrem) per year, which as discussed in Section 3.1.1.3 are not applicable, but may potentially be relevant and appropriate to OU-1. The calculated risk levels for a potential future groundskeeper are also generally within or slightly exceed EPA's accepted risk range of 10^{-4} to 10^{-6}. Although no additional cover would be necessary to meet the Missouri standards, placement of approximately 18 inches of additional soil over the top of Areas 1 and 2 would reduce the gamma exposure levels to 15 mrem/year (Figure 4-4), which is within the accepted risk range used by EPA of 10^{-4} to10^{-6}.

A potential future worker involved in outdoor storage or other activities on the surface of Area 1 and 2 that would be ancillary to commercial or industrial uses on the landfill adjacent to Areas 1 and 2 could theoretically be exposed to the radiologically-impacted materials 8 hours per day, 5 days per week, 50 weeks per year. The calculated radiation exposure under this scenario is approximately 15,000 mrem per year which is approximately three times greater than the Missouri standard, which although not considered to be applicable, may be relevant and appropriate to OU-1 (see discussion in Section 3.1.1.3). This exposure was calculated to result in excess lifetime cancer risks of 1 x 10^{-4} and 4 x 10^{-4} for Areas 1 and 2, respectively, which are generally within or slightly exceed EPA's accepted risk range. Installation of a 4 inch thick soil cover would reduce this potential exposure to meet the Missouri standard of 5,000 mrems per year (Figure 4-5). Installation of a 30-inch thick soil cover over the top of Areas 1 and 2 would reduce this potential exposure to approximately 15 mrems per year (Figure 4-5), which is approximately 3000 times less than the Missouri standard and within the accepted risk range used by EPA of 10^{-4} to 10^{-6}.

For purposes of the development of this alternative, it was assumed that approximately 30 inches of additional soil would be placed over Areas 1 and 2. The areas over which the additional soil cover would be placed are shown on Figure 4-6 and total approximately 45.2 acres. Based on the areas shown on this figure and assuming an 30-inch finished thickness for the additional soil cover, approximately 171,000 in-place yards of soil material will be required for this alternative. Assuming a 25% compaction rate (Caterpillar, 1996), a total of 228,000 loose cubic yards (LCY) of additional soil material would need to be brought on site. This additional soil material would be obtained from commercial sources in the St. Louis area and trucked to the Site. The soil cover would be seeded, fertilized, and mulched to establish vegetation.

After construction, the soil cover over Areas 1 and 2 would be inspected and maintained to ensure the long-term integrity of the cover. Inspection of Areas 1 and 2 would be performed on a semi-annual basis (spring and fall) or within 30 days of any severe weather conditions or other events that may have a possible impact on the cover integrity. Inspections would include walkovers of Areas 1 and 2 to identify areas, if any, of possible settlement, erosion, surficial cracking, animal burrows, and woody plant growth. If such conditions were identified, repairs would need to be made to minimize the potential for further cover damage or infiltration of storm water or snowmelt. Repairs would most likely consist of placement of additional soil as necessary to meet the design criteria listed above. Ongoing maintenance, including at least periodic (approximately three times per year) mowing or brushwacking of the vegetation on the surface of Areas 1 and 2 to minimize woody plant growth, would also be performed. In the event that any woody plants do take hold, maintenance activities would include removal of such plants including, to the maximum extent possible, the root materials and repair of the cover as necessary.

Alternative L3 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties. The presence of the buffer property allows for the placement of additional soil material in this area to reduce the slope. Other portions of the landfill slopes are not proposed for regrading as there has not been major erosion of these slopes, they are part of the overall landfill perimeter and therefore regrading these areas would require regrading slopes outside of Areas 1 and 2, and/or the toe of the landfill berm in these areas extends up to the property line and therefore there is no space available to place additional soil material.

The current slope of the southern portion of the landfill berm along the western boundary of Area 2 is approximately 42%. An estimated 15,000 yd^3 of additional in-place soil will be required to reduce the slope of the berm to 25%. Placement of this additional soil will extend the toe of the landfill berm into the Buffer Zone approximately 40 ft further to the north. Assuming a 25% reduction in volume due to placement and compaction of the soil (Caterpillar, 1996), a total of 20,000 loose cubic yards (LCY) of soil will need to be imported and placed to reduce the slope of the southern portion of the landfill berm on the western boundary of Area 2.

Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off of Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems. Storm water management facilities for the cover systems for Areas 1 and 2 would be coordinated with the storm water management system for the entire Bridgeton Sanitary Landfill and existing off-site storm water drainage systems. Any improvements needed to the adjacent landfill site or offsite storm drainage systems to address increased storm water flow, if any, that may occur as a result from placement of additional soil cover on Areas 1 and 2 would be included in the scope of Alternative L3.

In addition to placement of the additional soil cover, Alternative L3 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above (Section 4.4.4.1.2). Institutional controls will not only limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also will restrict activities that could potentially affect the integrity of the soil cover to be installed under Alternative L3

The groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L3. Alternative L3 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

As with any remedial action that may be selected by EPA for West Lake Landfill OU-1, the actual design of any soil cover, institutional controls, and inspection and maintenance requirements will be conducted as part of the remedial design phase. Information regarding the design basis and materials provided above is intended solely for describing the alternative and developing estimated costs as part of the FS.

4.4.4.1.4 Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System

Alternative L4 would consist of placing additional soil or inert fill material (non-putrescible construction and demolition debris such as concrete or asphalt rubble) or soil over Areas 1 and 2 to increase the final grades to achieve a minimum slope angle of 2%. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve a minimum slope of 2%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary. Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas. Design and construction of the landfill cover would include a rubble/rock layer to minimize bio-intrusion and erosion potential and increase the longevity of the landfill cover.

While the MDNR landfill regulations refer to a minimum slope of five percent (5%) [10 CSR 80-3.010(17)(B)(7)], during conversations between Mr. Evan Randall of Spencer Fane Britt & Browne, LLP and Mr. Frank Dolan of MDNR, Mr. Dolan indicated that the purpose of the minimum slope of 5% is to address potential settlement of a landfill over time and the creation of depressions in the landfill surface that would collect precipitation runoff and become areas of increased infiltration of precipitation. Mr. Dolan further indicated that MDNR previously required a 2% slope on the surface but, based on "common observations" of settlement of closed landfills MDNR subsequently determined that this slope angle was not great enough to prevent ponding of water due to differential settlement. Mr. Dolan referenced an article by Dean K. Wall and Chris Zeiss in the Journal of Environmental Engineering (Vol. 121, No. 3, March 1995) as the only formal document that MDNR used to select the 5% slope. In this article, the authors state that the process of differential settlement will take place within a 20 to 30 year period after a landfill is closed. The article does not address what the slope angle should be on the final surface of the landfill after settling.

Based on the fact that landfilling of the portions of the West Lake Landfill in which Areas 1 and 2 are located was completed approximately 30 years ago, differential settlement is not a concern because the majority of the differential settlement and compaction of the refuse has already occurred. Therefore, a 2% minimum slope should be sufficient to promote drainage and reduce infiltration of precipitation. As the 5% minimum final slope requirement was intended to be applied to active landfills and not retroactively applied to closed landfills, and given that the 2% slope is considered sufficient to promote drainage thereby reducing infiltration, the 5% final grade is not necessarily considered to be an appropriate requirement. Furthermore, use of a 2% slope should result in a lower potential for erosion increasing the life of the cover and overall longevity of the remedy compared to a 5% slope which would be subject to increase erosion potential. Alternative L4 has been developed to provide for a 2% minimum grade in Areas 1 and 2.

Portions of Areas 1 and 2 that contain slopes less than 2% and therefore may not adequately promote runoff of accumulated precipitation are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% and $33^1/_3$% are also displayed on Figure 4-7. In order to reduce precipitation infiltration, portions of Areas 1 and 2 possessing slopes less than 2% will be regraded through placement of additional inert fill or soil and/or by regrading (cutting and filling) the existing waste material and soil as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will also be regraded either through placement of additional fill material/soil and/or by cutting and filling of the existing material as part of this alternative. Regrading of slopes greater than 25% will be performed only in those areas where sufficient space exists between the toe of the landfill and the adjacent property.

Clean construction debris or other inert fill material or soil would be placed over the existing surface so as to achieve a 2% final grade. Figure 4-8 displays the approximate thickness of additional material that will need to be placed prior to construction of the final cover. The total volume of soil/fill material that will need to be placed to achieve the 2% final grade prior to cover construction is approximately 84,000 in-place yd^3. Allowing for compaction, approximately 112,000 LCY of soil will need to be imported to the Site. As settlement and compaction of the existing waste materials and soil may occur in response to placement of additional fill or soil cover, the estimated volume of additional fill may need to be increased to account for compaction during placement. The increased volume of the amount of material to be imported compared to the final in-place volume will be a function of the nature of the fill material to be used, placement and compaction techniques and moisture content.

Regrading of the landfill surface to achieve final grades can also be achieved by cutting and filling the existing waste material to achieve final slopes. Portions of Area 2 which contain slopes less than 2% and therefore may not adequately promote runoff of accumulated precipitation are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% are also displayed on Figure 4-7. In order to reduce precipitation infiltration, portions of Areas 1 and 2 possessing slopes less than 2% will be regraded by cutting and filling of the existing landfill materials to achieve the desired slopes as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will be regraded as part of this alternative.

Assuming a nearly balanced approach to the volume of cut and fill, a total of approximately 15,200 yd^3 would be cut and approximately 15,300 yd^3 would be filled in Area 1 for a net increase in total volume of approximately 100 yd^3 to be made up with additional soil or inert material. For Area 2, approximately 126,000 yd^3 would be cut and approximately 123,000 yd^3 would be filled in Area 2 with a net surplus in total volume of 3,000 yd^3 that would be used as a portion of the proposed final cover. Figure 4-9 displays the approximate thickness of material that will need to be cut and filled in Areas 1 and 2.

Alternative L4 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties. The presence of the buffer property allows for the placement of additional soil material in this area to reduce the slope. Other portions of the landfill slopes are not proposed for regrading as there has not been major erosion of these slopes and they are part of the overall landfill perimeter. Therefore, regrading these areas would require regrading slopes outside of Areas 1 and 2 and/or the toe of the landfill berm in these areas extends up to the property line and therefore there is no space available to place additional soil material.

The current slope of the southern portion of the landfill berm along the western boundary of Area 2 is approximately 42%. An estimated 15,000 yd^3 of additional in-place soil will be required to reduce the slope of the berm to 25%. Placement of this additional soil will extend the toe of the landfill berm into the Buffer Zone approximately 40 ft further to the north. Assuming a 25% reduction in volume due to placement and compaction of the soil (Caterpillar, 1996), a total of 20,000 loose cubic yards (LCY) of soil will need to be imported and placed to reduce the slope of the southern portion of the landfill berm on the western boundary of Area 2.

Regardless of whether the landfill is regraded through placement of additional fill material/soil or by cutting and filling of the existing waste material and soil, a new final cover will be installed consistent with the MDNR final cover requirements for operating demolition landfills. The final cover will be a Subtitle D-equivalent cover consisting of two-ft of compacted clay soil possessing a permeability of 1×10^{-5} centimeters per second (cm/sec) or less overlain by a one-foot thick, non-compacted soil layer that will be vegetated with native grasses (vegetation layer). Although not required for a Subtitle D cover, a two-ft thick layer of rock or concrete debris will be installed immediately beneath the clay layer to restrict the potential for bio-intrusion and erosion and increase the longevity of the landfill cover.

The cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2 with two feet of rock/concrete rubble and three feet of soil. From bottom to top, the cover systems would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick erosion layer of soil capable of sustaining vegetative growth.

Assuming that the landfill is regraded through placement of additional soil/fill material, the two feet of compacted clay would have volume of approximately 182,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 93,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-10. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 243,000 loose cubic yards (LCY) of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 126,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 173,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 61,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

Assuming that the landfill is regraded by cutting and filling of the existing waste material and soil, the two feet of compacted clay would have a volume of approximately 169,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 86,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-11. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 225,000 LCY of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 116,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 163,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 57,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

After construction, the landfill cover over Areas 1 and 2 would be inspected and maintained to ensure the long-term integrity of the cover. Inspection of Areas 1 and 2 would be performed on a semi-annual basis (spring and fall) or within 30 days of any severe weather conditions or other events that may have a possible impact on the cover integrity. Inspections would include walkovers of Areas 1 and 2 to identify areas, if any, of possible settlement, erosion, surficial cracking, animal burrows, and woody plant growth. If such conditions were identified, repairs would need to be made to minimize the potential for further cover damage or infiltration of storm water or snowmelt. Repairs would most likely consist of placement of additional compacted soil or vegetative layer soil as necessary to meet the design criteria listed above. Ongoing maintenance, including at least periodic (approximately three times per year) mowing or brushwacking of the vegetation on the surface of Areas 1 and 2 to minimize woody plant growth, would also be performed. In the event that any woody plants do take hold, maintenance activities would include removal of such plants including, to the maximum extent possible, the root materials and repair of the cover as necessary.

Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off of Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems. Storm water management facilities for the cover systems for Areas 1 and 2 would be coordinated with the storm water management system for the entire Bridgeton Sanitary Landfill and existing off-site storm water drainage systems. Any improvements needed to the adjacent landfill site or offsite storm drainage systems to address increased storm water flow, if any, that may occur as a result of the cover systems described for Areas 1 and 2 would be included in the scope of Alternative L4.

In addition to regrading the landfill through placement of additional soil or inert material or alternatively by regrading of the existing waste material and soil, and installation of the cover system, this alternative would also include the additional access restriction and institutional controls. Alternative L4 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above. These institutional controls are expected not only to limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also to restrict activities that could potentially affect the integrity of the landfill cover to be installed under Alternative L4.

Groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L4. In addition, Alternative L4 would include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

As with any remedial action that may be selected by EPA for West Lake Landfill OU-1, the actual design of the final grading plan and cover system, institutional controls, inspection and maintenance requirements, and design and maintenance of any associated surface water controls will be assessed as part of the remedial design phase. Information regarding the design basis, materials, and specifications provided above is intended solely for describing the alternative and developing a cost estimate as part of the FS.

4.4.4.1.5 Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System

Alternative L5 would consist of placing additional soil or inert fill material (non-putrescible construction and demolition debris such as concrete or asphalt rubble) over Areas 1 and 2 to increase the final grades to achieve a minimum slope angle of 5% specified in the MDNR regulations (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)) for final cover for operating municipal solid waste or construction and demolition landfills. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve a minimum slope of 5%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary. Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas. Design and construction of the landfill cover would include a rubble/rock layer to minimize bio-intrusion and erosion potential.

Portions of Areas 1 and 2 which contain slopes less than 5% are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% and $33^{1}/_{3}$% are also displayed on Figure 4-7. Portions of Areas 1 and 2 possessing slopes less than 5% will be regraded through placement of additional inert fill or soil and/or by regrading (cutting and filling) the existing waste material and soil as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will also be regraded either through placement of additional fill material/soil and/or by cutting and filling of the existing material as part of this alternative. Regrading of slopes greater than 25% will be performed only in those areas where sufficient space exists between the toe of the landfill and the adjacent property.

Clean construction debris or other inert fill material or soil would be placed over the existing surface so as to achieve a 5% final grade. Figure 4-12 displays the approximate thickness of additional material that will need to be placed prior to construction of the final cover. The total volume of soil/fill material that will need to be placed to achieve the 5% final grade prior to cover construction is approximately 218,000 in-place yd^3. As settlement and compaction of the existing waste materials and soil may occur, the estimated volume of additional fill needing to be placed may need to be increased to account for compaction during placement. The increased volume of the amount of material to be imported compared to the final in-place volume will be a function of the nature of the fill material to be used, placement and compaction techniques and moisture content.

Regrading of the landfill surface to achieve final grades can also be achieved by cutting and filling the existing waste material to achieve final slopes. Portions of Area 2 which contain slopes less than 5% and therefore may not adequately promote runoff of accumulated precipitation are shown on Figure 4-7. Portions of the landfill berm along the north side of Area 2 possessing slopes greater than 25% are also displayed on Figure 4-7. In order to reduce precipitation infiltration, portions of Areas 1 and 2 possessing slopes less than 5% will be regraded by cutting and filling of the existing landfill materials to achieve the desired slopes as part of this alternative. In order to prevent erosion of the landfill surface, those portions of Area 1 and 2 with slopes greater than 25% will be regraded as part of this alternative.

Assuming a nearly balanced approach to the volume of cut and fill, a total of approximately 17,000 yd^3 would be cut and filled in Area 1. For Area 2, approximately 115,000 yd^3 would be cut and filled in Area 2. Figure 4-13 displays the approximate thickness of material that will need to be cut and filled in Areas 1 and 2.

Alternative L5 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties. The presence of the buffer property allows for the placement of additional soil material in this area to reduce the slope. Other portions of the landfill slopes are not proposed for regrading as there has not been major erosion of these slopes and they are part of the overall landfill perimeter. Therefore, regrading these areas would require regrading slopes outside of Areas 1 and 2 and/or the toe of the landfill berm in these areas extends up to the property line and therefore there is no space available to place additional soil material.

The current slope of the southern portion of the landfill berm along the western boundary of Area 2 is approximately 42%. An estimated 15,000 yd^3 of additional in-place soil will be required to reduce the slope of the berm to 25%. Placement of this additional soil will extend the toe of the landfill berm into the Buffer Zone approximately 40 ft further to the north. Assuming a 25% reduction in volume due to placement and compaction of the soil (Caterpillar, 1996), a total of 20,000 loose cubic yards (LCY) of soil will need to be imported and placed to reduce the slope of the southern portion of the landfill berm on the western boundary of Area 2.

Regardless of whether the landfill is regraded through placement of additional fill material/soil or by cutting and filling of the existing waste material and soil, a new final cover will be installed consistent with the MDNR final cover requirements for operating demolition landfills. The final cover will be a Subtitle D-equivalent cover consisting of two-ft of compacted clay soil possessing a permeability of 1×10^{-5} cm/sec or less overlain by a one-foot thick, non-compacted soil layer that will be vegetated with native grasses (vegetation layer). Although not required for a Subtitle D cover, a two-ft thick layer of rock or concrete debris will be installed immediately beneath the clay layer to restrict the potential for bio-intrusion and erosion and increase the longevity of the landfill cover.

The cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2 with two feet of rock/concrete rubble and three feet of soil. From bottom to top, the cover systems would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick erosion layer of soil capable of sustaining vegetative growth.

Assuming that the landfill is regraded through placement of additional soil/fill material, the two feet of compacted clay would have a volume of approximately 155,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 80,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-14. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 206,000 loose cubic yards (LCY) of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 107,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 148,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 52,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

Assuming that the landfill is regraded by cutting and filling of the existing waste material and soil, the two feet of compacted clay would have volume of approximately 245,000 in-place yd^3, and the 1-foot thick soil layer for re-vegetation would have a volume of approximately 125,000 in-place yd^3. The resultant final grading plan is provided on Figure 4-15. Assuming a 25% reduction in volume during placement for the clay (Caterpillar, 1996), a total of 327,000 LCY of clay material would need to be imported and placed. Assuming a 26% reduction in volume for the earth material used to construct the vegetative layer (Caterpillar, 1996), a total of 169,000 LCY of soil will be required for construction of the vegetation layer. The concrete or rock layer would be composed of approximately 6 – 9 inch diameter rock or concrete placed to achieve a minimum thickness of 2-ft. It is anticipated that approximately 234,000 yd^3 of concrete rubble or rock would be required to construct this layer. In addition the void spaces within the rock or concrete rubble would need to be filled with soil to provide a uniform surface for construction of the overlying clay layer. Assuming a porosity (volume of open space) of 35% for the rock/concrete layer, approximately 82,000 yd^3 of soil will be required to fill the void spaces in the concrete/rock layer.

After construction, the landfill cover over Areas 1 and 2 would be inspected and maintained to ensure the long-term integrity of the cover. Inspection of Areas 1 and 2 would be performed on a semi-annual basis (spring and fall) or within 30 days of any severe weather conditions or other events that may have a possible impact on the cover integrity. Inspections would include walkovers of Areas 1 and 2 to identify areas, if any, of possible settlement, erosion, surficial cracking, animal burrows, and woody plant growth. If such conditions were identified, repairs would need to be made to minimize the potential for further cover damage or infiltration of storm water or snowmelt. Repairs would most likely consist of placement of additional compacted soil or vegetative layer soil as necessary to meet the design criteria listed above. Ongoing maintenance, including at least periodic (approximately three times per year) mowing or brushwacking of the vegetation on the surface of Areas 1 and 2 to minimize woody plant growth, would also be performed. In the event that any woody plants do take hold, maintenance activities would include removal of such plants including, to the maximum extent possible, the root materials and repair of the cover as necessary.

Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off of Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems. Storm water management facilities for the cover systems for Areas 1 and 2 would be coordinated with the storm water management system for the entire Bridgeton Sanitary Landfill and existing off-site storm water drainage systems. Any improvements needed to the adjacent landfill site or offsite storm drainage systems to address increased storm water flow, if any, that may occur as a result of the cover systems described for Areas 1 and 2 would be included in the scope of Alternative L5.

In addition to regrading the landfill through placement of additional soil or inert material or alternatively by regrading of the existing waste material and soil, and installation of the cover system, this alternative would also include the additional access restriction and institutional controls. Alternative L5 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above. These institutional controls are expected not only to limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also to restrict activities that could potentially affect the integrity of the landfill cover to be installed under Alternative L5.

Groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L5. Alternative L5 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

As with any remedial action that may be selected by EPA for West Lake Landfill OU-1, the actual design of the final grading plan and cover system, institutional controls, inspection and maintenance requirements, and design and maintenance of any associated surface water controls will be assessed as part of the remedial design phase. Information regarding the design basis, materials, and specifications provided above is intended solely for describing the alternative and developing a cost estimate as part of the FS.

4.4.4.1.6 Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and Regrading and Installation of a Subtitle D Cover System

Although as discussed elsewhere (Section 4.4.3 and Appendix B), the radiological materials in Areas 1 and 2 do not meet the criteria for "hot spot" removal as established in EPA's "Presumptive Remedy for CERCLA Municipal Landfill Sites" guidance (EPA, 1993b), removal of a portion of the radiologically impacted materials within Areas 1 and/or 2 has been retained as a potential remedial alternative for OU-1. The evaluations presented in Section 4.4.3 and Appendix B support the conclusion that there are no discrete, accessible principal threat wastes meeting the hot spot criteria as described in EPA's presumptive remedy guidance. While there are no "hot spots", based on the long-term hazard associated with radionuclides, this FS includes an alternative that examines possible excavation of some accessible portion(s) of the landfill material that may contain relatively higher concentrations of radiologically contaminated material.

Alternative L6 consists of excavation of that portion of the radiologically impacted materials in Area 2 that contain levels of radioactivity that are higher than those found in other portions of Area 2 along with the installation of an upgraded landfill cover. No specific criteria have been established or defined for identification of radiologically impacted materials containing higher levels of radioactivity. As part of the development of this alternative, excavation of all of the identified radiologically-impacted material was initially evaluated (Appendix B). This assessment indicated that over 250,000 yd^3 of material (including 130,000 yd^3 of radiologically-impacted materials and approximately 120,000 yds^3 of overburden waste materials and soil) would have to be excavated. This amount of excavation is substantially greater than the 100,000 yd^3 or less volume identified in EPA's Presumptive Remedy for CERCLA Municipal Landfill Sites guidance (EPA, 1993b) as being reasonable to consider for removal. Therefore, this alternative looks at the possibility of removing a smaller volume (a subset) of the radiologically-impacted materials from Area 2 which contains higher levels of radionuclides found at the Site.

For purposes of developing this alternative, the activity levels of individual radionuclides and gamma levels measured in the downhole (borehole) gamma logs were reviewed to identify those materials with levels of radioactivity that were higher than those found in other portions of Area 2. The purpose of this effort was to identify a sub-area(s) within Area 2 that are substantially smaller than the entire extent of Area 2 that could be considered for excavation as part of a possible "hot spot" removal alternative.

As a starting point, the total extent of the area containing radionuclides at levels above the UMTRCA criteria for unrestricted use (40 CFR 192) was identified. Figure 4-16 displays the approximate extent of radionuclides with levels of radium or thorium above the UMTRCA standard (40 CFR 192); that is radium or thorium levels greater than or equal to background plus 5 pCi/g. The total area containing radium or thorium at levels greater than 5 pCi/g above background is estimated to be approximately 818,000 ft^2 (approximately 18.8 acres).

The criteria used to identify an area for possible "hot spot" removal were the activity levels of individual radionuclides and the levels of downhole gamma readings. Figure 4-16 displays the approximate extent of radionuclides with levels of individual radionuclides above 100 pCi/g and/or downhole gamma readings above 100,000 counts per minute (cpm). The total area containing radionuclides greater than 100 pCi/g or downhole gamma readings above 100,000 cpm is estimated to be approximately 542,000 ft^2 (approximately 12.4 acres). This area represents approximately two-thirds of the entire area containing radionuclides above background in Area 2. The extent of the area containing individual radionuclides above 100 pCi/g and/or downhole gamma readings above 100,000 cpm represents the majority of Area 2, and therefore is not significantly different from the areal extent defined based on the UMTRCA criteria. Therefore, identification of an area for potential removal of a portion of radiologically impacted materials from Area 2 will not be based on criteria of 100 pCi/g and downhole gamma readings above 100,000 cpm.

Figure 4-16 also displays the approximate extent of radionuclides with levels of individual radionuclides above 1,000 pCi/g and/or downhole gamma readings above 500,000 cpm. Two separate areas are identified on this figure; one in the vicinity of boring WL-209 and a larger area around borings WL-210, WL-216, and WL-234. The total area containing radionuclides greater than 1,000 pCi/g or downhole gamma readings above 500,000 cpm is estimated to be approximately 190,000 ft^2 (approximately 4.4 acres). This area represents approximately one-fourth of the entire area containing radionuclides above background in Area 2. As this area represents a reasonable subset of the entire extent of Area 2, that is the identified volume is within the range that EPA defined in their presumptive remedy guidance (EPA, 1993b) as being reasonable for removal. Therefore, these criteria will be used to define the "hot spot" removal alternative.

Under this alternative, materials containing individual radionuclides with activity levels above 1,000 pCi/g or gamma readings above 500,000 cpm would be excavated. Under one scenario, all of these materials (construction and demolition debris, household and commercial refuse, radiologically impacted soil and unimpacted soil) would be shipped offsite for disposal at a licensed commercial low-level radioactive waste disposal facility. Based on characterization of the depth of radiologically impacted materials conducted during the RI (EMSI, 2000), the total thickness of the radiologically impacted materials to be removed under this alternative would be approximately 5 to 6 feet. The total in-place volume of radiologically impacted materials (soil and waste) to be removed under this alternative is estimated to be approximately 1,150,000 cubic feet (42,430 bank cubic yards [BCY]). Assuming an in-place density of approximately 1,500 lb/yd3, a total of 32,000 tons of material (soil and waste) would be excavated and hauled offsite for disposal.

Excavation of this material will result in an increase in the volume of materials. No specific information is available on the exact increase that will occur during this excavation. Typical bulking factors for soil are approximately 120% to 130% (i.e., a 20% to 30% increase in volume) [Caterpillar, 1996]. Due to expansion of the previously compacted wastes and the variability in the size and nature of materials disposed of in a municipal landfill, a greater degree of bulking is anticipated for solid waste compared to soil. Experience with excavation at the Tulalip Landfill NPL Site in Snohomish County, Washington indicated that during excavation of previously disposed solid waste, the waste materials increased in volume by a factor of two (a 200% bulking factor). Based on a bulking factor of 200%, the total volume of material (waste plus soil) to be shipped and disposed at a commercial low-level radioactive waste disposal facility in conjunction with excavation of "hot spot" material under this alternative is estimated to be approximately 85,000 yds^3.

Assuming 20 yds^3 trucks would be used to transport these materials (waste and soil) from the Site, a total of approximately 4,250 truckloads will be required to transport the excavated material offsite. If these trucks were to haul this material to a rail-loading facility and the material was placed in 100 yds^3 gondola rail cars [which can hold approximately 76 cu yds (McDaniel, et al, 1999)] for transport to a commercial disposal facility, a total of approximately 1,120 railcars would be required for transport of the excavated waste and soil material under this alternative.

As an alternative to shipping all of the excavated material (construction and demolition debris, commercial and household refuse, radiologically impacted soil, and unimpacted soil) for offsite disposal, the excavated material could be screened to separate out the soil (both impacted and unimpacted) fraction from the debris and refuse. Soil is used in landfill construction for daily, intermediate and final cover. Assuming that the amount of soil in the excavated material is typical of older solid waste landfills, the soil fraction is expected to be approximately 40 to 50%. This high percentage is due in part to the fact that only the upper portion of the landfill (the upper 5 to 6 ft) will be excavated and presuming a two foot thick final cover, results in the excavated material containing a higher percentage of soil than would be found in the landfill overall. Assuming a 40% soil fraction, the total volume of soil to be separated and disposed offsite is estimated to be approximately 17,000 yd^3. Assuming a bulking factor of 125% for soil (Caterpillar, 1996), this translates to a volume for transport and disposal of 21,250 yd^3 of soil after segregation from the refuse. A total of approximately 1,063 truck loads would be required to ship the recovered soil offsite and a total of approximately 213 train railcars would be needed to transfer the segregated soil material to a disposal facility. Assuming a density of 2,000 lb/yd^3, the total mass of soil to be shipped and disposed offsite is estimated to be 21,000 tons.

In addition to the selective excavation component described above, Alternative L6 would also include backfilling of the selective excavation with soil or inert fill material, regrading and construction of an upgraded landfill cover as described under Alternative L4 or L5; as well as the additional access restriction and institutional controls.

Alternative L6 incorporates the current and anticipated additional institutional control measures described as part of Alternative L2, above. These institutional controls are expected not only to limit activities and land uses that could result in potential exposure to waste materials or contaminants in the landfill, but also to restrict activities that could potentially affect the integrity of the landfill cover to be installed under Alternative L6.

Groundwater and landfill gas monitoring, and cover maintenance components identified under Alternative L2 would also be part of Alternative L6. Alternative L6 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.2 Buffer Zone and Crossroad Property Alternatives

Historic erosion of the landfill surface and slope of the landfill berm resulted in deposition of radiologically impacted soil onto property formerly owned by Ford Motor Credit Co. (Ford) located adjacent to the northern portion of Area 2. Prior to 1998, Ford subdivided and sold all of its property in this area. The majority of the Ford property was sold to Crossroad Properties LLC and has been developed into the Crossroad Industrial Park. Ford retained the 1.78 acres immediately adjacent to the western portion of the northern boundary of Area 2, referred to as the Buffer Zone, the ownership of which was subsequently acquired by Rock Road Industries, Inc. (Rock Road) on behalf of the Respondents. Prior to 1999, Crossroad had developed all of their property with the exception of Lot 2A2, a 3.58 acre parcel located immediately north of the Buffer Zone. It is the intention of the Respondents to amend the existing land use covenant so that it would also apply to the Buffer Zone as part of the implementation of the selected remedial action for OU-1.

In 1999, soil was scraped from Lot 2A2 and placed in piles on the Buffer Zone or Lot 2A1. The area subsequently became revegetated by natural processes. In 2004, it was discovered that Crossroad Lot 2A1 as well as the Buffer Zone property had been regraded, a gravel cover had been installed, and the area was being used by AAA Trailer for storage of trailers. AAA Trailer reported that the soil piles created in 1999 that had been present on Lot 2A2 and the Buffer Zone had been piled in the northeastern corner of Buffer Zone near the location of monitoring well WL-206. This area was characterized as part of the RI completed in 1998; soil sampling of this area was conducted in February 2000 after the 1999 soil grading activities by AAA Trailer; however, no additional soil sampling or other characterization activities were performed after the subsequent soil grading activities by AAA Trailer. For evaluation of remedial alternatives in this FS, it has been assumed that soil containing radionuclides at levels above those suitable for unrestricted use still remain on the Buffer Zone and Lot 2A2.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas. Under this scenario, the use restrictions will encompass the impacted area of the Buffer Zone and no additional use restrictions will be necessary to address this property. As previously discussed, radiologically-impacted soil may remain beneath portions of Lot 2A2 of the Crossroad property. Soil sampling will be undertaken to support the remedial design and evaluate the potential presence of radiologically impacted soil beneath Lot 2A2. In the event that radiologically impacted soil does remain beneath Lot 2A2 and such soil is not removed as part of the selected remedy, implementation of land use restrictions such as those described under Alternative F2 may be required for this property..

Four alternatives have been identified for the radiologically impacted soil on the Buffer Zone and Crossroad property. These alternatives are described in the following subsections.

4.4.4.2.1 Alternative F1 – No Action

Alternative F1 (No Action) is included as required by the NCP to serve as a baseline for comparison of the other alternatives. Under this alternative, no engineering measures will be implemented to reduce potential exposures to the radiologically impacted soil in the Buffer Zone and Crossroad property. Similarly, no new institutional controls and no additional fencing will be implemented to control land use, access or potential future exposures to the Buffer Zone and Crossroad properties. Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties. No long-term monitoring will be conducted to identify or evaluate any potential changes that may occur to conditions in the Buffer Zone or Crossroad property or to contaminant levels or occurrences in this area.

Alternative F1 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

In November 1999, it was discovered that the surface of Crossroad Lot 2A1 was graded and capped with gravel by, or on the behalf of AAA Trailer. This grading and capping occurred after completion of the investigations and sampling activities performed for the RI for OU-1 had been completed. Consequently additional sampling was performed in 2000 to assess the levels of radionuclides remaining in the surface soil of Lot 2A2 and the Buffer Zone (see discussion in Section 2.2.1.3). With the exception of the thorium-230 result for a single sample, the results of the additional sampling indicated that only background levels of radionuclides or levels slightly above background remained on Lot 2A2 and the Buffer Zone. As part of this regrading, piles of soil were created and left on portions of Crossroad Lot 2A2 and the Buffer Zone.

During preparation for additional groundwater sampling performed as part of the FS activities, it was discovered that additional grading and capping had been performed. The surface of Crossroad Lot 2A2 and the Buffer Zone had been graded and capped with gravel by, or on the behalf of AAA Trailer. This additional grading activity was performed after completion of the initial and additional investigations and sampling activities performed for completion of the RI and FS for OU-1. Although AAA Trailer has reported that the most recent regrading involved pushing soil into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206, the soil piles on Lot 2A2 and the Buffer Zone observed in 1999 and 2000 no longer exist and the final disposition of these soil piles (whether they were hauled offsite or spread out beneath the gravel layer) is unknown. Consequently, the current conditions of these two parcels with respect to radionuclide occurrences above background, if any, are unknown at this time.

For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. As part of the No Action alternative, or any of the other Buffer Zone and Crossroad property alternatives, additional soil sampling will need to be performed to assess the current levels of radionuclides, if any, in surface soil on Lot 2A2 and the Buffer Zone. These data will be used to assess whether current conditions allow for unrestricted use of these parcels or whether remedial actions such as those described for alternatives F2, F3 and F4 are required. This sampling will be performed in accordance with the MultiAgency Radiation Survey and Site Investigation Manual (MARRSIM).

4.4.4.2.2 Alternative F2 – Institutional and Access Controls

Alternative F2 would entail implementation of institutional and access controls on the Buffer Zone and Crossroad property. A full discussion of institutional controls and institutional control mechanisms appears at Sections 4.3.1 and Section 4.4.4.1.2, above. The following use restrictions would apply to the Buffer Zone and the Crossroads Property of the West Lake Landfill site under Alternative F2 (and also as discussed below F3).

1. Prevent development and use for residential housing, schools, childcare facilities or playgrounds.

2. Any new or existing structures for human occupancy should be assessed for gas accumulation, and mitigating engineering measures, such as foundation venting, should be employed as necessary.

3. Manage any construction activities, such as drilling, boring, digging, or other use of heavy equipment to avoid disturbance of the OU 1 Area.

4. Prevent the use of all groundwater underlying these areas.

5. Retain access necessary for continued maintenance, monitoring, inspections and repair.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Soil sampling will be undertaken to support the remedial design and confirm these assumptions. Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas within the Buffer Zone. Under this scenario, the use restrictions will encompass the impacted area of the Ford property and no additional use restrictions will be necessary to address the Buffer Zone; however, use restrictions may be required for Crossroad Lot 2A2 to prevent exposure to radiologically-impacted soil, if any, that may be present beneath this parcel and to protect the integrity of the landfill toe and cover system on the adjacent Buffer Zone.. The institutional control component (Appendix E) of the MDNR CALM draft regulations provides a useful format for implementing use restrictions at the West Lake Landfill site.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties.

Under this alternative, additional fencing would be installed as an additional access restriction around the Buffer Zone as necessary to complete the perimeter fence around this property to prevent access to this property. Specifically, approximately 900 feet of additional fencing would be installed along the northwestern and southwestern boundaries of the Buffer Zone (Figure 2-7). Signage would be installed to warn potential trespassers.

Alternative F2 would include additional soil sampling to assess the current conditions of the surface soil in Lot 2A2 and the Buffer Zone after the recent grading and capping activity performed by, or on the behalf of AAA Trailer. Alternative F2 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.2.3 Alternative F3 – Capping and Institutional and Access Controls

Alternative F3 includes construction of a cap consisting of a minimum 6-inch thick gravel layer, asphalt or other form of pavement, or another form of surface preparation installed over the Crossroad property to prevent direct contact with the radiologically impacted soil. Installation of gravel or pavement over the surface of the Crossroad property is consistent with the currently intended use of the property for outdoor storage of tractor trailers. Installation of a gravel cover or pavement would prevent direct contact by workers with the radiologically impacted soil.

The radiologically-impacted soil on the Buffer Zone (assuming some still remains after the recent regrading and construction of a gravel cap performed by, or on the behalf of, AAA Trailer) would either be capped in a similar manner or would be covered with additional, non-impacted soil as part of one of the landfill regrading alternatives. As part of the Area 1 and 2 Landfill Alternatives, it is expected that the slope of the landfill berm will be reduced through placement of additional clean fill over the top of the landfill berm to reduce the slope angle to below 25 degrees. As part of the regrading of the landfill berm, the toe of the berm would be extended to the north over the Buffer Zone, thereby providing a cover over the radiologically impacted soil.

Alternative F3 would also entail implementation of institutional controls in the form of a land use covenant to control potential future uses of the Buffer Zone and Crossroad property. The land use restrictions described under Alternative F2 would also apply to the Buffer Zone and the Crossroads Property under Alternative F3.

Contaminated soils may remain on portions of the Ford property, which consists of the buffer property owned by Rock Road and Lot 2A2 owned by Crossroad Industries (see Figure 2-8). Soil sampling will be undertaken to support the remedial design and confirm these assumptions. Under the Subtitle D landfill cover alternatives, it is anticipated that the toe of the landfill berm will be regraded and extended over the radiologically impacted areas in the Buffer Zone. Under this scenario, the use restrictions associated with the landfill cover alternatives will encompass the Buffer Zone and no additional use restrictions will be necessary to address this property. Land use restrictions may be required for Crossroad Lot 2A2 to prevent exposure to radiologically-impacted soil, if any, that may be present beneath this parcel and to protect the integrity of the landfill toe and cover system on the adjacent Buffer Zone.

Alternative F3 would include additional soil sampling to assess the current conditions of the surface soil in Lot 2A2 and the Buffer Zone after the recent grading and capping activity performed by, or on the behalf of AAA Trailer. Alternative F3 would also include installation of a perimeter fence to control access, institutional controls to control land use, and the performance of a 5-year review by EPA every five years, as described under Alternative L1.

4.4.4.2.4 Alternative F4 – Excavation of Soil with Radioactivity Above UMTRCA Standards

Alternative F4 would entail excavation of the radiologically impacted soil from the Buffer Zone and/or Crossroad property and consolidation of the radiologically impacted soil on the surface of Area 2. Prior to excavation of soil, the existing gravel cover previously constructed by AAA Trailer would need to be removed. All soil containing radium or thorium at levels greater than 5 pCi/g above background would be excavated and placed on top of Area 2. Upon completion of excavation, verification sampling would be performed followed by backfilling and regrading of the area and replacement of the gravel cover.

Based on the results of investigations of the Buffer Zone and Crossroad property conducted prior to 1999, the extent of radiologically impacted soil covered all of the Buffer Zone and the majority of Crossroad Lot 2A2, a total area of approximately 5.4 acres. In 1999, the surface of Crossroad Lot 2A2 and a portion of the Buffer Zone was scraped to a depth of approximately one to two feet and the removed soil was placed in stockpiles on the Buffer Zone. This soil removal was apparently performed by AAA Trailer, as part of their development of a parking area for tractor trailers on the adjacent Lot 2A1. Additional soil sampling and analyses were performed in February 2000 to assess potential occurrences of radionuclides that may remain after the 1999 soil removal. Results of this sampling indicated that with the exception of one sample (RC-02 obtained near the location of boring WL-206 on the Buffer Zone in the area of the former slope failure), all of the samples displayed radionuclide levels that were less than 5 pCi/g above background. Based on these data, the area that still contained radiologically impacted soil with radionuclide levels greater than 5 pCi/g above background was anticipated to be quite small and could possibly have been limited to the Buffer Zone. Based on the available data, the total extent of the area that may still contain radionuclides at levels greater than 5 pCi/g above background at that time (2000) was estimated to be approximately one acre.

The above description represents conditions found to exist in 2000, prior to the most recent regrading of Lot 2A1 and the Buffer Zone. AAA Trailer has reported that the most recent regrading involved pushing soil into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. Since the current soil conditions do not represent those during the February 2000 soil sampling, the extent of soil containing radionuclides at levels above unrestricted use standards could be greater or less than the one acre area estimated to exist in 2000. As previously indicated, for purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone.

The area to be excavated would be defined based on the results of additional sampling and laboratory analyses. Additional soil sampling and testing would be performed in accordance with the MultiAgency Radiation Survey and Site Investigation Manual (MARRSIM) to determine the extent of the area requiring excavation. Alternatively, a prescribed area and depth of excavation could be defined that would include all of the radiologically impacted soil along with unimpacted soil. For example, the top one-foot of soil could be removed from the entire area of the Buffer Zone and Lot 2A2 of the Crossroad property. Regardless of which technique is used to determine the extent of the area to be excavated, upon removal of the soil, additional confirmation testing will be performed to verify that all of the soil containing radium and thorium at levels greater than 5 pCi/g above background has been removed.

Upon completion of all excavation and verification testing activities, clean fill material would be placed in the excavated area to restore the property to the original grade. If any material is excavated from the Crossroad property, placement of clean fill material would be coordinated with the owner of Lot 2A2 and their development plans for that parcel. Presuming their intent is to place gravel or pavement over this area, the depth of clean fill to be replaced may be adjusted to allow for placement of the gravel surface or pavement. Similarly, placement of clean fill within any portions of the Buffer Zone that may be excavated will need to be coordinated with the anticipated grading plan that may be implemented as part of the landfill area alternatives.

Because Alternative F4 entails removal of all soil containing radium and thorium at levels greater than 5 pCi/g above background and refilling with clean material, no institutional controls or access restrictions are contemplated.

4.5 Screening of Alternatives

Often, prior to the detailed analysis of alternatives, a large number of remedial alternatives are screened in order to screen out certain alternatives, thereby allowing the more detailed evaluation to be undertaken with a reduced number of alternatives. The assembled alternatives are typically screened against the criteria of overall effectiveness in meeting the RAOs, implementability, and cost. The purpose of the screening is to reduce the number of alternatives that will undergo a more thorough and extensive analysis during the detailed evaluation of alternatives.

Given the limited number of remedial actions that are potentially viable for OU-1 (i.e., six for the landfill area and four for the Buffer Zone/Crossroad property), additional screening to eliminate alternatives was not required. Thus, all of the alternatives have been carried forward to the detailed analysis presented in Section 5.

5 DETAILED ANALYSIS OF ALTERNATIVES

In this section, the remedial alternatives (six landfill alternatives and four Buffer Zone/Crossroad property alternatives) developed in Section 4 are subjected to detailed analysis. The purpose of this detailed analysis is to provide sufficient information to allow for comparisons among the alternatives based on the standard criteria specified in the NCP.

The detailed evaluation of final alternatives for a remedial action is a two-stage process. During the first stage of evaluation, each of the alternatives is assessed against the nine criteria prescribed by the NCP. This first-stage evaluation of the final remedial action alternatives for the OU-1 of the West Lake Landfill is presented in this section. This evaluation is based on the conceptual descriptions of the final alternatives provided in Section 4.4.4.

In the second stage of the evaluation process, the alternatives are compared against each other to identify relative advantages and disadvantages and trade-offs among the alternatives in terms of the nine NCP criteria. The purpose of the comparative analysis is to provide information for a balanced remedy selection. The second-stage evaluation of the potential remedial action alternatives for the West Lake Landfill OU-1 is presented in Section 6.

The nine NCP evaluation criteria include:

Threshold Criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Modifying Criteria:

- State Acceptance
- Community Acceptance

The NCP [40 CFR Section 300.430(e)(9)(iii)] categorizes these nine criteria into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Each type of criteria has its own weight when it is evaluated. Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative, and include overall protection of human health and the environment and compliance with ARARs (unless a waiver is obtained).

Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The primary balancing criteria represent the main technical criteria upon which the alternative evaluation is based.

Modifying criteria include State acceptance and community acceptance. These criteria may be used to modify aspects of the preferred alternative when preparing the Proposed Plan. Modifying criteria are generally evaluated after public comment on the FS and the Proposed Plan. Accordingly, only the seven threshold and primary balancing criteria are used in the detailed analysis phase. The following sections provide descriptions of the evaluation criteria and the items considered when assessing alternatives with respect to each criterion.

5.1 Description of Evaluation Criteria

Details regarding the specific elements to be considered in the evaluation of the nine NCP criteria are described in this section.

5.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion assesses how each alternative provides and maintains adequate protection of human health and the environment. Alternatives are assessed to determine whether they can adequately protect human health and the environment from unacceptable risks posed by contaminants present at the site, in both the short and long term. This criterion is also used to evaluate how risks would be eliminated, reduced, or controlled through the remedial activities. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

5.1.2 Compliance with ARARs

This evaluation criterion is used to evaluate if each alternative would attain federal and State ARARs, or whether invoking waivers to specific ARARs is adequately justified. Other information, such as advisories, criteria, or guidance, is considered where appropriate during the ARARs analysis. The considerations evaluated during the analysis of the ARARs applicable to each alternative are presented below. Potential chemical-, location-, and action-specific ARARs for West Lake Landfill OU-1 were previously identified in Section 3.1.

Chemical-specific ARARs:

- Likelihood that the alternative will achieve compliance with chemical-specific ARARs within a reasonable period of time.
- If it appears that compliance with chemical-specific ARARs will not be achieved, then evaluation of whether a waiver is appropriate.

Location-specific ARARs:

- Determination of whether any location-specific ARARs apply to the alternative.
- Likelihood that the alternative will achieve compliance with the location-specific ARAR.
- Evaluation of whether a waiver is appropriate if the location-specific ARAR cannot be met.

Action-specific ARARs:

- Likelihood that the alternative will achieve compliance with action-specific ARARs.
- Evaluation of whether a waiver is appropriate if the action-specific ARAR cannot be met.

Other criteria and guidance:

- Likelihood that the alternative will achieve compliance with other criteria, such as risk-based criteria.

5.1.3 Long-Term Effectiveness and Permanence

This evaluation criterion addresses the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing the remedial action imposed by the alternative. The primary components of this criterion are the magnitude of residual risk remaining at the site after remedial objectives have been met and the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The considerations evaluated during the analysis of each alternative for long-term effectiveness and permanence are presented below. The components addressed for each alternative are described in more detail in the following subsections.

Magnitude of residual risks:

- Identity of remaining risks (risks from treatment residuals) as well as risks from untreated residual contamination.
- Magnitude of the remaining risks.

Adequacy and reliability of controls:

- Likelihood that the technologies will meet required process efficiencies or performance specifications.
- Type and degree of long-term management required.
- Long-term monitoring requirements.
- O&M functions that must be performed.
- Difficulties and uncertainties associated with long-term O&M functions.
- Potential need for technical components replacement.
- Magnitude of threats or risks should the remedial action need replacement.
- Degree of confidence that controls can adequately handle potential problems.
- Uncertainties associated with land disposal of residuals and untreated wastes.

5.1.3.1 Magnitude of Residual Risk

The magnitude of residual risk at the end of remedial activities is measured by numerical standards such as PRGs, or the volume or concentration of contaminants remaining. The characteristics of the residuals remaining are also evaluated, considering their volume, toxicity, and mobility.

5.1.3.2 Adequacy and Reliability of Controls

The adequacy and reliability of controls that are used to either manage treatment residuals or untreated materials that remain after attaining PRGs are evaluated. This criterion includes an assessment of containment systems and institutional controls to evaluate the degree of confidence that they adequately handle potential problems and provide sufficient protection. The criterion also addresses long-term reliability, the need for long-term management and monitoring, and the potential need to replace technical components of the alternative.

5.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

This evaluation criterion addresses the anticipated performance of the treatment technologies employed by each alternative in permanently and significantly reducing toxicity, mobility, and/or volume of contaminants associated with the OU. The NCP prefers remedial actions where treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The considerations evaluated during the analysis of each alternative for reduction of toxicity, mobility, or volume of contaminants present at a given site are presented below:

Treatment process and remedy:

- Likelihood that the treatment process addresses the principal threat.
- Special requirements for the treatment process.

Relative amount of hazardous material destroyed or treated:

- Portion (mass) of CoPC that is destroyed.
- Portion (mass) of CoPC that is treated.

Reduction in toxicity, mobility, or volume:

- Extent that the total mass of contaminants is reduced.
- Extent that the mobility of contaminants is reduced.
- Extent that the volume of contaminants is reduced.

Irreversibility of treatment:

- Degree that the effects of the treatment are irreversible.

Type and quantity of residuals remaining following treatment:

- Residuals that will remain.
- Quantities and characteristics of the residuals.
- Risk posed by the treatment residuals.

Statutory preference for treatment as a principal element:

- Extent to which the scope of the action covers the principal threats.
- Extent to which the scope of the action reduces the inherent hazards posed by the principal threats at the site.

5.1.5 Short-Term Effectiveness

Short-term effectiveness considers the effect of each remedial alternative on the protection of human health and the environment during the construction and implementation phase. The short-term effectiveness evaluation only addresses protection prior to meeting the RAOs. The considerations evaluated during the analysis of each alternative for short-term effectiveness are presented below:

Protection of the community during any remedial action:

- Risks to the community that must be addressed.
- How the risks will be addressed and mitigated.
- Remaining risks that cannot be readily controlled.

Protection of workers during remedial actions:

- Risks to the workers that must be addressed.
- How the risks will be addressed and mitigated and the effectiveness and reliability of measures to be taken.
- Remaining risks that cannot be readily controlled.

Environmental impacts of any remedial action:

- Environmental impacts that are expected with the construction and implementation of the alternative.
- Mitigation measures that are available and their reliability to minimize potential impacts.
- Impacts that cannot be avoided, should the alternative be implemented.

Time until RAOs are achieved:

- Time to achieve protection against the threats being addressed.
- Time until any remaining threats are addressed.
- Time until RAOs are achieved.

5.1.6 Implementability

Implementability evaluates the technical feasibility and administrative feasibility (i.e., the ease or difficulty) of implementing each alternative and the availability of required services and materials during its implementation. The following considerations are evaluated during the analysis of each alternative for implementability:

<u>Technical Feasibility</u>

Ability to construct and operate the technology:

- Difficulties associated with the construction.
- Uncertainties associated with the construction.

Reliability of the technology:

- Likelihood that technical problems will lead to schedule delays.

Ease of undertaking additional remedial action:

- Likely future remedial actions that may be anticipated.
- Difficulty implementing additional remedial actions.

Monitoring considerations with respect to effectiveness of the remedy:

- Migration or exposure pathways that cannot be monitored adequately.
- Risks of exposure, should the monitoring be insufficient to detect failure.

<u>Administrative Feasibility</u>

Coordination with other agencies:

- Steps required to coordinate with regulatory agencies to implement any remedy.
- Steps required to establish long-term or future coordination among agencies.
- Ease of obtaining permits for offsite activities, if required.

<u>Availability of Services and Materials</u>

Availability of treatment, storage capacity, and disposal services:

- Availability of adequate treatment, storage capacity, and disposal services.
- Additional capacity that is necessary.
- Whether lack of capacity prevents implementation.
- Additional provisions required to ensure that additional capacity is available.

Availability of necessary equipment and specialists:

- Availability of adequate equipment and specialists.
- Additional equipment or specialists that are required.
- Whether there is a lack of equipment or specialists.
- Additional provisions required to ensure that equipment and specialists are available.

Availability of prospective technologies:

- Whether technologies under consideration are generally available and sufficiently demonstrated.

- Further field applications needed to demonstrate that the technologies may be used full-scale to treat contaminants.
- When technology should be available for full-scale use.
- Whether more than one vendor will be available to provide a competitive bid.

5.1.7 Cost

The estimated costs are presented within the +50/-30 percent accuracy range stated in RI/FS guidance (USEPA, 1988). Capital and O&M costs were prepared using March 2005 dollars. In preparing the capital and O&M cost estimates, a contingency allowance of 25 percent was included to address unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the data on hand at the time the estimate is prepared. The total contingency allowance is a combination of both scope and bid contingency. Scope contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial design proceeds. Bid contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial action construction or O&M proceeds.

With respect to the present worth cost analyses, a discount rate of 7 percent (before taxes and after inflation) in accordance with A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, 2000) and a 30-year period of performance for costing purposes were assumed. Additional detail regarding assumptions used in preparing the estimated costs is provided in Appendix D.

In accordance with EPA guidance for conducting RI/FS (EPA, 1988a), a 30 year period of performance was used in the development of the present worth analysis. As wastes will remain onsite beyond 30 years and considering the longevity of radioactive materials, monitoring and maintenance activities will likely be required beyond the 30 year period used for preparation of the cost estimates. The use of a 30 year period for the present worth analysis of the cost of alternatives is not intended to imply or otherwise provide a basis to limit future site maintenance and monitoring activities to a duration of 30 years. The need for and scope of continued monitoring and maintenance both within and beyond 30 years will be subject to ongoing evaluation as part of the Five Year Review process for the Site. Although cost estimates could be prepared for periods greater than 30 years, the estimated annual costs of monitoring and maintenance activities are similar for all of the alternatives and therefore inclusion of costs beyond 30 years would not result in significant differentiate the between the alternatives.

5.1.8 State Acceptance

This criterion involves technical and administrative concerns that the State may communicate in its comments concerning each alternative.

5.1.9 Community Acceptance

The preferred alternative for OU-1 will be presented to the public in a Proposed Plan, which will provide a brief summary of all of the alternatives studied in the detailed analysis of alternatives section of this FS. In accordance with the NCP, the public will have an opportunity to review and comment on the selected remedial alternative presented in the Proposed Plan. The public's comments will be addressed in the responsiveness summary and ROD for OU-1 for the West Lake Landfill.

5.2 Results of the Detailed Analysis of Alternatives - Areas 1 and 2 Landfill Alternatives

The following sections present the detailed analysis of the six Area 1 and 2 Landfill Alternatives using the seven threshold and primary balancing criteria.

5.2.1 Alternative L1: No Action

This section presents the description and detailed analysis of the No Action alternative. Under the No Action alternative, no engineering measures will be implemented to reduce potential exposures or control potential migration from Areas 1 and 2. Similarly, no additional institutional controls beyond those already in place and no additional fencing will be implemented to control land use, access, or potential future exposures to Areas 1 and 2. As the existing institutional controls cannot be removed or modified without the approval of the land owner(s), EPA and MDNR, the existing institutional controls will remain in effect as part of the No Action alternative. As the West Lake Landfill continues to be an active operating landfill and industrial facility that is fenced and for which access is controlled, and it is anticipated that these ongoing uses will continue into the future, it is assumed that the existing fence and access controls will remain in effect for the No Action alternative. No monitoring will be conducted under the No Action alternative to identify or evaluate any potential changes that may occur to conditions at Areas 1 and 2 or to contaminant levels or occurrences. As radiologically-impacted materials and wastes containing other hazardous substances will remain on-site, a Five Year Review will be performed by EPA as part of the implementation of the No Action alternative.

As the No Action alternative does not include any active engineering measures, it is not consistent with the NCP expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable. In addition, as no engineering measures will be implemented under this alternative, the No Action alternative is inconsistent with the presumptive remedy approach established by EPA for CERCLA municipal landfill sites. Even so, the No

Action alternative will be evaluated in this FS, as required by the NCP and the presumptive remedy guidance, as it serves as the baseline for comparison of the effectiveness of the other alternatives.

5.2.1.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming the existing institutional controls are maintained, monitored and enforced and the disposal areas are monitored and maintained. Use of these areas for activities such as outdoor storage that would be ancillary to office or other commercial uses that may be conducted in the future on other portions of the landfill are currently not prohibited. Analysis of potential worker exposures associated with possible future use of Areas 1 and 2 for outdoor storage was performed as part of the BRA. These analyses indicated that future use of Areas 1 and 2 for outdoor storage could pose a risk to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. This analysis was dependent on the assumed frequency and duration that potential future onsite workers would be present in Areas 1 and 2. With increased frequency and duration of exposure, the potential risks would increase. As the surface of Areas 1 and 2 is not currently covered by a landfill cover meeting the requirements of the MDNR solid waste regulations, infiltration into and erosion of these areas poses a potential risk to human health and the environment in the future.

The No Action alternative does not provide for monitoring and enforcement of institutional controls which is necessary for long-term effectiveness. Additionally, this alternative does not provide for monitoring and maintenance of the disposal areas which would also be necessary to assure long-term effectiveness. Lastly, this alternative does not address all the pathways identified by the RAOs. Therefore, the No Action alternative is not considered to be protective of public health and absent appropriate response actions, the site poses an unacceptable risk over the long term.

5.2.1.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The No Action alternative is expected to meet some but not all of these potential chemical-specific ARARs. Overall radon emissions for Areas 1 and 2 were measured one time and found to be 21.8 pCi/m^{2}s compared to the UMTRCA standard and radon NESHAP of 20 pCi/m^{2}s. Although individual wells have shown some isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

The No-Action alternative is expected to meet all of the location-specific ARARs identified in Section 3.1.2 of this report.

As there are no active engineering measures associated with the No Action alternative, this alternative would not meet the intent of the EPA's presumptive remedy approach of establishing or enhancing containment of the landfill. Use of the presumptive remedy approach presumes that engineering measures will be employed to cover the waste materials according to relevant and appropriate requirements (e.g., Subtitle D landfill cover requirements). As such, the No Action alternative will not meet the action-specific ARARs associated with a landfill cover that are the presumed remedy under the presumptive remedy approach.

5.2.1.3 Long-Term Effectiveness and Permanence

All current and potential future risks would remain under the No Action alternative. Institutional controls would not be monitored or maintained and the disposal areas would not be monitored and maintained under the No Action alternative. Without monitoring and maintenance of the disposal areas and maintenance, monitoring and enforcement of the existing instructional controls, the no action would not be effective in meeting the RAOs. As indicated above, future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. As the surface of Areas 1 and 2 is not currently adequately covered, infiltration into and erosion of these areas poses an overall potential risk to human health and the environment in the future. Therefore, the No Action alternative may not be effective over the long-term.

The existing institutional controls cannot be changed without the agreement of EPA and MDNR; however, by their nature, institutional controls are not considered to be permanent. The No Action alternative does not include any additional engineered measures to increase the level of containment anticipated to be achieved as part of EPA's presumptive remedy approach for CERCLA municipal landfills and therefore is not a permanent alternative and does not provide the same degree of long-term effectiveness as would be achieved by active engineered measures. It contains no provisions to stabilize or maintain the physical integrity of the disposal areas, and there are no provisions to monitor and maintain existing institutional or access controls. Therefore, the No Action alternative is not considered to be effective over the long-term.

5.2.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.1.5 Short-Term Effectiveness

As there are no active remediation measures included in the No Action alternative, it does not pose any unacceptable short-term risks or other adverse impacts. Because no remedial action would be taken under the No Action alternative, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

The RAOs of (1) preventing direct contact with landfill contents and exposure to radiation; (2) minimizing infiltration and any resulting contaminant leaching to groundwater; (3) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and (4) controlling radon and landfill gas emissions from Areas 1 and 2 would not be met by the No Action alternative.

5.2.1.6 Implementability

As no active or passive remedial technologies would be implemented under the No Action alternative, there are no technical implementability concerns or issues associated with the No Action alternative. There are no engineering or administrative impediments to implementation of the No Action alternative for Areas 1 and 2; however, No Action would not meet the ARARs associated with the presumptive remedy for CERCLA municipal landfills and therefore would not be implementable.

5.2.1.7 Costs

As no active or passive engineering measures or monitoring will be performed, the only costs anticipated to be associated with Alternative L1, the No Action alternative, are costs associated with performance of Five Year Reviews. The estimated present worth cost for performance of Five Year Reviews over a 30-year period is $47,000.

5.2.2 Alternative L2: Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

This section presents the detailed analysis of Alternative L2 – Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring. Under this alternative, the existing landfill cover would be inspected; repaired as necessary to eliminate low areas, erosional channels, and re-establish vegetation; and subjected to future inspections and maintenance in conjunction with ongoing landfill operations or post-closure care of the West Lake Landfill. Under Alternative L2, the existing institutional controls at the Site would remain in effect and additional institutional controls will be implemented.

Institutional controls would be used to control current and future uses of the landfill area and of Areas 1 and 2 in particular to limit or restrict activities or land uses that could result in potential exposure to waste materials or contaminants in the landfill or that could affect the integrity of the existing/amended landfill cover included as part of Alternative L2. Institutional controls along with fencing would be used to control and restrict access to Areas 1 and 2. Due to the potential presence of landfill gas and radon, Alternative L2 would also include a provision for an additional land use proscriptive deed restriction covenants requiring installation of a foundation venting system or vapor barrier as part of any new construction that may be undertaken at the landfill. An additional land use covenant would also be implemented to prevent use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2. Long-term monitoring and enforcement of the institutional controls are also included under this alternative.

As an additional access restriction, additional fencing would be installed along those portions of the boundaries of Areas 1 and 2 that are not currently fenced. Alternative L2 would also include groundwater monitoring and landfill gas monitoring as described in Section 4.4.4.1.2.

5.2.2.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming institutional controls are maintained, monitored and enforced and the disposal areas are monitored and maintained. Although the evaluations performed for the BRA indicated that for the current uses, the Site does not pose an unacceptable risk to onsite workers or the offsite community, the BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses. As the surface of Areas 1 and 2 is not currently covered by a landfill cover meeting the requirements of the MDNR solid waste regulations, infiltration into and erosion of these areas poses a potential risk to human health and the environment in the future.

Analysis of potential worker exposures associated with possible future use of Areas 1 and 2 for outdoor storage was performed as part of the BRA. These analyses indicated that future use of Areas 1 and 2 for outdoor storage could pose a risk to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. This analysis was dependent on the assumed frequency and duration that potential future onsite workers would be present in Areas 1 and 2. With increased frequency and duration of exposure, the potential risks would increase.

Implementation of the additional institutional controls, fencing, and inspection and maintenance of the landfill cover would further ensure that no changes in existing land uses or cover conditions occur and that only those land uses that would not pose a potential risk would occur in the future. By doing so, Alternative L2 would restrict the potential for unacceptable exposure due to landfill cover degradation in Areas 1 and 2 or by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2.

5.2.2.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). Alternative L2 is expected to meet some but not all of these potential chemical-specific ARARs. Overall radon emissions for Areas 1 and 2 were measured one time and found to be 21.8 pCi/m^{2}s compared to the UMTRCA standard and radon NESHAP of 20 pCi/m^{2}s. Although individual wells have shown some isolated exceedances of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

Alternative L2 is expected to meet all of the location-specific ARARs identified in Section 3.1.2 of this report.

This alternative includes ongoing monitoring and maintenance of the existing landfill cover, but the existing landfill cover does not meet the landfill closure requirements (e.g., slope, thickness or permeability standards for landfill covers) of current RCRA Subtitle D regulations that were promulgated after closure of those portions of the landfill that contain Areas 1 and 2. As such, Alternative L2 will not meet the action-specific ARARs associated with a landfill cover that are the presumed remedy under the presumptive remedy approach.

5.2.2.3 Long-Term Effectiveness and Permanence

Alternative L2 includes ongoing monitoring and maintenance of the cover to reduce the potential for erosion by wind or water and eliminates ponding and reduces resultant infiltration, thereby increasing the long-term effectiveness and permanence of the remedy. This alternative would rely on existing land use covenants prohibiting residential use and groundwater use, and restricting construction of buildings and underground utilities and pipes within Areas 1 and 2. These land use covenants would be amended to prevent use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2. An additional land use covenant may need to be imposed to require testing and installation of foundation venting and/or vapor barrier systems as necessary as part of any new occupied structures that may be constructed in the future at the site outside of Areas 1 and 2. Additional fencing would be installed along the margins of Areas 1 and 2 to restrict access to these areas to authorized personnel. Therefore, Alternative L2 is expected to be effective in limiting potential direct exposure to waste materials. Ongoing monitoring and enforcement of the institutional controls and maintenance of the landfill cover will be required to maintain the effectiveness of this alternative.

The existing institutional controls cannot be changed without the agreement of EPA and MDNR and the same requirement would be implemented for the additional/amended institutional controls. Therefore Alternative L2 is considered to be permanent; however, as this alternative relies in part on Institutional Controls to achieve protectiveness, it is not considered to be as effective as other alternatives that employ engineered measures to provide a higher degree of permanence. Alternative L2 does not include engineered measures to increase the level of containment anticipated to be achieved as part of EPA's presumptive remedy approach for CERCLA municipal landfills.

5.2.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.2.5 Short-Term Effectiveness

Because no active remedial action would be taken under Alternative L2, no significant short-term risks to the community or to workers because of implementing the action would occur. A slight short-term risk to workers might occur during repair of the existing cover and installation of additional fencing along the margins of Areas 1 and 2. Similarly, no environmental impact from construction activities would occur.

The RAO of preventing direct contact with landfill contents and exposure to radiation would be met immediately upon completion of the repairs to the existing landfill cover, amendment to the access and land use covenants, and installation of additional fencing around Areas 1 and 2. Although Alternative L2 would improve conditions at the landfill, the RAOs of minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would not be completely met by Alternative L2.

5.2.2.6 Implementability

There are no engineering factors that would affect implementation of Alternative L2. The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, this alternative is administratively feasible.

Groundwater monitoring is a component of Alternative L2. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel and materials are readily available to implement the cover repairs and maintenance, additional fencing installation, institutional controls, and monitoring components of this alternative.

This alternative would not meet the ARARs associated with the presumptive remedy for CERCLA municipal landfills, and therefore is not implementable.

5.2.2.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L2 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 890,000
Estimated annual O&M costs:	$ 240,000 to 260,000
Estimated 30-year present worth costs:	$ 3,900,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4 and after, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years. Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.3 Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential

This section presents the detailed analysis of Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential. Alternative L3 would consist of placing a soil cover over Areas 1 and 2. The areas to be covered are estimated to be approximately 10.4 acres for Area 1 and 34.8 acres for Area 2. In order to provide shielding for a groundskeeper working in Areas 1 and 2 (eight hours per day, one day per week for 26 weeks per year) an 18-inch thick soil cover would need to be installed over Areas 1 and 2. In order to provide additional protection for a worker involved in outdoor storage or other activities on areas 1 and 2 (8 hours per day, 5 days per week, 50 weeks per year) a 30-inch thick soil cover would need to be constructed over Areas 1 and 2. The 30-inch thick cover has been assumed for purposes of the evaluations of Alternative L3. Prior to installation of the cover, the areas to be covered would be graded and leveled to provide a suitable surface for placement of the additional soil cover.

Alternative L3 would also include placement of additional soil on the portion of the landfill berm adjacent to the buffer property to reduce the slope of this berm to approximately 25%. This portion of the landfill berm would be regraded as it includes the area previously subject to slope erosion that resulted in transport of radionuclide impacted soil onto the buffer and Crossroad properties.

In addition to installation of a soil cover, the existing institutional controls and additional institutional controls discussed under Alternative L2 would also be implemented as part of Alternative L3 – Soil Cover to Address Gamma Exposure and Erosion Potential. These institutional controls are necessary to insure that residential uses do not occur at the landfill, and that commercial and industrial uses or ancillary uses do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the soil cover to be installed under Alternative L3. Long-term monitoring and enforcement of the institutional controls are also included under this alternative. With the placement of the additional soil cover to address potential gamma exposure, additional fencing of Areas 1 and 2 would not be necessary under this Soil Cover alternative. Groundwater monitoring and landfill gas monitoring as described under Alternative L2 (Section 4.4.4.1.2) would also be included under this alternative.

5.2.3.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming institutional controls are monitored and enforced and the disposal areas are monitored and maintained. Although the evaluations performed for the BRA indicated that the Site currently does not pose an unacceptable risk to onsite workers or the offsite community, the BRA did not necessarily evaluate all potential pathways or the maximum exposure scenario. The BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses that would be maintained under Alternative L3. Potential future use of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Implementation of the additional institutional controls would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk from direct contact with the landfill would occur in the future.

With installation of additional soil cover, Alternative L3 would eliminate the potential for unacceptable exposure in Areas 1 and 2 by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Therefore, Alternative L3 would be protective of human health.

Construction of a soil cover over Areas 1 and 2 would provide additional protection to site workers, potential trespassers or onsite recreational users (i.e., employees of future commercial or industrial development at the landfill that might regularly walk through Areas 1 and 2). Placement of 18 to 30 inches of soil would provide additional protection from gamma exposure and from potential direct contact with surface soil containing radionuclides. Installation and maintenance of a soil cover would also eliminate any potential for windblown dust containing radionuclides or for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment. Although placement of additional soil cover should reduce the potential for infiltration and subsequent leachate generation, this alternative would not be specifically designed to reduce infiltration and therefore may not be completely protective against possible impacts to groundwater.

5.2.3.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The soil cover to be installed under this alternative would meet the potential chemical-specific ARARs. Placement of additional soil cover and associated vegetative cover would decrease potential leaching and impacts to underlying groundwater. Given that the overall average radon emission measured during the RI only slightly exceeded the radon NESHAP, placement of additional soil cover under this alternative is expected to ensure that the UMTRCA radon standard and radon NESHAP are met. Installation of an 18-inch soil cover in conjunction with the anticipated additional access restrictions and institutional controls would meet the Missouri standard for maximum permissible exposure limit for ionizing radiation. The 30-inch soil cover would meet this standard with or without the additional access restrictions and institutional controls. Although individual wells have shown some isolated exceedances of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

As the Site is an inactive landfill, no prehistoric, historical or archeological data or resources are expected to remain at the West Lake Landfill. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site. Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent buffer and Crossroad properties are located within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. Because of the proximity of the Site to the floodplain, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain but were not intended to require removal of a large landfill previously constructed along the margin of a floodplain. As stated in the CERCLA Compliance with Other Laws Manual (EPA, 1988b) "A location-specific requirement may prohibit prospectively the deposit of certain substances in a floodplain. This prohibition may be appropriate with regard to remedial options in considering whether to create new disposal units in the floodplain. However, it is not likely to be appropriate to remove large existing landfills from the floodplain." The landfill was previously developed within this portion of the floodplain, and the only action to be taken under this Soil Cover alternative is the construction of an upgraded cover on an existing facility. This alternative does not include any construction, structures, or additional development in the floodplain. Therefore, the federal and state floodplain requirements do not have any effect or impose any additional conditions on this alternative.

As no wetlands exist onsite and this alternative does not include any actions related to the North Surface Water Body, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As it is expected that any borrow material that may be needed would come from an existing permitted quarry or borrow source(s); this alternative is not expected to impact any wetlands. As the landfill area is not farmland and it is expected that any borrow material that may be needed would come from an existing quarry or borrow source(s); this alternative is not expected to impact any farmlands.

While this alternative assumes placement of additional soil cover over the existing landfill surface, the amount of disturbance to the existing waste materials is anticipated to be minimal. As waste materials will not be exposed, or only minimally exposed during construction of this alternative, implementation of this alternative is not anticipated to result in an attractive nuisance with respect to birds. Therefore, this Alternative L3 should meet the RCRA Subtitle D and MDNR requirements with respect to potential bird hazards to jet aircraft using Lambert - St. Louis International Airport. A contingency can be included within the remedial design requiring mitigation (use of temporary covers, noise deterrents or other measures to minimize bird activity during construction) that could be implemented in the event that birds are attracted to the landfill area during construction of this alternative.

Several potential action-specific ARARs may need to be considered if the Soil Cover alternative were to be selected by EPA. These include the Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4), the Missouri Radiation Regulations (19 CSR 20-10.070 and 10.090), the Noise Control Act, as amended, and the Noise Pollution and Abatement Act.

The Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4) establish standards for final covers over solid waste landfills. Although placement of additional soil cover over the existing landfill grades would be protective of human health, it will not meet the minimum design or slope requirements established by the Missouri solid waste regulations (10 CSR 80-3 and 10 CSR 80-4). Missouri solid waste regulations require a cover consisting of two-feet of compacted clay with a permeability of 1×10^{-5} cm/sec overlain by at least one foot of soil capable of sustaining vegetation. The soil cover anticipated under this alternative may meet the permeability requirement but would not necessarily be designed or constructed to do so (achieving this requirement is the intent of Alternatives L4 and L5 discussed below). As the 30-inch soil cover would be installed over the existing surface grades, portions of Areas 1 and 2 would still possess slopes less than 2%. Existing slopes on Area 1 are greater than 1% and with the filling in of the low areas on Area 2 during construction of the soil cover; the slopes on Area 2 are expected to be at least 1% also. Consequently, although installation of the additional soil cover will meet the intent of promoting drainage and reducing infiltration through the landfill, this alternative would not meet the action-specific ARARs associated with the presumptive remedy for CERCLA municipal landfills.

The Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of clearing, grubbing and any regrading of the existing landfill material in Areas 1 and 2 prior to placement of the soil cover.

The Noise Control Act would impose limits on the amount of noise that could occur at the property boundaries during various times of day. This requirement would be addressed by controlling the hours of operation during which remediation activities are performed.

5.2.3.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current worker in or adjacent to Areas 1 and 2 are expected to be generally within the accepted risk range of 10^{-4} to 10^{-6} used by EPA based on an assumption of continuation of current uses at the Site. Changes in land use could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Placement of additional soil cover would eliminate potential exposures to trespassers or workers outside of Areas 1 and 2 that may otherwise use Areas 1 and 2 for ancillary purposes. Installation of a soil cover would eliminate or reduce potential for exposure or releases from the following pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, and incidental ingestion of soil containing radionuclides or other chemicals. As this alternative would not necessarily be designed to restrict infiltration and prevent leaching to groundwater or subsurface migration of radon and landfill gas, Alternative L3 may not be effective in preventing migration or exposure via all of the identified pathways at the Site.

Permanence of this alternative would be improved with regular cover inspection and maintenance, implementation of additional institutional controls restricting allowable uses and activities in Areas 1 and 2, and monitoring and enforcement of the existing and additional institutional controls. The current institutional controls cannot be removed or revised without the approval of the land owner(s), EPA and MDNR and therefore are considered to be permanent. Additional institutional controls that may be implemented as part of this alternative would be subject to the same condition and therefore are also considered to be permanent.

5.2.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.3.5 Short-Term Effectiveness

The short-term impact on the risks to the community and workers would be minimal during construction of the soil cover over Areas 1 and 2 and any surface drainage diversions, controls, and structures. Workers would be adequately protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices. Cover installation would require construction workers and equipment that would initially disturb the soil; however, as no regrading of waste materials is anticipated under this alternative, potential exposure to radioactively-impacted material during construction is expected to be minimal. Dust control measures would probably be required to limit worker exposure during construction.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during construction of the soil cover under Alternative L3, disturbance of the landfill surface will probably destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction and re-vegetation of the new soil cover over Areas 1 and 2 is completed. The RAOs of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new soil cover over Areas 1 and 2 is completed. As this alternative would not be designed to reduce infiltration, the RAO of minimizing infiltration and any resulting contaminant leaching to groundwater may not be met by this alternative.

5.2.3.6 Implementability

Placing a soil cover over Areas 1 and 2 is technically feasible. Covers are a well-known technology, commonly implemented at most landfill sites. Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes on the northern and western edges of the existing cover systems on Areas 1 and 2, it may be difficult to design and construct soil covers over some of the steeper slopes along the margin of Area 2. The southern portion of the landfill berm on the west side of Area 2 would be regraded to a more stable configuration through placement of additional soil and associated extension of the toe of the landfill berm to the west onto the Buffer Zone.

With respect to administrative feasibility for the soil cover component of Alternative L3, because Areas 1 and 2 are within a larger area in an existing landfill, design and construction of soil covers for Areas 1 and 2 would probably require coordination with the Closure and Post-Closure Plan final cover requirements for the Bridgeton Sanitary Landfill. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, this alternative is implementable.

The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, implementation of additional institutional controls is administratively feasible.

Groundwater monitoring is also a component of Alternative L3. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel, equipment, and materials are readily available to implement the soil cover, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of offsite soil borrow sources.

As this alternative would not meet the ARARs associated with the presumptive remedy for CERCLA municipal landfills, it is not implementable.

5.2.3.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L3 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 8,400,000
Estimated annual O&M costs:	$ 20,000 to 200,000
Estimated 30-year present worth costs:	$ 9,800,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years. Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.4 Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System

This section presents the detailed analysis of Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System. Alternative L4 would consist of placing additional soil or clean fill material (as defined in the Missouri solid waste regulations [10 CSR 80-2.010(11)]) over Areas 1 and 2 to increase the final grades to achieve minimum slope angles of 2%. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve minimum slopes of 2%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary.

Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas consistent with the MDNR final cover requirements for operating demolition landfills. The final cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2. Although not required for a Subtitle D cover, a layer of rock or concrete/asphaltic-concrete rubble would be installed immediately beneath the clay layer to minimize the potential for bio-intrusion and erosion and increase the longevity of the landfill cover. Surface drainage diversions, controls, and structures would also be designed and constructed on the surface of or adjacent to the landfill cover as necessary to route non-impacted, uncontaminated storm water runoff that has not contacted the underlying waste materials off of Areas 1 and 2 onto the adjacent landfill site or into off-site storm water drainage systems.

The cover system under Alternative L4 would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete/asphaltic concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick layer of soil capable of sustaining vegetative growth.

In addition to installation of a new cover, the existing institutional controls and additional institutional controls discussed under Alternative L2 would also be implemented as part of Alternative L4 (Regrading of Areas 1 and 2 to achieve a 2% minimum slope and Installation of a Subtitle D Cover System). These institutional controls are necessary to insure that residential uses do not occur at the landfill and that commercial and industrial uses or ancillary uses that could result in unacceptable risks do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the new landfill cover to be installed under Alternative L4. Long-term monitoring and enforcement of the institutional controls are also included under this alternative. The fencing of Areas 1 and 2 included under Alternative L2 would not be necessary under Alternative L4. Groundwater and landfill gas monitoring described under Alternative L2 would also be included under this alternative.

5.2.4.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community based on an assumption of continuation of current uses at the Site and assuming institutional controls are monitored and enforced. Although the evaluations performed for the BRA indicated that the Site currently does not pose an unacceptable risk to onsite workers or the offsite community, the BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses. Potential future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Implementation of the additional institutional controls would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk from direct contact with the landfill would occur in the future.

With placement of an upgraded landfill cover, Alternative L4 would effectively eliminate or greatly reduce potential exposure in Areas 1 and 2 by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Placement of an upgraded landfill cover over Areas 1 and 2 would provide additional protection to site workers, potential trespassers or onsite recreational users (i.e., employees of future commercial or industrial development at the landfill that might regularly walk through Areas 1 and 2). Placement of an upgraded landfill cover would provide additional protection from gamma exposure and from potential direct contact with surface soil containing radionuclides. Installation of a landfill cover would also eliminate any potential for windblown dust containing radionuclides, for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment, and for infiltration and any leaching to groundwater. Therefore, Alternative L4 would be protective of human health.

5.2.4.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The new landfill cover to be installed under this alternative would meet the potential chemical-specific ARARs. Construction of a new landfill cover would decrease potential leaching and impacts to underlying groundwater. The new landfill cover would ensure that the radon NESHAP is met. As previously discussed in Section 5.2.3.2 under Alternative L3, placement of 18-inches soil/clean fill material alone in conjunction with the anticipated additional access restrictions and institutional controls would meet the Missouri standard for maximum permissible exposure limit for ionizing radiation. Placement of a new landfill cover (which is anticipated to be at least 60-inches thick) would meet this standard with or without the additional access restrictions and institutional controls. Although individual wells have shown some isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

As the Site is an inactive or active modern landfill, no prehistoric, historical or archeological data or resources are expected to remain at the West Lake Landfill. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site. Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent buffer and Crossroad properties are located within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. Because of the proximity of the Site to the floodplain, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain but were not intended to require removal of a large landfill previously constructed along the margin of a floodplain. As stated in the CERCLA Compliance with Other Laws Manual (EPA, 1988b) “A location-specific requirement may prohibit prospectively the deposit of certain substances in a floodplain. This prohibition may be appropriate with regard to remedial options in considering whether to create new disposal units in the floodplain. However, it is not likely to be appropriate to remove large existing landfills from the floodplain.”

Although this alternative may include construction or additional development in the floodplain, the requirements of the floodplain ARARs should be met by this or any of the other alternatives as currently envisioned. As the landfill was previously developed within this portion of the floodplain, and the only action to be taken under Alternative L4 (Regrading of Areas 1 and 2 to a 2% minimum slope and Installation of a Subtitle D

Cover System) is construction of an upgraded cover on an existing facility, the federal and State floodplain requirements should be met by this alternative. This ARAR may potentially affect the ability to place additional soil material along a portion of the Area 2 landfill berm necessary to reduce the slope of the landfill berm as this additional soil material would be placed within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or the portion of the 100-year floodplain that is protected by levees. Design and construction of the regraded landfill berm will need to be performed to the extent practical, in a manner that does not diminish the usefulness of the floodplain. This could be achieved by cutting and filling the existing waste materials in a manner that does not increase the volume of waste or soil materials placed within the floodplain. Although placement of additional soil in the Buffer Zone necessary to meet the maximum slope requirements of the Missouri solid waste regulations may result in some limited construction within the floodplain, this activity is expected to meet the requirement of avoidance of any adverse impacts to the floodplain, to the maximum extent possible, as required by these ARARs.

As no wetlands exist onsite and this alternative does not include any actions related to the North Surface Water Body, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As it is expected that any borrow material that may be needed would come from an existing permitted quarry or borrow source(s), this alternative is not expected to impact any wetlands. As the landfill area is not farmland and it is expected that any borrow material that may be needed would come from an existing quarry or borrow source(s), this alternative is not expected to impact any farmlands.

A portion of Area 1 is located within 10,000 ft of the end of the proposed runway expansion at Lambert - St. Louis International Airport (Figure 3-1). Implementation of this alternative through placement of additional soil over the existing landfill surface to achieve the required grades should not result in significant disturbance or exposure of the existing waste materials and therefore is not anticipated to result in an attractive nuisance with respect to birds. Implementation of this alternative by cutting and filling of the waste materials to achieve the required final grades will result in exposure of the existing waste materials. Depending upon the nature and amount of degradation of the wastes (i.e., construction and demolition wastes versus undegraded municipal refuse), the exposed waste materials may attract birds resulting in non-conformance with the provisions of RCRA Subtitle D and the MDNR regulations regarding bird hazards to jet aircraft. A contingency can be included within the remedial design requiring mitigation (use of temporary covers, noise deterrents or other measures to minimize bird activity during construction) that could be implemented in the event that birds are attracted to that portion of Area 1 located within 10,000 ft of the proposed runway expansion if the runway expansion is completed prior to implementation of the remedial alternative for OU-1. Therefore, this alternative should meet the RCRA Subtitle D and MDNR requirements with respect to potential bird hazards to jet aircraft using Lambert - St. Louis International Airport.

Several potential action-specific ARARs may need to be considered if the Landfill Regrading/Cover alternative were to be selected by EPA. These include the Missouri Solid Waste Regulations for landfill covers (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)), the Missouri Radiation Regulations (19 CSR 20-10.070 and 10.090), the Noise Control Act, as amended, and the Noise Pollution and Abatement Act.

The Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4) establish standards for final covers over solid waste landfills. Under this alternative, Areas 1 and 2 would be regraded to achieve minimum slopes of 2%. The Missouri Solid Waste Regulations prescribe a 5% minimum slope for final covers installed over operating solid waste and construction and demolition landfills. As previously discussed in Section 4.4.4.1.6, the 5% slope requirement applies to operating or new landfills and was not intended to be applied retroactively to previously closed landfills. Landfilling in the vicinity of Areas 1 and 2 at the West Lake Landfill was completed approximately thirty years ago and therefore this standard is not applicable. Furthermore, the 5% minimum slope requirement was developed to allow for settlement that may occur over a period of 20 to 30 years after placement of waste materials. The portions of the West Lake Landfill containing Areas 1 and 2 were closed approximately 30 years ago and therefore settlement of this material has already occurred. Therefore, this requirement, although potentially relevant, is not considered to be appropriate for OU-1 at the West Lake Landfill. Regrading Areas 1 and 2 to achieve minimum slopes of 2% will meet the intent of the MDNR minimum slope requirements if not the actual prescribed value of 5%. Consequently, regrading Areas 1 and 2 to achieve minimum slopes of 2% along with installation of an upgraded landfill cover meeting the MDNR design standards for final landfill covers will meet the intent of promoting drainage and reducing infiltration through the landfill required by the MDNR regulations. As the same landfill cover will be installed under Alternatives L4 and L5, Alternative L4 will meet the same standard of performance as would be achieved through reconfiguration of the landfill final grade to 5% as envisioned under Alternative L5. Inclusion of corrective action requirements such as cover repair, cover modification, or groundwater containment as a contingency in the event that this alternative does not perform satisfactorily over time would insure consistency with the goal of this ARAR.

The Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of clearing, grubbing and any regrading of the existing wastes prior to placement of the initial layer of the Subtitle D cover.

The Noise Control Act would impose limits on the amount of noise that could occur at the property boundaries during various times of day. This requirement would be addressed by controlling the hours of operation during which remediation activities are performed.

5.2.4.3 Long-Term Effectiveness and Permanence

Alternative L4 would involve placement of additional soil/clean fill material over or regrading of the existing waste materials in Areas 1 and 2 to achieve minimum slopes of 2% followed by placement of an upgraded landfill cover. Construction of an upgraded landfill cover would effectively eliminate the potential pathways by which receptors could potentially be exposed to contaminants present in Areas 1 and 2. Regrading of the landfill and installation of a new landfill cover would eliminate any potential for exposure or releases from the following pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, incidental ingestion of soil containing radionuclides or other chemicals, and infiltration and any leaching to groundwater.

The permanence of this alternative is enhanced through inclusion of a two-foot thick bio-intrusion/erosion protection layer in the cover design which should increase the longevity of this alternative. Permanence of this alternative would also be improved with regular cover inspections and maintenance, implementation of additional institutional controls restricting allowable uses and activities in Areas 1 and 2, and monitoring and enforcement of existing and additional institutional controls. The current institutional controls cannot be removed or revised without the approval of the land owner(s), EPA and MDNR and therefore are considered to be permanent. Moreover, the land use covenants grant EPA, MDNR, and the owners the right to enforce the terms of the restrictions. Additional institutional controls that may be implemented as part of this alternative would be subject to the same conditions and enforcement rights and therefore are also considered to be permanent.

5.2.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.4.5 Short-Term Effectiveness

The short-term impact on the risks to the community and workers would be minimal during the placement of additional soil and installation of a Subtitle D landfill cover over Areas 1 and 2. Workers would be adequately protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices.

Although regrading of existing waste material may be a potential alternative to using clean fill, there are drawbacks associated with it. Disturbing the waste material may expose workers to radioactive waste, methane and radon gas, and cause an undesirable release of odors. Landfill regrading would require construction workers and equipment that would initially disturb the soil and possibly the underlying waste materials. Possible short-term impacts associated with regrading of the waste materials include potential exposure of workers to contaminated waste, potential for stormwater runoff to enter areas where waste is exposed, and potential for odor emissions or other aesthetic issues to arise from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of the remedial action. A stormwater management plan would be required to control runon and runoff during regrading activities. Dust and possibly odor control measures would probably be required to limit worker and public exposure during construction. Although mitigative measures such as those described above may reduce the potential for unacceptable exposures, the potential for exposure will nonetheless exist if regrading of the waste is performed.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during placement of additional soil or regrading of existing materials and installation of a Subtitle D landfill cover under Alternative L4, disturbance of the landfill surface would destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed. The RAOs of minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed.

Due to the time it may take to receive and place the additional soil or clean fill material to achieve the minimum grades of 2% and subsequently construct the upgraded landfill cover, this alternative could take several years to complete. Regrading the existing waste materials to achieve minimum slope angles of 2% and maximum slope angles of 25% may be completed in a shorter period of time.

5.2.4.6 Implementability

Placement of additional soil or regrading of existing materials to achieve minimum slopes of 2% followed by construction of an upgraded landfill cover over Areas 1 and 2 is technically feasible. Regrading of existing landfills through placement of additional soil or regrading of existing materials is a common remedial action that has been implemented at other NPL sites. Installation of an upgraded landfill cover to promote runoff and minimize infiltration is a commonly employed method of remediation at other CERCLA landfill sites. Construction of landfill covers is a well-established technology that is implemented at most landfill sites.

Cutting and filling of the existing waste materials to achieve final grades will require re-compaction of the replaced waste materials in order to minimize the potential for compaction or differential settlement over time that could affect the integrity of the landfill cover. Placement of additional fill material to achieve the final slope requirements and for construction of the landfill cover may result in compaction of the waste materials dependent upon the nature, age and amount of prior degradation of the waste materials. Uniform or differential compaction of the waste materials could necessitate placement of additional soil over all or portions of the area to achieve the required final grades. The potential for uniform or differential compaction can be addressed through several possible mechanisms including the following: (1) performance of plate load tests during the remedial design activities to assess the potential for and possible degree of compaction or differential settlement; (2) management of the placement of soil stockpiles to pre-compact/pre-consolidate the waste materials prior to final grading activities and cover construction; or (3) provision for a stock pile of suitable soil materials to be used to fill in low spots that may occur over time as a result of differential settlement; or (4) a combination of these techniques. These techniques have been employed at other CERCLA municipal landfill sites such as the Tulalip Landfill in Washington, the Lowry Landfill in Colorado, and others. Long-term maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to address the potential for differential settlement or surface erosion of a landfill cover over time. Long-term maintenance including cover inspection and repair is anticipated to be part of this alternative.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes on the portions of the northern and eastern edges of Area 1 and the northern and western edges of Area 2 (Figure 4-7), it may be difficult to achieve the desired maximum slope grades along the entire margin of Areas 1 and 2. The southern portion of the landfill berm on the west side of Area 2 would be regraded to a more stable configuration through placement of additional soil and associated extension of the toe of the landfill berm to the west onto the Buffer Zone. It may not be feasible to regrade (reduce the slope angle of those portions of the landfill berm with slopes greater than 25% or possibly greater than $33^1/_3$% to less than 25%) the northern portion of the landfill berm along the western margin of Area 2 using any of the techniques described. The toe of the landfill extends up to the property boundary/fence line in this area thereby eliminating the potential for placement of additional soil or fill material. As access to this area can only be achieved from above, the ability to regrade this portion of the landfill through excavation of the existing waste and soil material will be limited making it more difficult and more expensive but not necessarily impossible. Fortunately, this portion of the landfill berm has never exhibited any sign of or tendency towards slope or erosional failures and therefore, appears to meet the criteria (10 CSR 80-3.017(B)(3) and 10 CSR 80-4.017(B)(3)) of demonstrating stability at slope angles greater than 25%; however, much of this area contains slope angles greater than $33^{1}/_{3}$% (Figure 4-7) for which there is no provision for demonstration of stability in the Missouri Solid Waste Regulations (10 CSR 80-3.017(C)(3) and 10 CSR 80-4.017(C)(1)). Similar constraints exist for portions of the landfill in Area 1 (Figure 4-7) due to the presence of the landfill access road which is located along the northern toe of the landfill berm in Area 1 and the presence of the property/fence line along the eastern toe of the landfill and the presence of the drainage ditch along St. Charles-Rock Road immediately outside of the fence line.

As Areas 1 and 2 are within a larger area in an existing landfill, landfill regrading and installation of an upgraded landfill cover under Alternative L4 would require coordination with the landfill owner and operator. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, this alternative is considered administratively implementable. The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, implementation of additional institutional controls is also considered to be administratively feasible.

Groundwater monitoring is also a component of Alternative L4. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel, equipment, and materials are readily available to implement the cover systems, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of clean fill materials and/or offsite soil borrow sources if and when this alternative is implemented.

5.2.4.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L4 are as follows. Detailed cost estimates and a present worth summary are included in Appendix D. Cost estimates for two options to achieve the minimum slope of 2% before the Subtitle D cover is placed are included.

Soil fill option to achieve minimum slope of 2%:

Estimated capital costs:	$ 21,800,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 23,100,000

Cut/fill existing materials option to achieve minimum slope of 2%:

Estimated capital costs:	$ 20,500,000
Estimated annual O&M costs:	$ 15,000 to 200,000

Estimated 30-year present worth costs: $ 21,700,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4 and after, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years. Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.5 Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System

Alternative L5 would consist of placing additional soil or other clean fill material (as defined in the MDNR regulations (10 CSR 80-2.010(11)) over Areas 1 and 2 and/or regrading of the existing landfill materials to increase the final slope angles to 5% achieve the minimum grades specified in the MDNR regulations (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)) for landfill covers. Alternatively, the existing waste material and soil in these areas could be regraded (cut and filled) to achieve a minimum slope of 5%. Portions of the landfill berm that contain slopes greater than 25% would be regraded through placement of additional material or cutting and filling of existing material to reduce the slope angles to 25% subject to physical constraints associated with the location of the toe of the landfill relative to the property boundary.

Upon completion of the landfill regrading, a new Subtitle D-equivalent landfill cover would be constructed over these areas. The final cover system would cover approximately 10.4 acres for Area 1 and 34.8 acres for Area 2. Although not required for a Subtitle D cover, a layer of rock or concrete/asphaltic concrete debris would be installed immediately beneath the clay layer to minimize the potential for bio-intrusion and erosion and increase the longevity of the landfill cover. Surface drainage diversions, controls, and structures would also be designed and constructed as necessary to route storm water runoff off from Areas 1 and 2 into the adjacent landfill site or into off-site storm water drainage systems.

The cover system under Alternative L5 would consist of the following layers:

- A two foot thick bio-intrusion/erosion protection layer consisting of approximately 6-inch diameter pieces of rock or concrete rubble;

- A two-foot thick infiltration layer of compacted low permeability soil with a coefficient of permeability of 1×10^{-5} cm/sec or less; and

- A one-foot thick layer of soil capable of sustaining vegetative growth.

In addition to installation of a new cover, the existing institutional controls and additional institutional controls discussed under Alternative L2 would also be implemented as part of Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System. These institutional controls are necessary to insure that residential uses do not occur at the landfill and that commercial and industrial uses or ancillary uses that could result in unacceptable risks do not occur on Areas 1 and 2. In addition to prohibiting land uses that could result in potential exposure to waste materials or contaminants in the landfill, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the new landfill cover to be installed under Alternative L5. Long-term monitoring and enforcement of the institutional controls are also included under this alternative. The fencing of Areas 1 and 2 included in Alternative L2 would not be necessary under Alternative L5. Groundwater and landfill gas monitoring described under Alternative L2 would also be included under this alternative.

5.2.5.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community based on an assumption of continuation of current uses at the Site and assuming institutional controls are monitored and enforced. Although the evaluations performed for the BRA indicated that the Site currently does not pose an unacceptable risk to onsite workers or the offsite community, the BRA evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses. Potential future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Implementation of the additional institutional controls would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk from direct contact with the landfill would occur in the future.

With placement of an upgraded landfill cover, Alternative L5 would effectively eliminate or greatly reduce the potential exposure in Areas 1 and 2 by potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Placement of an upgraded landfill cover over Areas 1 and 2 would provide additional protection to site workers, potential trespassers or onsite recreational users (i.e., employees of future commercial or industrial development at the landfill that might regularly walk through Areas 1 and 2). Placement of an upgraded landfill cover would provide additional protection from gamma exposure and from potential direct contact with surface soil containing radionuclides. Installation of a landfill cover would also significantly reduce any potential for windblown dust containing radionuclides, for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment, and for infiltration and any leaching to groundwater. Therefore, Alternative L5 would be protective of human health.

5.2.5.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA radon emission and groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radionuclides, VOCs, inorganic chemicals and others (Table 3-1). The new landfill cover to be installed under this alternative would meet the potential chemical-specific ARARs. Construction of a new landfill cover would decrease potential leaching and impacts to underlying groundwater. The new landfill cover would ensure that the radon NESHAP is met. As previously discussed in Section 5.2.3.2 under Alternative L3, placement of 18-inches soil/clean fill material alone in conjunction with the anticipated additional access restrictions and institutional controls would meet the Missouri standard for maximum permissible exposure limit for ionizing radiation. Construction of a new landfill cover (which is expected to be at least 60-inches thick) would meet this standard with or without the additional access restrictions and institutional controls. Although individual wells have shown some isolated occurrences of chemical or radiological constituents at levels slightly above MCLs, a plume of groundwater contamination does not exist beneath the West Lake Landfill.

As the Site is an inactive or active modern landfill, no prehistoric, historical or archeological data or resources are expected to remain at the West Lake Landfill. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site. Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent buffer and Crossroad properties are located within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. Because of the proximity of the Site to the floodplain, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain but were not intended to require removal of a large landfill previously constructed along the margin of a floodplain. As stated in the CERCLA Compliance with Other Laws Manual (EPA, 1988b) "A location-specific requirement may prohibit prospectively the deposit of certain substances in a floodplain. This prohibition may be appropriate with regard to remedial options in considering whether to create new disposal units in the floodplain. However, it is not likely to be appropriate to remove large existing landfills from the floodplain."

Although this alternative may include construction or additional development in the floodplain, the requirements of the floodplain ARARs should be met by this or any of the other alternatives as currently envisioned. As the landfill was previously developed within this portion of the floodplain, and the only action to be taken under Alternative L5 (Regrading of Areas 1 and 2 to a 5% minimum slope and Installation of a Subtitle D Cover System) is construction of an upgraded cover on an existing facility, the federal and State floodplain requirements should be met by this alternative. This ARAR may potentially affect the ability to place additional soil material along a portion of the Area 2 landfill berm necessary to reduce the slope of the landfill berm as this additional soil material would be placed within either the 500-year floodplain, a portion of the 100-year floodplain subject to flooding depths of less than one foot, or the portion of the 100-year floodplain that is protected by levees. Design and construction of the regraded landfill berm will need to be performed to the extent practical, in a manner that does not diminish the usefulness of the floodplain. This could be achieved by cutting and filling the existing waste materials in a manner that does not increase the volume of waste or soil materials placed within the floodplain. Although placement of additional soil in the Buffer Zone necessary to meet the maximum slope requirements of the Missouri solid waste regulations may result in some limited construction within the floodplain, this activity is expected to meet the requirement of avoidance of any adverse impacts to the floodplain, to the maximum extent possible, as required by these ARARs.

As no wetlands exist onsite and this alternative does not include any actions related to the North Surface Water Body, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As it is expected that any borrow material that may be needed would come from an existing permitted quarry or borrow source(s), this alternative is not expected to impact any wetlands. As the landfill area is not farmland and it is expected that any borrow material that may be needed would come from an existing quarry or borrow source(s), this alternative is not expected to impact any farmlands.

A portion of Area 1 is located within 10,000 ft of the end of the proposed runway expansion at Lambert - St. Louis International Airport (Figure 3-1). Implementation of this alternative through placement of additional soil over the existing landfill surface to achieve the required grades should not result in significant disturbance or exposure of the existing waste materials and therefore is not anticipated to result in an attractive nuisance with respect to birds. Implementation of this alternative by cutting and filling of the waste materials to achieve the required final grades will result in exposure of the existing waste materials. Depending upon the nature and amount of degradation of the wastes (i.e., construction and demolition wastes versus undegraded municipal refuse), the exposed waste materials may attract birds resulting in non-conformance with the provisions of RCRA Subtitle D and the MDNR regulations regarding bird hazards to jet aircraft. A contingency can be included within the remedial design requiring mitigation (use of temporary covers, noise deterrents or other measures to minimize bird activity during construction) that could be implemented in the event that birds are attracted to that portion of Area 1 located within 10,000 ft of the proposed runway expansion if the runway expansion is completed prior to implementation of the remedial alternative for OU-1. Therefore, this alternative should meet the RCRA Subtitle D and MDNR requirements with respect to potential bird hazards to jet aircraft using Lambert - St. Louis International Airport.

Several potential action-specific ARARs may need to be considered if the Landfill Regrading/Cover alternative were to be selected by EPA. These include the Missouri Solid Waste Regulations for landfill covers (10 CSR 80-3.010(17) and 10 CSR 80-4.010(17)), the Missouri Radiation Regulations (19 CSR 20-10.070 and 10.090), the Noise Control Act, as amended, and the Noise Pollution and Abatement Act.

The Missouri Solid Waste Regulations (10 CSR 80-3 and 10 CSR 80-4) establish standards for final covers over solid waste landfills. Under this alternative, Areas 1 and 2 would be regraded to achieve minimum slopes of 5%. Therefore, regrading Areas 1 and 2 to achieve minimum slopes of 5% will meet the MDNR minimum slope requirements. Consequently, regrading Areas 1 and 2 to achieve minimum slopes of 5% along with installation of an upgraded landfill cover will meet the requirement of promoting drainage and reducing infiltration through the landfill.

The Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of clearing, grubbing and any regrading of the existing wastes prior to placement of the initial layer of the Subtitle D cover.

The Noise Control Act would impose limits on the amount of noise that could occur at the property boundaries during various times of day. This requirement would be addressed by controlling the hours of operation during which remediation activities are performed.

5.2.5.3 Long-Term Effectiveness and Permanence

Alternative L5 would include placement of additional soil/clean fill material over Areas 1 and 2 or regrading of the existing waste materials in Areas 1 and 2 to achieve minimum slopes of 5% followed by placement of an upgraded landfill cover. Construction of an upgraded landfill cover would effectively eliminate the potential pathways by which receptors could potentially be exposed to contaminants present in Areas 1 and 2. Regrading of the landfill and installation of a new landfill cover would effectively eliminate any potential for exposure or releases from the following pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, incidental ingestion of soil containing radionuclides or other chemicals, and infiltration and any leaching to groundwater.

The permanence of this alternative is enhanced through inclusion of a two-foot thick bio-intrusion/erosion protection layer in the cover design which should increase the longevity of this alternative. Permanence of this alternative would be improved with regular cover inspections and maintenance, implementation of additional institutional controls restricting allowable uses and activities in Areas 1 and 2, and monitoring and enforcement of existing and additional institutional controls. The current institutional controls cannot be removed or revised without the approval of the land owner(s), EPA and MDNR and therefore are considered to be permanent. Moreover, the land use covenants grant EPA, MDNR and the owners the right to enforce the terms of the restrictions. Additional institutional controls that may be implemented as part of this alterative would be subject to the same condition and enforcement rights and therefore are also considered to be permanent.

5.2.5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.5.5 Short-Term Effectiveness

The short-term impact on the risks to the community and workers would be minimal during the placement of additional soil and installation of a Subtitle D landfill cover over Areas 1 and 2. Workers would be adequately protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices.

Although regrading of existing waste material may be a potential alternative to using clean fill, there are drawbacks associated with it. Disturbing the waste material may expose workers to radioactive waste, methane and radon gas, and cause an undesirable release of odors. Landfill regrading would require construction workers and equipment that would initially disturb the soil and possibly the underlying waste materials. Possible short-term impacts associated with regrading of the waste materials include potential exposure of workers to contaminated waste, potential for stormwater runoff to enter areas where waste is exposed, and potential for odor emissions or other aesthetic issues to arise from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of the remedial action. A stormwater management plan would be required to control runon and runoff during regrading activities. Dust control and possibly odor control measures would probably be required to limit worker and public exposure during construction. Although mitigative measures such as those described above may reduce the potential for unacceptable exposures, the potential for exposure will nonetheless exist if regrading of the waste is performed.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during placement of additional soil or regrading of existing materials and installation of a Subtitle D landfill cover under Alternative L5, disturbance of the landfill surface would destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed. The RAOs of minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed.

Due to the time it may take to receive and place the additional soil or clean fill material to achieve the minimum grades of 5% and subsequently construct the upgraded landfill cover, this alternative could take several years to complete. Regrading the existing waste materials to achieve minimum slope angles of 5% and maximum slope angles of 25% may be completed in a shorter period of time.

5.2.5.6 Implementability

Placement of additional soil or regrading of existing materials to achieve minimum slopes of 5% followed by construction of an upgraded landfill cover over Areas 1 and 2 is technically feasible. Regrading of existing landfills through placement of additional soil or regrading of existing materials is a common remedial action that has been implemented at other NPL sites. Installation of an upgraded landfill cover to promote runoff and minimize infiltration is a commonly employed method of remediation at other CERCLA landfill sites. Construction of landfill covers is a well-established technology that is implemented at most landfill sites.

Cutting and filling of the existing waste materials to achieve final grades will require re-compaction of the replaced waste materials in order to minimize the potential for compaction or differential settlement over time that could affect the integrity of the landfill cover. Placement of additional fill material to achieve the final slope requirements and for construction of the landfill cover may result in compaction of the waste materials dependent upon the nature, age and amount of prior degradation of the waste materials. Uniform or differential compaction of the waste materials could necessitate placement of additional soil over all or portions of the area to achieve the required final grades. The potential for uniform or differential compaction can be addressed through several possible mechanisms including the following: (1) performance of plate load tests during the remedial design activities to assess the potential for and possible degree of compaction or differential settlement; (2) management of the placement of soil stockpiles to pre-compact/pre-consolidate the waste materials prior to final grading activities and cover construction; or (3) provision for a stock pile of suitable soil materials to be used to fill in low spots that may occur over time as a result of differential settlement; or (4) a combination of these techniques. These techniques have been employed at other CERRCLA municipal landfill sites such as the Tulalip Landfill in Washington, the Lowry Landfill in Colorado, and others. Long-term maintenance of the landfill covers at other Superfund sites and at non-Superfund site solid waste landfills is typically required to address the potential for differential settlement or surface erosion of a landfill cover over time. Long-term maintenance including cover inspection and repair is anticipated to be part of this alternative.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes on the portions of the northern and eastern edges of Area 1 and the northern and western edges of Area 2 (Figure 4-7), it may be difficult to achieve the desired maximum slope grades along the entire margin of Areas 1 and 2. The southern portion of the landfill berm on the west side of Area 2 would be regraded to a more stable configuration through placement of additional soil and associated extension of the toe of the landfill berm to the west onto the Buffer Zone. It may not be feasible to regrade (reduce the slope angle of those portions of the landfill berm with slopes greater than 25% or possibly greater than $33^1/_3$% to less than 25%) the northern portion of the landfill berm along the western margin of Area 2 using any of the techniques described. The toe of the landfill extends up to the property boundary/fence line in this area thereby eliminating the potential for placement of additional soil or fill material. As access to this area can only be achieved from above, the ability to regrade this portion of the landfill through excavation of the existing waste and soil material will be limited making it more difficult and more expensive but not necessarily impossible. Fortunately, this portion of the landfill berm has never exhibited any sign of, or tendency towards slope or erosional failures and therefore, appears to meet the criteria (10 CSR 80-3.017(B)(3) and 10 CSR 80-4.017(B)(3)) of demonstrating stability at slope angles greater than 25%; however, much of this area contains slope angles greater than $33^1/_3$% (Figure 4-7) for which there is no provision for demonstration of stability in the Missouri Solid Waste Regulations (10 CSR 80-3.017(C)(3) and 10 CSR 80-4.017(C)(1)). Similar constraints exist for portions of the landfill in Area 1 (Figure 4-7) due to the presence of the landfill access road which is located along the northern toe of the landfill berm in Area 1 and the presence of the property/fence line along the eastern toe of the landfill and the presence of the drainage ditch along St. Charles-Rock Road immediately outside of the fence line.

As Areas 1 and 2 are within a larger area in an existing landfill, landfill regrading and installation of an upgraded landfill cover under Alternative L5 would require coordination with the landfill owner and operator. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, this alternative is considered theoretically implementable. The owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC. Therefore, implementation of additional institutional controls is administratively feasible.

Groundwater monitoring is also a component of Alternative L5. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to offsite groundwater monitoring wells. Based on the assumed cooperation of property owners, this alternative is administratively feasible.

Personnel, equipment, and materials are readily available to implement the cover systems, institutional controls, and monitoring components of this alternative. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of clean fill materials and/or offsite soil borrow sources if and when this alternative is implemented.

5.2.5.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L5 are as follows. Detailed cost estimates and a present worth summary are included in Appendix D. Cost estimates for two options to achieve the minimum slope of 5% before the Subtitle D cover is placed are included.

Soil fill option to achieve minimum slope of 5%:

Estimated capital costs:	$ 24,600,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 25,800,000

Cut/fill existing materials option to achieve minimum slope of 5%:

Estimated capital costs:	$ 19,900,000
Estimated annual O&M costs:	$ 15,000 to 200,000
Estimated 30-year present worth costs:	$ 21,100,000

The variation in annual operations and maintenance costs reflects the variation in the frequency of groundwater monitoring activities proposed for years 1 through 3 compared to year 4 and after, variations in the monitoring frequency in years 4 through 30, and the 5-year CERCLA review only occurring every five years. As was discussed in Section 4.4.4.1.2, for purposes of the FS it was assumed that the wells would be sampled quarterly for three years and semiannually on a biennial basis after the first three years.

Consequently, the actual annual operations and maintenance costs would vary from year to year.

5.2.6 Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and Regrading and Installation of a Subtitle D Cover System

This section presents the detailed analysis of Alternative L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and Regrading and Installation of a Subtitle D Cover System. Alternative L6 would consist of excavation of some accessible portion(s) of the landfill material in Area 2 that may contain relatively higher concentrations of radiologically contaminated material. As discussed elsewhere in this report (Section 4.4.3 and Appendix B), the radiologically-impacted materials in OU-1 do not meet the definition of a "hot spot" as that term is defined in EPA's guidance for the presumptive remedy approach for CERCLA Municipal Landfills (EPA, 1993b). However, evaluation of a potential "hot-spot" removal alternative has been included in this FS report to confirm that the presumptive approach to municipal landfills is appropriately applied. In addition to excavation and offsite disposal of waste materials containing relatively higher levels of radionuclides, Alternative L6 would also include regrading of the landfill surface and construction of a new landfill cover that meets the requirements of the Missouri solid waste regulations, long-term inspection and maintenance of the landfill cover, groundwater and methane monitoring, and monitoring and enforcement of the existing and additional institutional controls described under Alternatives L4 and L5.

5.2.6.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, these evaluations were predicated upon assumptions of continuation of existing land uses and restrictions on certain types of future land uses that would be maintained. Although the evaluations performed for the BRA indicated that for current use the Site does not pose an unacceptable risk to onsite workers or the offsite community, potential future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA.

Regrading of the landfill and installation of a new landfill cover would effectively eliminate potential exposure in Areas 1 and 2 by future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Excavation of radiologically-impacted material is not required to achieve protection of human health and the environment as installation and maintenance of a landfill cover meets the remedial action objectives and is protective of human health and the environment. Excavation and offsite removal of the radiologically impacted materials in Area 2 that contain higher levels of radioactivity would increase the level of protection of public health and the environment over that achieved by installation of a new landfill cover alone in the unlikely event that institutional and engineering controls fail. Although excavation and offsite disposal could increase the level of protection, accidental or inadvertent spillage or dispersal of radioactively impacted materials during excavation or transport could result in increased short-term risks to onsite workers or the public.

Maintenance and enforcement of the existing and additional institutional controls as proposed under landfill Alternatives L2 through L5 would assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk of direct contact with the waste materials or site chemicals would occur in the future.

With implementation of the measures described above, Alternative L6 would eliminate or reduce the potential exposure in Areas 1 and 2 to the public and potential future industrial/commercial workers that may work in areas adjacent to Areas 1 and 2. Therefore, Alternative L6 would be protective of human health.

5.2.6.2 Compliance with ARARs

As this alternative includes regrading of the landfill surface and installation of a new landfill cover, the ARARs identified for alternatives L4 and L5 would apply to this alternative. Additional ARARs associated with excavation and offsite disposal of waste materials containing higher levels of radionuclides would need to be complied with by this alternative.

Excavation of the waste materials in Area 2 with higher levels of radioactivity should not entail any construction or adverse impact to the floodplain. Several potential action-specific ARARs may need to be considered if selective excavation of material with higher levels of radionuclides were to be selected by EPA.

Transportation of the excavated materials for offsite disposal would have to be performed in compliance with Department of Transportation requirements. Although not a promulgated regulation, offsite disposal of the excavated material would need to comply with EPA’s policy for offsite disposal from CERCLA sites. Offsite disposal would also need to comply with specific requirements such as waste profiling established by the selected disposal facility.

5.2.6.3 Long-Term Effectiveness and Permanence

Alternative L6 would involve excavation and offsite disposal of that portion of the radiologically-impacted material in Area 2 with higher levels of radionuclides and/or gamma activity than other portions of Area 2 as well as landfill regrading and installation of a Subtitle D landfill cover. As previously discussed under Alternatives L4 and L5, regrading of the landfill and installation of a Subtitle D landfill cover would provide effective and permanent containment of the waste materials. Removal of the radiologically-impacted materials with the higher levels of radionuclides or gamma activity would reduce the overall magnitude of the residual radioactivity at the Site thereby providing an additional level of protectiveness in the unlikely event of failure of institutional or engineering controls. As radiologically-impacted materials would still remain on site, excavation of "hot spots" alone is neither effective nor permanent. The long-term effectiveness and permanence would be achieved through implementation of one of the landfill regrading/cover alternatives (L4 or L5) discussed in the previous sections.

5.2.6.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.2.6.5 Short-Term Effectiveness

Excavation and offsite transport of radiologically-impacted material in Area 2 with higher levels of radionuclides and/or gamma activity would result in short-term impacts and potential risks to onsite workers and the community. Traffic accidents associated with offsite truck and rail transport will result in risk of physical injury and potentially death to members of the public. Implementation of the offsite disposal portion of this alternative is anticipated to require approximately 4,300 truck trips of approximately 10 miles roundtrip each to haul the excavated material to a rail facility and approximately 1,100 train railcar load trips (eleven train trips of 100 cars each) of 1,600 miles each. Based on 2002 accident rates for large trucks of 2.14 fatal accidents and 44 injury accidents per 100 million vehicle miles traveled (National Highway Transportation Safety Administration [NHTSA], 2003), the truck trips are expected to pose a risk of fatality from an accident of 9.2×10^{-4} (approximately a one in one-thousand risk) and a risk of injury from an accident of nearly 2% (1.9×10^{-2}). Based on 2003 accident rates for train traffic of 4 per million train miles exclusive of train-highway accidents and 3.95 per million train miles for train-highway accidents (Federal Railroad Administration [FRA], 2004), transport of excavated waste by train could result in a risk of accident of nearly 28%.

Disturbing the waste material may expose workers to radioactive waste, methane and radon gas, and cause an undesirable release of odors. Excavation of existing waste materials will undoubtedly result in odor emissions during the period of time that existing wastes may be handled or exposed. Mitigation of odors through engineering means is limited; however, by performing the waste excavation activities during the winter months, the impacts of odor emissions can be minimized.

Workers involved in the excavation activities may be subject to potential short-term risks. Possible short-term impacts associated with regrading of the waste materials include potential exposure of workers to contaminated waste, potential for stormwater runoff to enter areas where waste is exposed, and potential for odor emissions or other aesthetic issues to arise from exposed waste. Worker exposures would be addressed through development and implementation of a site safety plan and performance of personnel and environmental monitoring during implementation of remedial action. Workers would be protected during construction by adhering to Occupational Safety and Health Administration (OSHA) practices; however, as this alternative entails excavation, handling and transportation of radiologically impacted materials containing higher levels of radioactivity, OSHA work practices and personal protective equipment may not provide adequate protection against exposure to gamma radiation.

Excavation would require construction workers and equipment that would initially disturb the soil and underlying waste materials. Dust control measures would probably be required to limit worker exposure during construction. Segregation of radiologically-impacted soil from solid wastes and construction/demolition debris may result in adverse risks to remediation workers. Screens used to segregate large items and debris from the soil will become fouled with plastic, wood, and other debris that potentially may need to be physically removed by workers. Such activities will require workers to conduct activities in close proximity to the radiologically-impacted materials thereby increasing short-term exposures for workers.

In addition to development and implementation of a worker health and safety plan, a stormwater management plan would be required to control runon and runoff during regrading activities. Dust and odor control measures would also likely be required. Although mitigative measures such as these may reduce the potential for unacceptable exposures, the potential for exposure will nonetheless exist if excavation and offsite disposal of waste is performed as part of the selected remedial action.

As noted in the BRA (Auxier & Associates, 2000), some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during excavation of waste materials under Alternative L6, disturbance of the landfill surface would destroy those portions of the habitats that currently exist on the surface of Area 2, forcing wildlife to migrate to other areas.

The RAOs of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur and minimizing infiltration and any resulting contaminant leaching to groundwater would not be met by excavation and offsite disposal of waste materials containing relatively higher levels of radionuclides without implementation of one of the engineered landfill capping alternatives.

The RAO of preventing direct contact with landfill contents and exposure to radiation associated with anticipated future uses of the West Lake Landfill and adjacent areas do not occur would be met immediately upon implementation of the amendment to the land use covenants. Achievement of this RAO would be further ensured once construction of the new landfill cover over Areas 1 and 2 is completed. The RAOs of (1) minimizing infiltration and any resulting contaminant leaching to groundwater; (2) controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and (3) controlling radon and landfill gas emissions from Areas 1 and 2 would be met once construction of the new landfill cover over Areas 1 and 2 is completed. Implementation of a “hot spot” removal alternative does not affect achievement of the RAOs although it likely will reduce the source term and thereby the magnitude of potential exposures to radionuclides, potential future radon emissions, and potential leaching of radionuclide constituents.

Initiation of this alternative would require significant planning and permitting due to the limited number of offsite disposal facilities capable of taking this material. In addition, as discussed above, implementation of this alternative may need to be timed to occur in the winter months to reduce impacts associated with generation of odors during excavation and handling of existing waste materials. Excavation of existing waste materials would also have to occur prior to any landfill regrading or placement of additional cover materials. Based on the size of Area 2, the volumes of materials to be excavated, and experience at other CERCLA sites with excavation and segregation of radiologically impacted materials, it is anticipated that this alternative will take several years to implement followed by several additional years to complete landfill regrading and cover construction.

5.2.6.6 Implementability

Excavation of radiologically-impacted materials with higher levels of radionuclides and/or gamma activity from Area 2 is technically feasible. Segregation of the soil fraction from the waste materials may be technically feasible, but as discussed above could result in increased worker exposures and attendant risks. Disposal of the excavated materials at an offsite facility is considered to be technically feasible; however, only a limited number of offsite disposal facilities exist and some may not be able to handle materials other than soil (i.e., debris).

Personnel, equipment, and materials are readily available to perform the excavation, and load and transport the material. As there is no railroad access at the Site, a suitable location with existing railcar loading facilities will need to be located or possibly constructed. The implementability and potential cost of this alternative will be greatly influenced by the availability and location of an offsite rail-loading facility and the offsite disposal facility to be used if and when this alternative was to be implemented.

Removal of the impacted soil would require excavation of large volumes of the landfill with the attendant odor and health and safety issues and subsequent screening of the refuse to separate out the soil material, a difficult, time- and labor-consuming, and potentially hazardous activity. Screening of trash material would necessitate use of personnel to remove plastic, wood and other material that would otherwise clog or foul the screens. Workers involved in such activities would be exposed to elevated levels of gamma radiation for which practical, effective protection could not be readily and/or effectively implemented. Furthermore, the act of screening would result in mixing of the more highly impacted soil with less impacted and unimpacted soil.

5.2.6.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative L6 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D. The most significant cost component of this alternative is the disposal fee at the offsite disposal facility. The cost estimate provided below is based on a 1999 U.S. Army Corps of Engineers contracted disposal fee for another CERCLA site and is probably not indicative of current disposal fees.

The estimated costs for Alternative L6 are considered to be highly uncertain due to the uncertain nature and volume of the radiologically-impacted materials that may be excavated and shipped for offsite disposal, the extremely limited number of offsite disposal facilities capable of accepting the radiologically-impacted materials, and the resultant limited pricing options that exist as a result of the nearly monopolistic conditions associated with the few available disposal facilities.

This alternative also includes regrading of the landfill and installation of a new landfill cover and other components (groundwater and methane gas monitoring and additional institutional controls) as described under Alternatives L4 and L5. Assuming a new landfill cover similar to that described for Alternative L5 using soil fill to achieve a minimum slope of 5% is selected, the total costs of implementing Alternative L6 would be as follows:

Soil fill option to achieve minimum slope of 5%:

Estimated capital costs:	\$ 75,000,000
Estimated annual O&M costs:	\$ 15,000 to 200,000
Estimated 30-year present worth costs:	\$ 76,000,000

5.3 Results of the Detailed Analysis of Alternatives - Buffer Zone / Crossroad Property (Ford property) Alternatives

The following sections present the detailed analysis of the four alternatives for addressing radiologically impacted soil, if any, that may still be present on the Buffer Zone and possibly Lot 2A1 of the Crossroad property. The four alternatives for the Buffer Zone and Crossroad property are evaluated using the two threshold and five balancing criteria specified in the NCP.

In November 1999, the vegetation and surface soil were scraped from the Buffer Zone property and a portion of the adjacent Crossroad property to a depth of approximately 2 to 6 inches. These activities were unauthorized and reportedly conducted by AAA Trailer, a neighboring property owner. The removed materials were piled in a berm along the southern boundary of the buffer property, adjacent to the northwestern boundary of the West Lake Landfill. A small amount of removed materials was also placed in a small pile on the Crossroad property. An investigation of radionuclide occurrences beneath this area was performed as part of the RI activities and a supplemental investigation was performed in February 2000 after the soil regrading activities were discovered in November 1999.

A recent inspection of this area indicated that additional soil removal/grading had been performed on the remaining portion of the Crossroad property and the Buffer Zone. AAA Trailer has reported that the most recent regrading activity involved the soil piles created during the previous regrading activity as well as the remaining soil on Lot 2A2 and the Buffer Zone that had not been excavated during the prior regrading being pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. This area is currently being used by AAA Trailer for storage of trailers although use of the Buffer Zone, which is owned by Rock Road, for this purpose has not been authorized.

The levels and extent of radionuclides that may remain in the soil in the Buffer Zone and Crossroad property after the most recent soil regrading activities conducted by AAA Trailer are unknown. For purposes of the evaluation of remedial alternatives for this area, it is assumed that radiologically-impacted material is still present in this area. Prior to implementation of any alternative for the Crossroad property or any soil removal alternative for the Buffer Zone, an investigation of the current conditions of these properties would need to be performed to determine the presence and extent of any radiologically-impacted soil that may still remain in this area.

5.3.1 Alternative F1 – No Action

This section presents the detailed analysis of Alternative F1 – No Action. Under this alternative, no engineering measures will be implemented to reduce potential exposures to the radiologically impacted soil in the Buffer Zone and Crossroad property. Similarly, no additional institutional controls and no additional fencing will be implemented to control land use, access or potential future exposures to the Buffer Zone or Crossroad property Lot 2A1. No monitoring will be conducted to identify or evaluate any potential changes that may occur to conditions in the Buffer Zone or Crossroad Lot 2A2 or to contaminant levels or occurrences in this area.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties. The No Action alternative assumes that these controls will not be maintained or enforced.

5.3.1.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated upon assumptions of continuation of existing land uses. The BRA did not evaluate potential risks that may be posed by unrestricted use of these properties. Although access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties, there are no access or land use restrictions that would prevent changes in the use of the Buffer Zone or Crossroad Lot 2A2 in the future. Therefore, Alternative F1 may not be protective of all possible future uses of the Buffer Zone and Crossroad Lot 2A2. For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. Therefore, the No Action alternative would not be protective of human health. To the extent that the surface grading and gravel placement actions performed by or on the behalf of AAA Trailer have resulted in removal and/or capping of the radiologically-impacted soil in this area, the No Action alternative may be protective, or more protective than assumed for purposed of this FS.

5.3.1.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). Since the current levels and extent of radionuclides on the Buffer Zone and Crossroad Lot 2A2 after the recent grading and gravel placement activities conducted by AAA Trailer are unknown, it is presumed that levels of radium and thorium in surface soil on the Buffer Zone exceed the UMTRCA standards. However, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) would need to be performed to verify this assumption. Data obtained in February 2000 prior to the most recent grading activities reported by AAA Trailer indicated that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 did not exceed the UMTRCA standards. AAA Trailer has reported that the regrading activities that occurred subsequent to the February 2000 soil sampling event involved soil being pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206. Because of the nature of this regrading, it is possible that the radionuclide levels in soil on Lot 2A2 may now be above the UMTRCA standards; however, this cannot be confirmed without additional testing.

Therefore, for purposes of this FS, it is assumed that Alternative F1 would not meet the potential chemical-specific ARARs; however this cannot be confirmed without additional testing.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F1. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As the No Action alternative does not include any construction, placement of structures or additional development in the floodplain, it would meet the requirements of the federal and State floodplain ARARs.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 is no longer used as farmland, this alternative is not expected to impact any farmlands.

As this alternative is the No Action alternative, no action-specific ARARs have been identified for this alternative.

5.3.1.3 Long-Term Effectiveness and Permanence

All current and potential future risks would remain under the No Action alternative. The calculated human health risks to a potential current or future receptor working in the Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA

(Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk.

To the extent that the most recent surface grading and gravel placement actions reported by AAA Trailer have resulted in removal and/or capping of the radiologically-impacted soil in this area, the No Action alternative may be protective. However, this protectiveness would need to be verified by additional sampling and testing. Although results from soil sampling performed during the RI and in February 2000 after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use, levels and extent of radionuclides that currently exist after the most recent regrading reported by AAA Trailer are unknown. In particular, although AAA Trailer has reported that the most recent regrading involved pushing the soil into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206, the disposition of the soil is unknown. Therefore, no action with respect to the Crossroad Lot 2A2 is assumed to not be effective.

Some of the soil samples obtained from the Buffer Zone property, which is owned by Rock Road and is considered to be part of the landfill property, contained radionuclides above the levels for unrestricted use. Therefore the No Action alternative may not be protective of unrestricted use for this area. To the extent that the surface grading and gravel placement actions recently reported by AAA Trailer have resulted in removal and/or capping of the radiologically-impacted soil in this area, the No Action alternative may be protective for the Buffer Zone; however, this cannot be confirmed without performance of additional sampling.

As evidenced by AAA Trailer's use of the Buffer Zone, the existing institutional and access controls are insufficient and/or are not sufficiently monitored and enforced to prevent unauthorized use of this property. Therefore, the No Action alternative is not considered to be effective in preventing uses that could result in unacceptable exposure to radiologically-impacted soil.

5.3.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.3.1.5 Short-Term Effectiveness

As there are no active remediation measures included in Alternative F1, it does not pose any unacceptable short-term risks or other adverse impacts. Because no remedial action would be taken on the Buffer Zone and Crossroad Lot 2A2 under Alternative F1, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

As the levels of radionuclides in soil on the Buffer Zone and Crossroad Lot 2A2 may pose an unacceptable risk, the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties may not be met by this alternative. As the levels and extent of radionuclides in the surface soil resulting from the most recent regrading activity reported by AAA Trailer are unknown, this alternative may not meet the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials. Due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative.

5.3.1.6 Implementability

As no active or passive remedial technologies would be implemented under Alternative F1, there are no implementability concerns or issues associated with Alternative F1. There are no impediments to implementing Alternative F1.

5.3.1.7 Costs

The only capital cost associated with the No Action alternative is the cost associated with a one-time soil sampling to assess current radionuclide occurrence on Crossroad Lot 2A2 and the Buffer Zone. This cost is estimated to be approximately $160,000. No ongoing operation and maintenance costs are anticipated to be associated with Alternative F1, the No Action alternative for the Buffer Zone and Crossroad Lot 2A2.

5.3.2 Alternative F2 – Institutional and Access Controls

This section presents the detailed analysis of Alternative F2 – Institutional and Access Controls. Alternative F2 would entail implementation of institutional controls in the form of a land use covenant to control potential future uses of the Buffer Zone and Crossroad property. Under this alternative, land use covenants would be implemented to prohibit residential use of the Buffer Zone and Crossroad property. Additional fencing would be installed along the Buffer Zone as an additional access restriction to complete the perimeter fence around the landfill property.

5.3.2.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated upon assumptions of continuation of existing industrial/commercial land uses. The BRA evaluations did not address unrestricted (residential) use of these properties. In addition, due to the recent regrading activities reported by AAA Trailer, the current levels and extent of radionuclides on these properties is uncertain. For purposes of this FS, it has been assumed that unrestricted use of these properties would not be protective and that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial/industrial uses would restrict the potential for residential use and the associated potential risks. Therefore, Alternative F2 is protective of human health for the current and projected future uses of these properties.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties. Implementation of institutional controls and fencing as proposed under Alternative F2 would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. By doing so, Alternative F2 would limit the potential for unacceptable exposure in the Buffer Zone and Crossroad Lot 2A2 by potential future industrial/commercial workers that may work in these areas. Although AAA Trailer has reported that the recent regrading activity involved soil being pushed into a pile in the northeast corner of the Buffer Zone near monitoring well WL-206, the levels and extent of radionuclides in the soil are unknown. Until results of soil sampling can confirm conditions, it is presumed that levels of radium and thorium in surface soil on the Buffer Zone and Lot 2A2 exceed standards for unrestricted use of these properties. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F2 would be protective of human health.

As Alternative F2 relies on institutional controls and access restrictions to achieve the additional protectiveness, it is not considered to meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks.

5.3.2.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). Data obtained in February

2000 prior to the most recent grading activities reported by AAA Trailer indicated that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 did not exceed the UMTRCA standards. However, since the current levels and extent of radionuclides in Buffer Zone and Crossroad Lot 2A2 surface soil after the recent grading and gravel placement activities reported by AAA Trailer are unknown, it is presumed that levels of radium and thorium in surface soil may exceed the UMTRCA standards. Specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) would need to be performed to verify this assumption. Therefore, for purposes of this FS, it is assumed that Alternative F2 would not meet the potential chemical-specific ARARs; however, this can only be confirmed through performance of additional testing.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F2. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As this alternative does not include any construction, structures or additional development in the floodplain, it would meet the requirements of federal and State floodplain ARARs.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 is no longer used as farmland, this alternative is not expected to impact any farmlands.

As Alternative F2 only entails implementation of institutional controls and fencing, no action-specific ARARs have been identified for this alternative.

5.3.2.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current or future receptor working in the Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA (Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial/industrial uses would restrict the potential for residential use and the associated potential risks.

Although soil sampling performed during the RI and in February 2000 after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use, levels and extent of radionuclides that may currently exist after the most recent regrading activity reported by AAA Trailer are unknown. AAA Trailer has reported that the most recent regrading activity involved pushing soil into a pile located in the northeast corner of the Buffer Zone near monitoring well WL-206. Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F2 would be protective with respect to Lot 2A2 and the Buffer Zone; however, as this alternative relies solely on implementation, monitoring and enforcement of institutional controls to insure that unacceptable risks (unrestricted use) do not occur, it is not considered to be as effective or permanent as alternatives that utilize engineered measures to insure protectiveness.

Implementation of additional institutional controls and access restrictions would assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. Therefore, Alternative F2 is expected to be effective with respect to the Buffer Zone and Crossroad Lot 2A2. As Alternative F2 relies on institutional controls and access restrictions to achieve the additional protectiveness, it is not considered to meet the NCP expectation of relying on engineered measures to reduce or eliminate potential risks

5.3.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.3.2.5 Short-Term Effectiveness

As there are no active remediation measures included in Alternative F2, it does not pose any unacceptable short-term risks or other adverse impacts. Because no remedial action would be taken on the Buffer Zone and Crossroad Lot 2A2 other than implementation of institutional controls and access restrictions under Alternative F2, no short-term risks to the community or to workers from implementation of this action would occur. Similarly, no environmental impact from construction activities would occur.

Implementation, monitoring and enforcement of institutional controls limiting these properties to commercial/industrial uses would insure that the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties would be met. As it is presumed that surface soil containing radionuclides may still be present on the Buffer Zone and Crossroad Lot 2A2, the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials would not be met under Alternative F2. As previously discussed, due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative as well as any of the other Buffer Zone/Crossroad property alternatives.

5.3.2.6 Implementability

No active remedial technologies would be implemented under Alternative F2, therefore, implementation of institutional controls and installation of additional fencing along the Buffer Zone are the only aspect of this alternative that may pose implementability concerns or issues. The Buffer Zone is currently owned by Rock Road Industries on behalf of the Respondent group, and therefore implementation of institutional controls and access restrictions is considered to be implementable. Implementation of institutional controls and access restrictions for Crossroad Lot 2A2 would require the consent of the current owner of Lot 2A2. Crossroads Lot 2A2 is currently used and is zoned for commercial/industrial uses. Implementation of a land use restriction limiting future use of this property to commercial/industrial uses only would be consistent with the current and anticipated future uses of the property. No discussions have been held with the owner of this property with respect to their willingness to implement land-use restrictions for this property. Therefore the implementability of this alternative with respect to Crossroad Lot 2A2 is unknown.

5.3.2.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative F2 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 210,000
Estimated annual O&M costs:	$ 6,000 – 14,000
Estimated 30-year present worth costs:	$ 290,000

5.3.3 Alternative F3 – Capping and Institutional and Access Controls

This section presents the detailed analysis of Alternative F3 – Capping and Institutional and Access Controls. Alternative F3 would entail implementation of institutional controls in the form of a land use covenant to control potential future uses of the Buffer Zone and Crossroad property. In addition to prohibiting land uses that could result in potential exposure to radioactively impacted materials that may still be present beneath the Buffer Zone or Crossroad Lot 2A2, if any, these institutional controls would also limit or prohibit land uses or activities that could disrupt the integrity of the cap to be installed in these areas under Alternative L5. Under this alternative, land use covenants would be implemented to prevent residential use of the Buffer Zone and Crossroad property. In conjunction with the institutional controls, a perimeter fence would be installed along the boundary of the Buffer Zone to control access to the landfill property and a cap consisting of a minimum 6-inch thick gravel layer, asphalt or other form of pavement, or another form of surface preparation would be installed over the Buffer Zone and Crossroad property to prevent direct contact with the radiologically impacted soil. Alternative F3 would also include the performance of a 5-year review by EPA every five years, as described under Alternative L1.

It should be noted that during a site inspection conducted in October 2003 in conjunction with the additional groundwater sampling, it was discovered that Crossroad Lot 2A2 and the Buffer Zone had been graded and a gravel cover had been installed. Trailers associated with AAA Trailer's operations were parked in this area. No information has been obtained regarding the nature of the grading work, the disposition of the soil piles created as part of the previous (1999) grading of Lot 2A1 by AAA Trailer, or the nature and thickness of the gravel cover other than AAA Trailer reporting that soil was pushed into a pile located in the northeast corner of the Buffer Zone near monitoring well WL-206. The most recent grading and gravel placement reported by AAA Trailer is similar to what is proposed to be conducted under this alternative. As discussed earlier, for purposes of this FS, it is assumed that soil containing levels of radium and thorium above UMTRA standards are still present in this area. Therefore, the NCP factors such as implementability and costs have been evaluated under the assumption that the grading and gravel cap installation have yet to be performed.

5.3.3.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated upon assumptions of continuation of existing industrial/commercial land uses. Placement of a cap over Lot 2A2 and the Buffer Zone would provide an engineered barrier to limit potential worker exposures and therefore provide an additional level of protection. The BRA evaluations did not address unrestricted (residential) use of these properties and due to the most recent regrading activities reported by AAA Trailer, the current levels and extent of radionuclide occurrences on these properties is uncertain. Therefore, for purposes of this FS it is assumed that unrestricted use of these properties would not be protective. Implementation, monitoring, and enforcement of institutional controls limiting these properties to commercial industrial uses in conjunction with construction of a cap would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F3 would be protective of human health.

Access to the Buffer Zone and Crossroad property is already limited due to the controls on access that are currently in place for the entire West Lake Landfill property and the overall Crossroad development as part of the private industrial uses of these properties.

Placement of a gravel, asphalt or other type of cover over the surface of the Buffer Zone and Crossroad Lot 2A2 would further reduce potential risk to workers or the offsite community by eliminating direct contact with or inhalation or inadvertent ingestion of soil containing radionuclides. Implementation of institutional controls and fencing as described under Alternative F2 would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. By doing so, Alternative F3 would further eliminate the potential for unacceptable exposure with respect to the Buffer Zone and Crossroad Lot 2A2 by potential future industrial/commercial workers that may work in these areas. Therefore, Alternative F3 would be protective of human health.

5.3.3.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). Data obtained in February 2000 prior to the most recent grading activities reported by AAA Trailer indicated that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 did not exceed the UMTRCA standards. However, the current levels and extent of radionuclides in surface soil on the Buffer Zone and Crossroad Lot 2A2 after the most recent grading and gravel placement activities reported by AAA Trailer are unknown. It is presumed that levels of radium and thorium in surface soil on the Buffer Zone may currently exceed the UMTRCA standards; however, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) would need to be performed to verify this assumption. Therefore, for purposes of this FS, it is assumed that Alternative F3 would not meet the potential chemical-specific ARARs; however, this can only be confirmed through performance of additional testing.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F3. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As construction of a gravel, asphalt or other surface cap would be conducted under Alternative F3, the federal and State floodplain requirements are potentially applicable or relevant and appropriate to this alternative. Regrading and capping of these properties would need to be designed and implemented in a manner that minimizes potential changes or impacts to the floodplain.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 are no longer used as farmland, this alternative is not expected to impact any farmlands.

Alternative F3 entails construction of a gravel, asphalt or other cap over the Buffer Zone and Crossroad Lot 2A2. No specific potential action-specific ARARs that may apply to this alternative were identified.

5.3.3.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current or future receptor working in the Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA (Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk. Construction of a cap and implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would restrict the potential for residential use and the associated potential risks.

Although soil sampling performed during the RI and in February 2000 after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use, levels and extent of radionuclides in surface soil that may currently exist after the most recent regrading reported by AAA Trailer are unknown. Construction of a cap and perimeter fence along the boundary of the Buffer Zone would provide an additional level of protectiveness for site workers and implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would eliminate the potential for residential use and the associated potential risks. Therefore, Alternative F3 would be protective with respect to Lot 2A2 and the Buffer Zone; however, as this alternative relies in part on implementation, monitoring and enforcement of institutional controls to insure that unacceptable risks (unrestricted use) do not occur, it is not considered to be as effective or permanent as alternatives that utilized engineered measures to insure protectiveness.

Construction of a gravel, asphalt or other cover over the surface of the Buffer Zone and Crossroad Lot 2A2 would effectively eliminate or greatly reduce potential for dermal contact, inhalation or inadvertent ingestion of soil containing radionuclides on the Buffer Zone or Crossroad Lot 2A2. Implementation of additional institutional controls and access restrictions would further assure that no changes in existing land uses occur and that only those land uses that would not pose a potential risk would occur in the future. Therefore, Alternative F3 is expected to be effective with respect to the Buffer Zone and Crossroad Lot 2A2. To the extent that the surface grading and gravel placement actions performed by or on the behalf of AAA Trailer have resulted in removal of the radiologically-impacted soil in this area, this alternative would be even more likely to be effective.

5.3.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

There is no reduction in the toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.

5.3.3.5 Short-Term Effectiveness

As the only active remediation measure included in Alternative F3 is construction of a gravel, asphalt or other type of cap, it does not pose any unacceptable short-term risks or other adverse impacts. No short-term risks to the community or to workers from implementation of this action are expected to occur. Similarly, no environmental impact from construction activities are expected to occur.

Installation of a cap and implementation, monitoring and enforcement of institutional controls limiting these properties to commercial industrial uses would insure that the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties would be met. Installation of the gravel, asphalt or other type of cap further assures that potential exposures to radiation will not occur. As the surface soil containing radionuclides on the Buffer Zone and Crossroad Lot 2A2 would be covered by a cap, the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials would be met under Alternative F3. As previously discussed, due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative or any of the Buffer Zone/Crossroad property alternatives. Installation of a cap over these areas would further insure that these objectives are met.

5.3.3.6 Implementability

Construction of a gravel, asphalt or other cap on the Crossroad Lot 2A2 property would be performed by Crossroad or by AAA Trailer consistent with the construction of the asphalt and gravel surfaces previously constructed over the AAA Trailer and Lot 2A1 properties. As AAA Trailer has already constructed a gravel surface over Lot 2A2 and the Buffer Zone, this alternative is considered to be implementable.

The Buffer Zone is currently owned by Rock Road and therefore construction of a cap and implementation of institutional controls and access restrictions is considered to be implementable. Implementation of institutional controls and access restrictions for Crossroad Lot 2A2 would require the consent of the current owner of Lot 2A2. Crossroads Lot 2A2 is currently used and is zoned for commercial/industrial uses. Implementation of a land use restriction limiting future use of this property to commercial/industrial uses only would be consistent with the current and anticipated future uses of the property. No discussions have been held with the owner of this property with respect to their willingness to implement land-use restrictions for this property. Therefore the implementability of this alternative with respect to Crossroad Lot 2A2 is unknown.

5.3.3.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative F3 are summarized below. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 340,000
Estimated annual O&M costs:	$ 6,000 – 14,000
Estimated 30-year present worth costs:	$ 420,000

5.3.4 Alternative F4 – Soil Excavation and Consolidation in Area 2

This section presents the detailed analysis of Alternative F4 – Soil Excavation and Consolidation in Area 2. Alternative F4 would consist of excavation of the radiologically impacted soil from the Buffer Zone and/or Crossroad property and consolidation of the excavated material on the surface of Area 2. Under this alternative, all of the soil containing total radium or total thorium greater than 5 pCi/g above background would be excavated and placed on top of Area 2. As previously discussed, the presence, if any, and extent of soil containing total radium or total thorium greater than 5 pCi/g above background after implementation of the most recent regrading and capping of this area performed by, or on the behalf of AAA Trailer is unknown. For purposes of this alternative, it is assumed that the extent of soil containing total radium or total thorium greater than 5 pCi/g above background remains the same as was identified during the prior investigations of this area. Prior to implementation of this alternative, additional investigation of this area would need to be performed to determine if any soil containing total radium or total thorium greater than 5 pCi/g above background still remains in this area.

5.3.4.1 Overall Protection of Human Health and Environment

Based on the results of the BRA evaluations (Auxier & Associates, 2000), conditions on the Buffer Zone and Lot 2A2 associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community; however the BRA evaluations were predicated upon assumptions of continuation of existing industrial/commercial land uses. The BRA evaluations did not address unrestricted (residential) use of these properties. Also, after the recent regrading activities reported by AAA Trailer, the current levels and extent of radionuclides on these properties is uncertain. Therefore, for purposes of this FS it is assumed that unrestricted use of these properties would not be protective. Under this alternative, all soil containing radionuclides at levels above standards for unrestricted use would be removed from these properties. Therefore, Alternative F4 would be protective of human health under both current and all possible future uses of these properties.

Excavation of the radiologically-impacted soil on the Buffer Zone and Crossroad Lot 2A2 and consolidation of the excavated soil on the surface of Area 2 would eliminate any potential for unacceptable risk to workers or the offsite community that may exist on the Buffer Zone or Crossroad Lot 2A2 by eliminating direct contact with or inhalation or inadvertent ingestion of soil containing radionuclides. Removal of all soil containing radionuclides at levels of 5 pCi/g above background would meet the UMTRCA standard for unrestricted land use. Therefore, Alternative F4 would be protective of human health.

5.3.4.2 Compliance with ARARs

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). As the current levels and extent of radionuclides in surface soil on the Buffer Zone and Crossroad Lot 2A2 after the recent grading and gravel placement activities reported by AAA Trailer are unknown, it is presumed that levels of radium and thorium in surface soil on the Buffer Zone may exceed the UMTRCA standards. However, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area) has not been performed. Under this alternative, all soil containing radionuclides at levels above standards for unrestricted use would be removed from these properties. Therefore, Alternative F4 would meet the potential chemical-specific ARARs.

As the Buffer Zone and Crossroad Lot 2A2 is an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Alternative F4. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As excavation of radiologically-impacted soil would be conducted under Alternative F4, the federal and State floodplain requirements are potentially applicable or relevant and appropriate to this alternative. Excavation of soil from these properties would need to be designed and implemented in a manner that minimizes potential changes or impacts to the floodplain.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 are no longer used as farmland, this alternative is not expected to impact any farmlands.

Alternative F4 entails excavation of radiologically-impacted soil from the Buffer Zone and Crossroad Lot 2A2. The UMTRCA soil cleanup standards (40 CFR Part 192) are potential action-specific ARARs for this alternative.

5.3.4.3 Long-Term Effectiveness and Permanence

The calculated human health risks to a potential current or future receptor working in Buffer Zone or Lot 2A2 are less than the accepted risk range of 10^{-4} to 10^{-6} used by EPA (Auxier & Associates, 2000); however, as noted above these evaluations were predicated on the assumption of continuation of existing land uses. Uncertainties remain with respect to potential future land uses of Lot 2A2 and the Buffer Zone that could result in an unacceptable risk. Excavation of soil containing radionuclides at levels above standards for unrestricted use would be effective in eliminating all possible risks.

Excavation of radiologically-impacted soil from the Buffer Zone and Crossroad Lot 2A2 would eliminate any potential for dermal contact, inhalation or inadvertent ingestion of soil containing radionuclides that may exist on the Buffer Zone or Crossroad Lot 2A2. Excavation of all soil containing radionuclides at levels greater than 5 pCi/g above background would meet the UMTRCA standard for unrestricted land use. Therefore, Alternative F4 is expected to be effective with respect to the Buffer Zone and Crossroad Lot 2A2.

5.3.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative F4 includes removal of radiologically-impacted soil from the Buffer Zone and Crossroad Lot 2A2 and implementation of institutional controls and access restrictions for the Buffer Zone and Crossroad Lot 2A2. This alternative would provide a reduction in toxicity, mobility and volume of radiologically-impacted material on the Buffer Zone and Crossroad Lot 2A2. There would be no reduction of toxicity, mobility or volume through treatment of radiologically-impacted soil on these properties because no treatment technologies would be employed by this alternative. Therefore, no treatment residuals would be generated.

5.3.4.5 Short-Term Effectiveness

The surface soil present on the Buffer Zone and Crossroad Lot 2A2 potentially contains only low levels of radionuclides. Transport of soil excavated from these areas will likely be conducted using internal roads. Consequently, Alternative F4 does not pose any unacceptable short-term risks or other adverse impacts. No short-term risks to the community or to workers from implementation of this action are expected to occur. Similarly, no environmental impact from construction activities are expected to occur.

Excavation of soil containing radionuclides at levels above standards for unrestricted uses would eliminate all potential risks. Therefore, this alternative would insure that the RAO of preventing direct contact with and exposure to radiation associated with anticipated future uses of these properties would be met. As the surface soil containing radionuclides on the Buffer Zone and Crossroad Lot 2A2 would be removed, the RAO of controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials would be met under Alternative F4. As previously discussed, due to the low levels of radionuclides in soil beneath the Buffer Zone and Crossroad properties, the remedial action objectives of minimizing infiltration to reduce the potential for leaching to groundwater and controlling radon and landfill gas emissions are expected to be met by the No Action alternative or any of the Buffer Zone/Crossroad property alternatives. Excavation of the radiologically impacted materials from these properties would further insure that these objectives are met.

5.3.4.6 Implementability

Prior to removal of the remaining radiologically-impacted soil, if any, from this area, AAA Trailer would have to relocate the trailers they are currently storing in this area and the gravel surface recently constructed by AAA Trailer over Lot 2A2 and the Buffer Zone would have to be removed. As the Respondents do not own or exercise any control over the activities conducted on Lot 2A2, implementation of any remedial activities on this property would be subject to obtaining permission and an access agreement from the current owner and possibly current lessee.

As the Buffer Zone is currently owned by Rock Road Industries on behalf of the Respondent group, excavation of radiologically-impacted soil is considered to be implementable.

5.3.4.7 Costs

Estimated capital, annual O&M, and 30-year present worth costs for Alternative F4 are summarized below. These costs are based on the assumption that the extent of radiologically-impacted soil beneath Lot 2A2 and the Buffer Zone is the same as the extent identified prior to the more recent regrading and capping activities conducted by, or on the behalf of AAA Trailer. Detailed cost estimates and a present worth summary are included in Appendix D.

Estimated capital costs:	$ 600,000
Estimated annual O&M costs:	$ 0
Estimated 30-year present worth costs:	$ 600,000

6 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents the comparative analysis for the alternatives that were evaluated in Section 5. The relative performance of each alternative is evaluated against the performance of the other alternatives for each of the threshold and primary balancing criteria. This comparative analysis identifies the advantages and disadvantages of each alternative to assist in the decision-making process leading to the Proposed Plan.

6.1 Threshold Criteria

Two of the nine criteria specified in the NCP relate directly to statutory findings that must ultimately be made in the ROD. These two criteria are (1) overall protection of human health and the environment, and (2) compliance with ARARs. They are classified as threshold criteria, as each alternative must meet these two criteria.

6.1.1 Overall Protection of Human Health and the Environment

This criteria addresses how risks would be eliminated, reduced, or controlled by the remedial alternatives to provide short- and long-term protection of human health and the environment from unacceptable risks posed by contaminants present at the Site.

6.1.1.1 Areas 1 and 2 Landfill Alternatives

Based on the results of the BRA evaluations, conditions associated with OU-1 do not currently pose an unacceptable risk to onsite workers or the offsite community assuming the existing institutional controls are monitored and enforced and the disposal areas are monitored and maintained. Uncertainties remain with respect to potential future use of Areas 1 and 2. For example, use of these areas for activities such as outdoor storage that would be ancillary to office or other commercial uses that may be conducted in the future on other portions of the landfill are currently not prohibited. Analysis of potential worker exposures associated with use of Areas 1 and 2 for outdoor storage was performed as part of the BRA. These analyses indicated that use of Areas 1 and 2 for outdoor storage would pose potential risks to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Therefore, Alternative L1 (No Action) would not be protective of human health. In addition, as the No Action alternative does not include an engineered and maintained landfill cover, it will not protect against ongoing or potential erosion, infiltration, intrusion and other destabilizing mechanisms. Therefore, the No Action alternative is not protective of public health and the environment.

Under Alternatives L2 and L3, the existing institutional controls would be supplemented to prohibit ancillary uses of Areas 1 and 2, effectively limiting the future use of Areas 1 and 2 to private open space. Access to Areas 1 and 2 is already restricted as part of the overall control of access to the entire West Lake Landfill. Construction of additional fencing around Areas 1 and 2 would be performed as part of Alternatives L2 and L3 providing additional access restrictions thereby further limiting exposure to these areas. Construction of additional fencing under Alternatives L2 and L3 would further limit potential future exposure to Areas 1 and 2 by providing a physical barrier to access to these areas.

Implementation of the additional institutional controls would limit future uses to those that would not result in exposure in Areas 1 and 2 at levels that could pose a potential risk at the levels above the generally accepted risk range used by EPA. Maintenance of the existing landfill cover would be performed to protect against, erosion, infiltration, intrusion or other destabilizing influences. Alternatives L2 would rely on implementation, monitoring and enforcement of access restrictions, institutional controls, and cover maintenance to insure protectiveness.
As Alternative L2 would rely on institutional and access controls and monitoring to insure protectiveness, it does not meet the statutory preference for use of engineered measures to achieve protection and is inconsistent with the expectation of an engineered landfill cover included as a basic premise of EPA's presumptive remedy approach for CERCLA municipal landfills; however, Alternative L2 would be protective of human health.

Construction of a 30-inch soil cover under Alternative L3 and regrading of the landfill and placement of a new cover under Alternatives L4, L5, or L6 over Areas 1 and 2 would provide additional physical protection to site workers or potential trespassers from gamma exposure and from potential direct contact with surface soil containing radionuclides. The combination of the engineered controls (landfill cover improvements) under Alternatives L3, L4, L5, and L6, along with the maintenance of the existing and additional land use covenants, results in Alternatives L3, L4, L5, and L6 providing the greatest level of protection of human health relative to potential gamma exposure and direct contact with waste materials. Installation of the cover materials under Alternatives L3, L4, L5, and L6 would also eliminate any potential for windblown dust containing radionuclides or for storm water/snowmelt erosion of radiologically impacted materials and subsequent transport as suspended sediment. Installation of the cover materials under Alternatives L3, L4, L5, and L6 would also reduce potential radon emissions and infiltration of precipitation and potential leaching of radiological and non-radiological contaminants into the underlying groundwater. As Alternatives L4, L5, and L6 include a low permeability layer within the landfill cover design, these three alternatives provide a greater level of protection relative to potential radon emissions and any leaching to groundwater.

Excavation of the radiologically-impacted materials that contain levels of radioactivity that are higher than those found in other portions of Area 2 under Alternative L6 would reduce the overall levels of radionuclides in Area 2, thereby reducing the residual risk that could potentially be posed by the Site in the unlikely event of failure of the institutional and engineering controls. As radiologically-impacted materials would still remain on-site, a new landfill cover would also be installed under Alternative L6.

As discussed above, protection of public health is achieved through installation of the landfill cover. Excavation and offsite disposal of a portion of the radiologically impacted materials in Area 2 containing higher levels of radionuclides or gamma radiation is not required to achieve protection of public health and the environment nor does it reduce the need for or scope of the landfill capping remedy.

6.1.1.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Based on the results of the BRA evaluations, conditions associated with Lot 2A2 and the Buffer Zone (former Ford property) do not currently pose an unacceptable risk to onsite workers or the offsite community; however, the BRA evaluations were predicated on an assumption of continuation of existing commercial/industrial land uses. The BRA did not evaluate potential risks that may be posed by unrestricted use of these properties. Soil sampling performed during the RI and after the 1999 grading activities by AAA Trailer indicated that the levels of radionuclides in soil on Lot 2A2 were below the UMTRCA standard for unrestricted use. As additional grading was subsequently conducted by AAA Trailer, additional sampling would need to be performed to confirm that the UMTRCA standards for unrestricted use of Crossroad Lot 2A2 and/or the Buffer Zone are met. For purposes of completion of this FS, it is assumed that soil containing radionuclides at levels greater than those that would allow for unrestricted use are still present beneath Lot 2A2 and the Buffer Zone. Therefore, the No Action alternative (Alternative F1) would not be protective of human health.

Under Alternative F2, institutional controls would be implemented to restrict future uses of the former Ford property (the Buffer Zone and Lot 2A2 of the Crossroad property) to commercial and industrial uses. Implementation of institutional controls would effectively eliminate or greatly reduce the unlikely potential that the former Ford property would be used for residential or other land uses that were not considered reasonable in the BRA evaluations. Assuming radionuclides at levels above standards for unrestricted use are still present in soil on these properties and assuming future unrestricted use of these properties, Alternative F2 would not be protective of human health.

Alternative F3 includes capping of the Buffer Zone and Lot 2A2 of the Crossroad property to prevent direct contact with or erosion of any radiologically impacted soil that may still exist along with implementation of institutional and access controls to restrict future uses of the Buffer Zone and Crossroad Lot 2A2. Capping of Lot 2A2 and the Buffer Zone would eliminate exposure to soil containing radionuclides at levels above standards for unrestricted use and would prevent erosion of soil containing radionuclides. Therefore, Alternative F3 would be protective.

Alternative F4 entails excavation of radiologically-impacted soil at levels above the UMTRCA standards thereby allowing for unrestricted future use of the Buffer Zone and Crossroad Lot 2A2. By removing soil containing radionuclides, this alternative would allow for unrestricted use of these properties and therefore is the alternative that is most protective of human health and the environment.

6.1.2 Compliance with ARARs

Compliance with ARARs also serves as a threshold criterion that must be met by any alternative for it to be selected as a remedy, unless an ARARs waiver is obtained. Possible ARARs that may potentially be applicable or relevant and appropriate to OU-1 are summarized on Tables 3-1, 3-2 and 3-3.

6.1.2.1 Areas 1 and 2 Landfill Alternatives

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to OU-1 are the UMTRCA groundwater protection standards, the radon NESHAP, the Missouri radiation regulations for protection against ionizing radiation, and the Missouri MCLs for radium and non-radionuclide constituents (Table 3-1). The No Action (L1) and the Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls and Monitoring (L2) alternatives are expected to meet some but not all of these potential chemical-specific ARARs. The soil cover alternative (L3) and landfill regrading and cover alternatives (L4, L5, and L6) are expected to meet all of the chemical-specific ARARs.

With the exception of two monitoring wells that slightly exceed the MCL for radium, groundwater beneath the Site currently meets the UMTRCA groundwater protection standards and the Missouri MCLs for radionuclides. A few monitoring wells in the vicinity of Areas 1 and 2 also contain benzene and/or arsenic at levels slightly above the MCLs for these constituents. Occurrences of these constituents are isolated and not representative of a plume or large area of groundwater contamination beneath or downgradient of the landfill. Therefore all six landfill alternatives comply with these chemical-specific ARARs. Occurrences of radium, benzene and arsenic above their respective MCLs would not be addressed by the No Action (L1) or the Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls and Monitoring (L2) alternatives. To the extent that these occurrences result from infiltration of precipitation and leaching within Areas 1 and 2, implementation of an engineered landfill cover may reduce the levels of radium, benzene and arsenic detected in these few wells. If these occurrences are related to sources other than Areas 1 and 2 or are otherwise not the result of infiltration through Areas 1 and 2, none of the alternatives may result in any change in these occurrences.

Radon emissions from the OU-1 portion of the landfill were obtained as part of the RI and resulted in an average value of 21.8 pCi/m^{2}s which slightly exceeds the radon NESHAP of 20 pCi/m^{2}s. Therefore Alternative L1 would not meet this ARAR. Repair and maintenance of the existing landfill cover (Alternative L2), placement of additional soil over the landfill surface under Alternative L3 or the construction of an upgraded landfill cover under Alternatives L4, L5, and L6 are expected to provide sufficient attenuation and reduction of radon emissions to meet this standard. All six landfill alternatives provide protection against ionizing radiation; however, Alternatives L1 and L2 rely solely on institutional controls to achieve this protection whereas Alternatives L3, L4, L5, and L6 rely on engineered measures as well as institutional controls to provide this protection.

As no active engineering measures would be implemented under Alternative L1 (No Action), this alternative should meet all of the location-specific ARARs. With respect to location-specific ARARs for Alternatives L2, L3, L4, L5, and L6, archeological resources, endangered species, or wetlands requirements are not considered applicable or relevant and appropriate at the Site. In addition, impact to wetlands or farmland is not expected at any offsite quarry and/or borrow source(s) that may be used for borrow and/or cover materials for these alternatives. Depending upon the method used to regrade the landfill, implementation of Alternatives L4, L5, or L6 could trigger either the floodplain or the proximity to airport runways location-specific ARARs. If the landfill berm is regraded through placement of additional soil, the additional soil would need to be placed within the 500-year floodplain or the 100-year floodplain that is protected by levees. This will result in a minor modification of the shape of the floodplain in this area. If that portion of Area 1 located within 10,000 ft of the proposed runway expansion of the Lambert - St. Louis International Airport is regraded by cutting and filling of the existing waste materials, exposure of the waste materials could result in attraction of birds necessitating mitigative measures to comply with the proximity to the end of a runway used for turbojet aircraft. With these two exceptions, all six landfill alternatives (L1 through L6) equally address potential location-specific ARARs.

Several potential action-specific ARARs may need to be considered if Alternatives L2, L3, L4, L5, or L6 were to be selected by EPA. Specifically, the Missouri Radiation Regulations (10 CSR 20-10.090) require that no releases to air or water should cause exposure of any person above the limits specified in 10 CSR 20-10.041 (see Table 3-1). These regulations would require monitoring to be conducted during the period of cover repair or maintenance (Alternative L2) or clearing/grubbing and any regrading of the existing wastes prior to placement of the initial layers of cover (Alternatives L3, L4, L5, and L6). The Noise Control Act and Noise Pollution and Abatement Act would limit the amount of noise that could occur at the property boundaries during various times of day under Alternatives L2, L3, L4, L5, and L6.

The Missouri Solid Waste Regulations provide specific design criteria for construction of final landfill covers. As the landfill in Areas 1 and 2 was closed in the 1970's before these criteria were promulgated, these criteria are not applicable. They are, however, potentially relevant and appropriate for any remedial alternatives that entail construction of an upgraded landfill cover over Areas 1 and 2. The Missouri solid waste criteria include design standards for the minimum and maximum slope angles for the final cover as well as the specific design criteria for the thickness and engineering properties of the materials used for construction of the final cover.

As previously discussed, Alternatives L2 and L3 are considered to be protective of human health and the environment, but would not comply with the cover design or slope criteria of the Missouri regulations as neither of these alternatives meet the Subtitle D landfill closure requirement ARARs associated with the presumptive remedy for CERCLA municipal landfills.
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The other landfill regrading/cover alternatives (L4, L5 and L6) are anticipated to meet the cover design and engineering property criteria for construction of a final landfill cover. Alternative L4 entails placement of additional inert fill material or soil or regrading of the existing refuse to achieve a minimum slope angle of 2%, which although not strictly in conformance with the final slope angle criteria of the Missouri solid waste regulations, does meet the intent of the regulations in that this alternative would including regrading of the landfill area to achieve slope angles that are technically sufficient to minimize infiltration by promoting drainage while minimizing erosion potential. Therefore, Alternative L4 (2% slopes) would meet the intent of the MDNR regulations regarding final cover design. Alternative L5 would meet all of the potential landfill cover action-specific ARARs and the 5% slope criteria in the Missouri solid waste regulations. Alternative L6 includes excavation and offsite disposal of Area 2 soil with higher levels of radionuclides followed by regrading to either 2% or 5% slopes and installation of a new landfill cover (similar to alternatives L4 or L5) and therefore would also meet the potential landfill cover action-specific ARARs.

Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes of the existing cover systems along the northern and eastern boundaries of Area 1 and the northern and western boundaries of Area 2, technically it may be difficult to design and construct covers over the steeper slopes along the margins of Area 2. Due to the proximity of the property boundary with these areas, placement of additional fill material or regrading to achieve slope angles of 25%, or even $33^1/_3$% or less is also expected to be difficult.

Transportation and offsite disposal of the excavated materials under Alternative L6 would need to be conducted in compliance with Department of Transportation requirements, EPA's CERCLA Offsite Disposal Policy and requirements associated with the disposal site that may be used for this alternative.

6.1.2.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Chemical-specific ARARs that may potentially be applicable or relevant and appropriate to the former "Ford property" alternatives of OU-1 are the Missouri regulations for protection against ionizing radiation and the soil cleanup criteria in 40 CFR Part 192 (UMTRCA Standards). The current conditions on the Buffer Zone and Crossroad Lot 2A2 meet the Missouri standards for protection against ionizing radiation. Levels of radium and thorium in surface soil on the Buffer Zone may exceed the UMTRCA standards; however, specific testing using these criteria (i.e., testing to determine the average activity levels over a 100 square meter area or implementation of MARRSIM statistical-based sampling procedure) has not been performed. As previously discussed, for purposes of completing this FS, it is assumed that the radionuclide levels in soil on the Buffer Zone and Crossroad Lot 2A2 exceed the UMTRCA standards. Therefore, Alternatives F1 and F2 for the former Ford property would not meet the potential chemical-specific ARARs; however, this cannot be confirmed without the performance of additional testing. Alternative F3 which includes installation of a cover over Lot 2A2 and the Buffer Zone would be protective but may not meet the UMTRA ARAR for cleanup of offsite soil to levels suitable for unrestricted use. Alternative F4 which entails excavation of soil containing radium and thorium at levels above the UMTRA standard and disposal of the excavated soil in Area 2 is the only Ford property alternative that meets the UMTRA standard.

As the Buffer Zone and Crossroad Lot 2A2 are part of an area that has previously been used for agriculture and has been disturbed in conjunction with current commercial and industrial uses of these properties, no prehistoric, historical or archeological data or resources are expected to remain on these properties. Therefore, the Archeological and Historic Preservation Act and the Archeological Resources Protection Act are neither applicable nor relevant and appropriate.

The RI investigations did not identify any endangered or threatened species or critical habitat at or adjacent to the Site, including the Buffer Zone and Crossroad Lot 2A2 (former Ford property). Therefore, the federal and State requirements associated with endangered species are neither applicable nor relevant to this alternative.

The FEMA Flood Insurance Map Number 29189C0039 H (FEMA, 1995) indicates that the West Lake Landfill and the adjacent Buffer Zone and Crossroad properties are located within either the 500-year floodplain or a portion of the l00-year floodplain that is protected by levees. As previously discussed (Section 2.1.1), the elevation of the West Lake property has been significantly increased through the placement of landfill materials and therefore is now above the floodplain. The Buffer Zone and Crossroad Lot 2A2 are situated in the area of the 100-year floodplain that is protected by levees. Therefore, the requirements of Executive Order 11988 and 40 CFR 6.302(b) related to floodplains are potential location-specific ARARs for Lot 2A2 and the Buffer Zone alternatives. These regulations require avoidance, to the maximum extent possible, of any adverse impacts associated with direct or indirect development of a floodplain. As no active construction is anticipated under Alternatives F1 and F2, these alternatives would meet the federal and State floodplain requirements. As Alternative F3 includes construction of a cap over this area and Alternative F4 includes excavation of radiologically-impacted soil from this area, the federal floodplain requirements are potentially applicable or relevant and appropriate to these alternatives. Similarly, the State floodplain requirements are also potentially applicable or relevant and appropriate to these alternatives. As it is expected that Alternatives F3 and F4 would be implemented without a significant change in surface elevation or grade, these alternatives are expected to comply with the floodplain ARARs.

As no wetlands exist on the Buffer Zone or Crossroad Lot 2A2, the requirements of the Clean Water Act related to discharge of dredge or fill materials and potential impacts to wetlands are not considered to be applicable or relevant to this alternative. As the Buffer Zone and Crossroad Lot 2A2 is no longer used as farmland, none of the alternatives for these areas are expected to impact any farmlands.

6.2 Primary Balancing Criteria

The alternatives are comparatively analyzed in this section for the next five of the nine criteria, the primary balancing criteria. These five criteria include long-term effectiveness and permanence; reduction of toxicity, mobility and volume through treatment; short-term effectiveness; implementability; and cost. These five criteria are collectively described as the primary balancing criteria as they provide the primary basis for differentiation among the various alternatives.

As Alternatives L1, F1 and F2 were determined to not be protective of public health and the environment and/or did not meet the requirements of the chemical- or action-specific ARARs, these alternatives did not meet the threshold criteria and therefore will not be evaluated or discussed further.

Although it was considered to be protective, Alternative L2 achieves is protectiveness primarily from implementation of existing and additional institutional controls and not from engineering controls. Therefore, this alternative does not meet the CERCLA statutory preference for use of engineering controls. Alternative L2 also did not meet all of the requirements of potential chemical- or action-specific ARARs. Therefore alternative L2 will not be considered further.

Although it was considered to be protective, Alternative L3 did not meet the potential action-specific requirements associated with the CERCLA presumptive remedy for municipal landfills –the cover design and construction requirements associated with MDNR solid waste regulations. Therefore, this alternative does not meet the ARAR requirement for Missouri solid waste management landfills and Alternative L3 will not be considered further.

Consequently, the focus of the comparison of the alternatives in terms of the primary balancing criteria will be on Alternatives L4, L5 and L6 and F3 and F4.

6.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is a measure of the following two principal factors:

- The magnitude of residual risk; and
- The adequacy and reliability of controls.

6.2.1.1 Areas 1 and 2 Landfill Alternatives

As radiologically impacted materials will remain on site under all of the potential remedial alternatives, potential risks associated with the radiologically impacted materials will remain. Construction of a new soil or landfill cover over Areas 1 and 2 under Alternatives L4, L5 and L6 would provide an engineered barrier and therefore should reduce the magnitude of residual risk. Construction of an engineered barrier will also reduce infiltration and provide protection against erosion and intrusion and therefore would reduce the magnitude of residual risk and provide a reliable method to control potential migration of or exposure to hazardous substances present within the waste materials.

Regrading of Areas 1 and 2 through placement of additional clean fill material or soil or by regrading of existing materials and construction of a new landfill cover (Alternatives L4, L5 and L6), would reduce potential exposures and magnitude of residual risk for trespassers or workers outside of Areas 1 and 2 that may otherwise use Areas 1 and 2 for ancillary purposes. Implementation of additional land use covenants restricting the property from being used for outdoor storage or other ancillary uses thereby preventing these potential exposure pathways would provide an additional level of protectiveness. Institutional controls that restrict the types of land use that can be conducted on areas 1 and 2 and at the overall landfill property would also provide protection against possible future disruption of the landfill cover.

Construction of a new landfill cover as envisioned under Alternatives L4, L5, and L6 would eliminate or reduce any potential for exposure from the following potential pathways: gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, and incidental ingestion of soil containing radionuclides or other chemicals. Permanence of these alternatives would be improved with cover maintenance and additional institutional controls restricting allowable uses and activities in Areas 1 and 2. Implementation of an engineered landfill cover could reduce the necessity for or degree of reliance on institutional controls and could allow for a limited number of additional possible future uses (outdoor storage, parking lots, etc.).

Implementation of the “hot spot” removal under Alternative L6, would potentially reduce the overall magnitude of residual risk posed by the radiologically-impacted materials as removal of the radiologically-impacted materials that contain levels of radioactivity that are higher than those found in other portions of Area 2 will reduce the overall levels of radionuclides in Area 2. However, as radiologically-impacted materials would still remain on-site, implementation of Alternative L6 would not lessen the need for or scope of the new landfill cover. As radiologically-impacted materials would still remain, removal of “hot spots” in and of itself does not significantly improve the reliability or degree of control that would be achieved by installation and maintenance of a new landfill cover.

The lower 2% slope to be achieved under Alternative L4 would provide a greater degree of reliability against long-term erosion of the soil cover compared to the 5% slopes included in Alternative L5. In contrast, the 5% slopes of Alternative L5 should provide a greater degree of reliability against possible subsidence and associated increased infiltration that could result from subsidence.

6.2.1.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Depending upon the current conditions (conditions after recent grading and capping activities performed by or on the behalf of AAA Trailer), radiologically-impacted soil may remain beneath the former Ford property. The levels of radionuclides present beneath Lot 2A2 were evaluated during the RI before the recent grading and capping activities by AAA Trailer, and were determined to be below the UMTRCA standards. Based on the BRA evaluations, the levels of radionuclides in the Buffer Zone and Lot 2A2 were calculated to pose potential risks within EPA’s accepted risk range. The levels of radionuclides present at the surface beneath the northernmost portion of the Buffer Zone may exceed the UMTRCA standards for surface soil; however, the Buffer Zone is part of the property owned by Rock Road and therefore, under Alternative F3 will be subject to institutional controls on future use. Additional soil cover is proposed to be placed in this area as part of landfill toe regrading under Alternatives L4 and L5 which would eliminate potential exposure to the existing soils and any radionuclides that may remain in this area.

Under Alternative F3, the Buffer Zone and Lot 2A2 would be capped to prevent direct contact with the radiologically impacted materials and to control surface water runoff and erosion and thereby decrease the potential for erosion and subsequent transport of any radiologically impacted materials that may still be present in this area. Therefore, the level of residual risk that may remain if Alternative F3 were selected is minimal. Alternative F4 entails excavation of soil containing radionuclides above the UMTRCA standards from Crossroad Lot 2A2, if any, and the Buffer Zone and therefore would remove any residual risk that might otherwise be remain in these areas. Excavation of radiologically-impacted soil at levels above the UMTRCA standards under Alternative F4 would allow for unrestricted future use of the Buffer Zone and Crossroad Lot 2A2 and would not rely on institutional controls. Consequently, this alternative is considered to be more reliable than the other Ford property alternatives.

6.2.2 Reduction in Toxicity, Mobility, or Volume through Treatment

This criterion is a measure of the following five principal factors:

- Statutory preference for treatment as a principal element;
- Irreversibility of treatment;
- Type and quantity of treatment residual;
- Amount of hazardous material destroyed or treated; and
- Reduction in toxicity, mobility, or volume.

Due to the overall large volume combined with the overall low activity levels of the radioactively impacted materials, none of the remedial alternatives include any treatment components. As radionuclides are naturally occurring elements, they cannot be neutralized or destroyed by treatment. Treatment technologies such as mixing impacted soil with cement could be used to reduce the mobility of the radionuclides although such treatment would result in an increased volume of radiologically-impacted soil. Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable. Containment technologies such as an engineered landfill cover do not address the statutory preference for treatment and are not subject to evaluation under this criterion.

The lack of significant reduction in volume or toxicity of the various landfill and Ford property alternatives is to be expected given the nature of the radiologically impacted materials and is consistent with the presumptive remedy approach for CERCLA municipal landfills. None of the landfill or Ford property alternatives would employ treatment techniques and therefore none of the alternatives would provide any reduction in the volume or toxicity of contaminants beyond the naturally occurring degradation process.

6.2.2.1 Areas 1 and 2 Landfill Alternatives

The potential mobility of the contaminants would be reduced or eliminated through installation of a new landfill cover over Areas 1 and 2 as envisioned under Alternatives L4, L5, and L6 thus eliminating dispersal of radiologically-impacted materials, if any, by infiltration and wind action. Although implementation of Alternative L6 would result in removal of some of the radiologically-impacted materials, this alternative in and of itself is not expected to result in a significant reduction in the mobility of the radionuclides. Excavation of "hot spots" with separation of radiologically impacted soil from municipal solid waste could result in a reduction in the overall volume of impacted materials; however, as discussed below, this option potentially poses additional risks to remediation workers.

6.2.2.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Implementation of the Ford property capping (F3) or soil excavation and consolidation (F4) alternatives would reduce or eliminate the potential for erosion of radiological-impacted soil from this area, if any still remains after the recent activities conducted by AAA Trailer, thereby reducing the mobility of radionuclides from this area.

6.2.3 Short-Term Effectiveness

Short-term effectiveness is a measure of the protection afforded by each alternative during the construction and implementation process. As such, the time until RAOs are achieved is an important component of this criterion. The availability of equipment and specialists to implement the alternative is also a consideration.

This criterion is a measure of the following three principal factors:

- Protection of workers and the community during the remedial action;
- Environmental impacts; and
- Time until remedial response objectives are achieved.

6.2.3.1 Areas 1 and 2 Landfill Alternatives

For Alternatives L4, L5, and L6, the short-term impact on the risks to the community and workers would be minimal during construction of cover systems over Areas 1 and 2 and any surface drainage diversions, controls, and structures. Workers would be adequately protected during construction by adhering to OSHA practices. Cover installation alternatives (Alternatives L4, L5, and L6) would require construction workers and equipment that would initially disturb the soil. Dust control measures would probably be required to limit worker exposure and potential offsite transport during construction. For Alternatives L4, L5, and L6, the RAOs of preventing direct contact with landfill contents and exposure to radiation; minimizing infiltration and any resulting contaminant leaching to groundwater; controlling surface water runoff and erosion and decreasing the potential for erosion and subsequent transport of radiologically impacted materials; and controlling radon and landfill gas emissions would be met immediately upon completion of construction of the cover systems over Areas 1 and 2.

Excavation of the radiologically-impacted materials from Area 2 that contain higher levels of radionuclides or gamma radiation will result in increased exposures to workers in conjunction with excavation and loading of the radiologically-impacted materials. This alternative would entail excavation, handling, loading and offsite transport of materials with higher levels of radionuclides at the Site and therefore will pose increased risks to onsite workers. The potential for increased exposure and risks is considered to be even higher if screening to separate the soil fraction from the waste materials is included as part of Alternative L6 due to the increased exposure that would occur as a result of the need to clear debris (plastic, wood, etc.) from the screening equipment during the screening process.

Alternative L6 is also expected to result in increased potential exposure and risk to the community during shipment of the excavated materials to the offsite disposal facility. The potential for truck or rail accidents could result in release of and possible exposure to radiologically-impacted soil. The shear numbers of truck and rail trips required to ship the materials will also result in additional physical risk due to potential traffic accidents even if no release of the radiologically-impacted materials occurs as a result of such accidents.

As noted in the BRA, some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. With respect to short-term environmental impacts during construction of the cover systems under Alternatives L4, L5, and L6, disturbance of the landfill surface will probably destroy the habitats that currently exist in Areas 1 and 2, forcing wildlife to migrate to other areas.

Excavation of radiologically-impacted materials from Area 2 that contain higher levels of radionuclides or gamma radiation will increase the time required for regrading and installation of the upgraded landfill cover and for completion of the entire remedial action. Screening of the excavated material is also expected to increase the overall time that would be required for completion of Alternative L6.

6.2.3.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Significant increases in potential exposure or risk to workers or the community is not anticipated to occur as a result of any of the alternatives for the former Ford property. As the former Ford property was previously disturbed by grading activities performed by AAA Trailer in 1999 and 2003, no additional environmental impacts are anticipated for this area.

6.2.4 Implementability

Implementability evaluates the technical and administrative difficulties associated with implementing each alternative.

Personnel, equipment, and materials are readily available to implement the additional fill or regrading, cover repair and maintenance, cover system construction, institutional controls, and monitoring components of Alternatives L4, L5, and L6 and the capping or soil excavation and consolidation components of Alternatives F3 and F4. Personnel, equipment, and materials are also available for implementation of the "hot spot" removal component of Alternative L6; however, only a very limited number of offsite disposal facilities will accept "debris" containing radiologically-impacted materials.

6.2.4.1 Areas 1 and 2 Landfill Alternatives

Implementation of additional institutional controls and construction of additional fencing are administratively feasible, as the owners of the various parcels that comprise the West Lake Landfill property are parties to the AOC.

Groundwater monitoring is a component of Alternatives L4, L5, and L6. The only administrative feasibility issue associated with future groundwater monitoring activities would be the ability to continue to obtain access to groundwater monitoring wells located on adjacent properties (Crossroad property and the St. Charles Rock Road right-of-way). Based on the assumed cooperation of property owners, this component of these alternatives is administratively feasible.

The technical feasibility of construction of the cover system component of Alternatives L4, L5, and L6 is similar. Placing soil covers is a well-known technology, commonly implemented at landfill sites. Because of the configuration and location of Areas 1 and 2 within the overall existing larger landfill and the existing relatively steep sideslopes of the existing cover systems along the northern and eastern boundaries of Area 1 and the northern and western boundaries of Area 2, technically it may be difficult to design and construct covers over the steeper slopes along the margins of Area 2. Due to the proximity of the property boundary with these areas, placement of additional fill material or regrading to achieve slope angles of 25%, or even $33^{1}/_{3}$% or less is also expected to be difficult.

The technical feasibility of the excavation and disposal of radiologically-impacted materials with higher levels of radionuclides and/or gamma activity from Area 2 component of Alternative L6, however, will be significantly more difficult. Extremely challenging technical issues include excavation of large volumes of landfilled materials commingled with the radiologically-impacted materials, addressing the attendant odor concern associated with excavation of landfilled refuse/waste material, segregation/screening of the soil fraction from the waste materials (if necessary with respect to the type of material accepted by the disposal facility), and the construction of an offsite railcar loading facility if an existing loading facility does not exist within a reasonable distance from the site.

With respect to administrative feasibility for the cover system component of Alternatives L4, L5, and L6, because Areas 1 and 2 are within a larger area in an existing landfill, design and construction of separate cover systems for Areas 1 and 2 would require coordination with the existing landfill operator relative to anticipated final grades and closure of adjacent areas of the landfill. As the owners and operators of the other portions of the Bridgeton Sanitary Landfill are parties to the AOC, Alternatives L4, L5, and L6 are considered to be implementable from the administrative perspective. The implementability and potential cost of Alternatives L4, L5, and L6 will also be greatly influenced by the availability and locations of offsite soil borrow sources if and when any of these alternatives are implemented.

6.2.4.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

Implementation of institutional controls and installation of additional fencing as an additional access restriction for the Buffer Zone are considered to be administratively feasible as this property is owned and controlled by Rock Road on behalf of the Respondents. Implementation of institutional controls for Crossroad Lot 2A2 would require cooperation and coordination with the current and future owners of this property. Based on prior experience, implementation of institutional controls on Lot 2A2 may be difficult.

Construction of a gravel, asphalt or other cap over Lot 2A2 is considered to be administratively feasible as construction of this type of surface is consistent with the current use of this property. Excavation of radiologically-impacted soil from Lot 2A2 under Alternative F4 would require cooperation of and coordination with the owners of this property and previously was anticipated to be administratively feasible as this activity was anticipated to be consistent with the intended use of this property. With the recent grading and gravel placement in this area and current use for storage of trailers by AAA Trailer, this alternative may not be as easily implemented as Alternative F3.

6.2.5 Cost

For comparison purposes, the estimated total capital cost, estimated annual O&M costs, and estimated 30-year present worth cost estimates are presented in Table 6-1 for each of the alternatives.

6.2.5.1 Areas 1 and 2 Landfill Alternatives

The estimated capital costs for Alternative L4 – Regrading of Areas 1 and 2 (2% minimum slope) and Installation of a Subtitle D Cover System range from $20,500,000 if regrading is achieved through cut and fill of previously placed waste materials to $21,800,000 if regrading is achieved solely through import and placement of additional soil fill. The annual operations and maintenance costs to maintain the cover and conduct groundwater monitoring are between $15,000 and $200,000 per year for either option resulting in estimated 30-year present worth costs for this alternative of $21,700,000 (cut-and-fill of existing materials) to $23,100,000 (additional soil placement).

The estimated capital costs for Alternative L5 – Regrading of Areas 1 and 2 (5% minimum slope) and Installation of a Subtitle D Cover System range from $19,900,000 if regrading is achieved through cut and fill of previously placed waste materials to $24,600,000 if regrading is achieved solely through import and placement of additional soil fill. The annual operations and maintenance costs to maintain the cover and conduct groundwater monitoring are between $15,000 and $200,000 per year for either option resulting in estimated 30-year present worth costs for this alternative of $21,100,000 (cut-and-fill of existing materials) to $25,800,000 (additional soil placement).

The estimated capital cost of the alternative that includes a “hot spot” removal component as well as regrading of Areas 1 and 2 and installation of a Subtitle D cover system (Alternative L6) is approximately $76,000,000. As previously noted, there is a high degree of uncertainty with this estimate due to the uncertain nature and volume of the radiologically-impacted materials that may be excavated and shipped for offsite disposal, the extremely limited number of offsite disposal facilities capable of accepting the radiologically-impacted materials, and the resultant limited pricing options that exist as a result of the nearly monopolistic conditions associated with the few available disposal facilities. Overall, the anticipated costs for “hot spot” removal are significantly greater than those associated with construction of a new landfill cover. Furthermore, adding a “hot spot” removal component will not eliminate the need for, reduce the scope or cost of, or improve the performance of the new landfill cover as the protectiveness of this alternative is derived from installation and maintenance of a new landfill cover not from excavation and offsite disposal of a portion of the radiologically impacted materials.

6.2.5.2 Buffer Zone/Crossroad Property (Ford Property) Alternatives

The capital costs for implementation of Ford property Alternatives F3 and F4 are estimated to be $310,000 and $570,000, respectively. Annual operations and maintenance activities are estimated to range from $6,000 to $14,000 per year for Alternative F3. No ongoing O&M costs are expected to occur under Alternative F4. Estimated 30-year present worth values for Alternatives F3, and F4 are $400,000, and $570,000, respectively.

6.3 Modifying Criteria

The final two of the nine criteria are state acceptance and community acceptance. These two criteria are evaluated following comment on the FS report and Proposed Plan and as such are termed modifying criteria.

6.3.1 State Acceptance

This criterion addresses the State's apparent preferences among or concerns about the various alternatives. The State will be provided an opportunity to review and comment on this FS. Upon completion of the FS, EPA will prepare a Proposed Plan describing their evaluation of the statutory requirements for the development and evaluation of alternatives and selection of a remedy for OU-1 and describing their proposed remedy for OU-1. The State will also provided an opportunity to comment on EPA's Proposed Plan. The State acceptance criterion will be evaluated by EPA as part of the final decision-making process during the preparation of the ROD for OU-1.

6.3.2 Community Acceptance

This criterion addresses the community's apparent preferences among or concerns about the various alternatives. Upon completion of the FS, EPA will prepare a Proposed Plan describing their evaluation of the statutory requirements for the development and evaluation of alternatives and selection of a remedy for OU-1 and describing their proposed remedy for OU-1. The Proposed Plan will be issued for public review and comment and a public meeting may be held where verbal comments on the Proposed Plan will be accepted. Individual members or group representatives of the community will also provided an opportunity to provide written comments on EPA's Proposed Plan. The community acceptance criterion will be evaluated by EPA as part of the final decision-making process during the preparation of the ROD for OU-1.

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Tables

Figures

Appendix A – Presumptive Remedy Guidance for CERCLA Municipal Landfill Sites

U.S. Environmental Protection Agency

Presumptive Remedies

Municipal Landfills

- Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (December 1996) [PDF: 1.5M / 18pp.]
- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (Executive Summary only) (February 1991) [PDF: 33K / 6pp.]
- Landfill Presumptive Remedy Saves Time and Cost (January 1997) [PDF: 48K / 6pp.]
- Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide (August 1995) [PDF: 67K / 8pp.]
- Presumptive Remedy for CERCLA Municipal Landfill Sites (September 1993) [PDF: 472K / 14pp.]
- Reuse of CERCLA Landfill and Containment Sites (September 1999) [PDF: 413K / 17pp.]
- Superfund Accelerated Cleanup Bulletin: Presumptive Remedies for Municipal Landfill Sites (Volume 1 Number 1, April 1992) [PDF: 132K / 1pp.]
- Superfund Accelerated Cleanup Bulletin: Presumptive Remedies for Municipal Landfill Sites (Volume 2 Number 1, February 1993) [PDF: 424K / 2pp.]

Some of the documents above are in PDF format. For information on PDF, please click on the "About PDF" icon.

About PDF

Last updated on Wednesday, August 14th, 2002
URL: http://www.epa.gov/superfund/resources/presump/landfill.htm

United States Environmental Protection Agency
Office of Solid Waste and Emergency Response
Directive No.9355.0-67FS
EPA/540/F-96/020
PB96-963314
December 1996

EPA

Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills

Federal Facilities Restoration and Reuse Office
Mail Code 5101
Quick Reference Fact Sheet

Presumptive remedies are preferred technologies for common categories of sites based on historical patterns of remedy selection and the U.S. Environmental Protection Agency's (EPA's) scientific and engineering evaluation of performance data on technology implementation. By streamlining site investigation and accelerating the remedy selection process, presumptive remedies are expected to ensure the consistent selection of remedial actions and reduce the cost and time required to clean up similar sites. Presumptive remedies are expected to be used at all appropriate sites. Site-specific circumstances dictate whether a presumptive remedy is appropriate at a given site.

EPA established source containment as the presumptive remedy for municipal landfill sites regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in September of 1993 (see the directive *Presumptive Remedy for CERCLA Municipal Landfill Sites*). The municipal landfill presumptive remedy should also be applied to all appropriate military landfills. This directive highlights a step-by-step approach to determining when a specific military landfill is an appropriate site for application of the containment presumptive remedy. It identifies the characteristics of municipal landfills that are relevant to the applicability of the presumptive remedy, addresses characteristics specific to military landfills, outlines an approach to determining whether the presumptive remedy applies to a given military landfill, and discusses administrative record documentation requirements.

PURPOSE

This directive provides guidance on applying the containment presumptive remedy to military landfills. Specifically, this guidance:

- Describes the relevant characteristics of municipal landfills for applicability of the presumptive remedy;
- Presents the characteristics specific to military installations that affect application of the presumptive remedy;
- Provides a decision framework to determine applicability of the presumptive remedy to military landfills; and
- Provides relevant contacts/specialists in military wastes, case histories, administrative record documentation requirements, and references.

BACKGROUND

Municipal landfills are those facilities in which a combination of household, commercial and, to a lesser extent, industrial wastes have been co-disposed. The presumptive remedy for municipal landfills – source containment – is described in detail in the directive *Presumptive Remedy for CERCLA Municipal Landfill Sites*. Highlight 1 outlines the components of the containment presumptive remedy. Highlight 2 lists the characteristics of municipal landfills that are compatible with the presumptive remedy of containment.

Highlight 1
Components of the Containment Presumptive Remedy

- Landfill cap
- Source area groundwater control to contain plume
- Leachate collection and treatment
- Landfill gas collection and treatment
- Institutional controls to supplement engineering controls

> *Highlight 2*
>
> **Appropriate Municipal Landfill Characteristics for Applicability of the Presumptive Remedy**
>
> - Risks are low-level, except for "hot spots"
> - Treatment of wastes is usually impractical due to the volume and heterogeneity of waste
> - Waste types include household, commercial, nonhazardous sludge, and industrial solid wastes
> - Lesser quantities of hazardous wastes are present as compared to municipal wastes
> - Land application units, surface impoundments, injection wells, and waste piles are not included

The presumptive remedy process involves streamlining of the remedial investigation/feasibility study (RI/FS) or, for non-time-critical removals, an Engineering Evaluation/Cost Analysis (EE/CA) by:

- Relying on existing data to the extent possible rather than characterizing landfill contents (limited or no landfill source investigation unless there is information indicating a need to investigate hot spots);
- Conducting a streamlined risk assessment; and
- Developing a focused feasibility study that analyzes only alternatives consisting of appropriate components of the presumptive remedy and, as required by the National Contingency Plan, the no action alternative.

Several directives, including ***Presumptive Remedy for CERCLA Municipal Landfill Sites, Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites,*** and ***Streamlining the RI/FS for CERCLA Municipal Landfill Sites,*** provide a complete discussion of these streamlining principles.

USE OF THIS GUIDANCE

EPA anticipates that the containment presumptive remedy will be applicable to a significant number of landfills found at military facilities. Although waste types may differ between municipal and military landfills, these differences do not preclude use of source containment as the primary remedy at appropriate military landfills.

Additionally, EPA continues to seek greater consistency among cleanup programs, especially in the process of selecting response actions for sites regulated under CERCLA and corrective measures for facilities regulated under the Resource Conservation and Recovery Act (RCRA). In general, even though the Agency's presumptive remedy guidances were developed for CERCLA sites, they should also be used at RCRA Corrective Action sites to focus RCRA Facility Investigations, simplify evaluation of remedial alternatives in the Corrective Measures Study, and influence remedy selection in the Statement of Basis. For more information, refer to the *RCRA Corrective Action Plan,* the proposed *Subpart S regulations,* and the *RCRA Corrective Action Advance Notice of Proposed Rulemaking.*

CHARACTERISTICS OF MILITARY LANDFILLS

The size of the landfill and the presence, proportion, distribution, and nature of wastes are fundamental to the application of the containment presumptive remedy to military landfills.

An examination of 31 Records of Decisions (RODs) that document the remedial decisions for 51 landfills at military installations revealed that no action was chosen for 10 landfills and remedial actions were chosen at 41 landfills (see Appendix). Of these 41 landfills, containment was selected at 23 (56 percent). For the remaining 18 landfills where other remedies were selected, institutional controls only were selected at three landfills, excavation and on-site consolidation were selected at four landfills, and excavation and off-site disposal were selected for 11 landfills.

The military landfills examined in the 51 RODs mentioned above ranged in size from 100 square feet to 150 acres and contained a wide variety of waste types. Of the 41 landfills for which remedial actions were chosen, 14 (34 percent) were one acre or less in size; containment was not selected for any of these landfills. Containment was chosen at 23 (85 percent) of the 27 landfills that were greater than one acre in size. This information suggests that the size of the landfill area is an important factor in determining the use of source containment at military landfills.

The wastes most frequently deposited at these military landfills were municipal-type wastes: household, commercial (e.g., hospital wastes, grease, construction debris), and industrial (e.g., process wastes, solvents, paints) wastes. Containment was the remedy selected at the majority of these sites. Military-specific wastes (e.g., munitions) were found at only 5 of the 51 landfills (10 percent).

Highlight 3 lists typical municipal and military wastes, including:

(1) Wastes that are common to both municipal landfills and military landfills;

(2) Wastes that are usually specific to military bases but that do not necessarily pose higher risks than other industrial wastes commonly found in municipal landfills (i.e., low-hazard military-specific wastes), depending on the volume and heterogeneity of the wastes; and

(3) High-hazard military wastes that, because of their unique characteristics, would require special consideration (i.e., high-hazard military-specific wastes).

The proportion and distribution of hazardous wastes in a landfill are important considerations. Generally, municipal landfills produce low-level threats with occasional hot spots. Similarly, most military landfills present only low-level threats with pockets of some high-hazard waste. However, some military facilities (e.g., weapons fabrication or testing, shipbuilding, major aircraft or equipment repair depots) have a high level of industrial activity compared to overall site activities. In these cases, there may be a higher proportion and wider distribution of industrial (i.e., potentially hazardous) wastes present than at other less industrialized facilities.

PRACTICAL CONSIDERATIONS

Sensitive Environments

Site-specific conditions may limit the use of the containment presumptive remedy at military landfills. For example, the presence of high water tables, wetlands and other sensitive environments, and the possible destruction or alteration of existing habitats as a result of a particular remedial action could all be important factors in the selection of the remedy.

Land Use

Reasonably anticipated future land use is also an important consideration at all sites. However, at military bases undergoing base closure procedures, where expeditiously converting property to civilian use is one of the primary goals, land use may receive heightened attention. Thus, at bases that are closing, it is particularly important for reuse planning to proceed concurrently with environmental investigation and restoration activities. The local reuse group is responsible for developing the preferred reuse alternatives. The Base Realignment and Closure Team should work closely with the reuse group to integrate reuse planning into the cleanup process, where practicable (see the *Land Use in CERCLA Remedy Selection* directive).

Highlight 3
Examples of Municipal-Type and Military-Specific Wastes

Municipal-Type Wastes

Municipal landfills contain predominantly nonhazardous materials. However, industrial solid waste and even some household refuse (e.g., pesticides, paints, and solvents) can possess hazardous components. Further, hazardous wastes are found in most municipal landfills as a result of past disposal practices.

<u>Predominant Constituents</u>

Household refuse, garbage, and debris
Commercial refuse, garbage, and debris
Construction debris
Yard wastes

<u>Found in Low Proportion</u>

Asbestos
Batteries
Hospital wastes
Industrial solid waste(s)
Paints and paint thinner
Pesticides
Transformer oils
Other solvents

Military-Specific Wastes

The majority of military landfills contain primarily nonhazardous wastes. The materials listed in this column are rarely predominant constituents of military landfills.

<u>Low-Hazard Military-Specific Wastes</u>

These types of wastes are specific to military bases but generally are no more hazardous than some wastes found in municipal landfills.

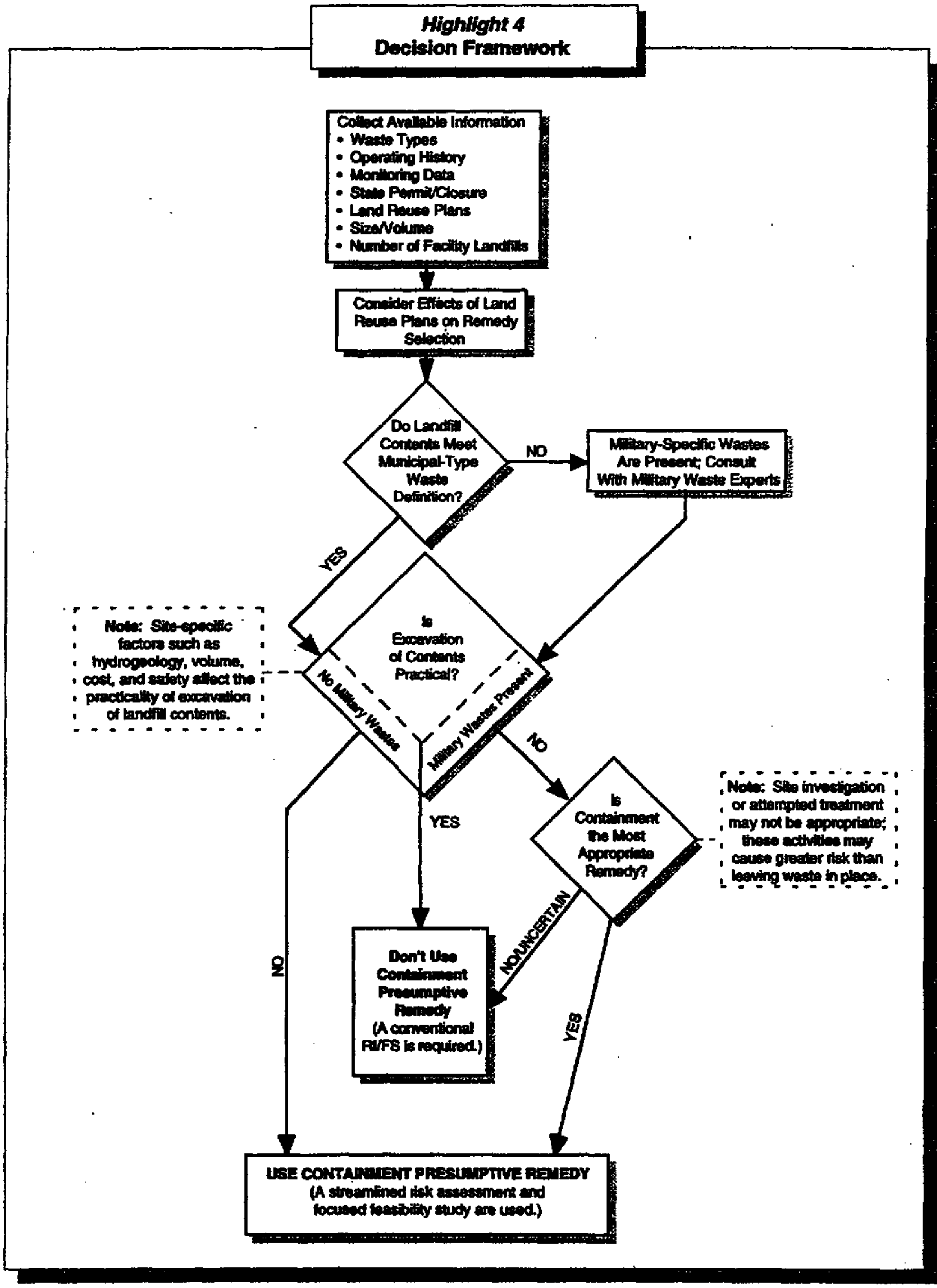
Low-level radioactive wastes
Decontamination kits
Munitions hardware

<u>High-Hazard Military-Specific Wastes</u>

These wastes are extremely hazardous and may possess unique safety, risk, and toxicity characteristics. Special consideration and expertise are required to address these wastes.

<u>Military Munitions</u>

Chemical warfare agents
(e.g., mustard gas, tear agents)
Chemical warfare agent training kits
Artillery, small arms, bombs
Other military chemicals
(e.g., demolition charges, pyrotechnics, propellants)
Smoke grenades



Highlight 4
Decision Framework
Collect Available Information
• Waste Types
• Operating History
• Monitoring Data
• State Permit/Closure
• Land Reuse Plans
• Size/Volume
• Number of Facility Landfills
Consider Effects of Land Reuse Plans on Remedy Selection
Do Landfill Contents Meet Municipal-Type Waste Definition?
NO
Military-Specific Wastes Are Present; Consult With Military Waste Experts
YES
Note: Site-specific factors such as hydrogeology, volume, cost, and safety affect the practicality of excavation of landfill contents.
Is Excavation of Contents Practical?
No Military Wastes
Military Wastes Present
NO
YES
NO
Is Containment the Most Appropriate Remedy?
Note: Site investigation or attempted treatment may not be appropriate; these activities may cause greater risk than leaving waste in place.
NO/UNCERTAIN
Don't Use Containment Presumptive Remedy (A conventional RI/FS is required.)
YES
USE CONTAINMENT PRESUMPTIVE REMEDY (A streamlined risk assessment and focused feasibility study are used.)

DECISION FRAMEWORK TO EVALUATE APPLICABILITY OF THE PRESUMPTIVE REMEDY TO MILITARY LANDFILLS

This Section and Highlight 4 describe the steps involved in determining whether the containment presumptive remedy applies to a specific military landfill.

1. What Information Should Be Collected? Determine the sources, types, and volumes of landfill wastes using historical records, state files, closure plans, available sampling data, etc. This information should be sufficient to determine whether source containment is the appropriate remedy for the landfill. If adequate data do not exist, it may be necessary to collect additional sampling or monitoring data. The installation point of contact (environmental coordinator, base civil engineer, or public works office) should be contacted to obtain records of disposal practices. Current and former employees are also good sources of information.

2. How May Land Reuse Plans Affect Remedy Selection? For smaller landfills (generally less than two acres), land reuse plans may influence the decision on the practicality of excavation and consolidation or treatment of landfill contents. Excavation is a remedial alternative that is fundamentally incompatible with the presumptive remedy of source containment.

3. Do Landfill Contents Meet Municipal Landfill-Type Waste Definition? To determine whether a specific military landfill is appropriate for application of the containment presumptive remedy, compare the characteristics of the wastes to the information in Highlights 2 and 3.

4. Are Military-Specific Wastes Present? Military wastes, especially high-hazard military wastes, may possess unique safety, risk, and toxicity characteristics. Highlight 3 presents examples of these types of materials. If historical records or sampling data indicate that these wastes may have been disposed at the site, special consideration should be given to their handling and remediation. Caution is warranted because site investigation or attempted treatment of these contaminants may pose safety issues for site workers and the community. Some high-hazard military-specific wastes could be considered to present low-level risk, depending on the location, volume, and concentration of these materials relative to environmental receptors. Consult specialists in military wastes (see Highlight 5) when determining whether military-specific wastes at a site fall into either the low-hazard or the high-hazard military-specific waste category found in Highlight 3.

> ***Highlight 5***
>
> **Specialists in Military Wastes**
>
> The installation point of contact will notify the major military command's specialists in military wastes (Explosive Ordnance Disposal Team) for assistance with regard to safety and disposal issues related to any type of military items.
>
> *Army chemical warfare agents specialists:*
>
> - Project Manager, Non-Stockpile Chemical Materiel, Aberdeen Proving Ground, Maryland 21010-5401, (410) 671-1083.
>
> *Navy ordnance related items specialists:*
>
> - The Navy Ordnance Environmental Support Office, Naval Surface Warfare Center, Indian Head, Maryland 20460-5035, (301) 743-4534/4906/4450.
>
> *Navy low-level radioactive wastes specialists:*
>
> - The Naval Sea Systems Command Detachment, Radiological Affairs Support Office, Yorktown, Virginia 23691-0260, (804) 887-4692.
>
> *Air Force ordnance specialists:*
>
> - The Air Force Civil Engineering Support Agency, Contingency Support Division, Tyndall AFB, Florida 32403-5319, (904) 283-6410.

Responsibilities for response are clearly spelled out in the regulation *Interservice Responsibilities For Explosive Ordnance Disposal.*

5. Is Excavation of Contents Practical? The volume of landfill contents, types of wastes, hydrogeology, and safety must be considered when assessing the practicality of excavation and consolidation or treatment of wastes. Consideration of excavation must balance the long-term benefits of lower operation and maintenance costs and unrestricted land use with the initial high capital construction costs and potential risks associated with excavation. Although no set excavation volume limit exists, landfills with a content of more than 100,000 cubic yards (approximately two acres, 30 feet deep) would normally not be considered for excavation. If military wastes are present, especially high-hazard military wastes such as ordnance, safety considerations may be very important in determining the practicality of excavation.

If excavation of the landfill contents is being considered as an alternative, the presumptive remedy should not be used. Therefore, a standard RI/FS would be required to adequately analyze and select the appropriate remedial actions.

6. Can the Presumptive Remedy Be Used? The site manager will make the initial decision of whether a particular military landfill site is suitable for the presumptive remedy or whether a more comprehensive RI/FS is required. This determination must be made before the RI/FS is initiated. This decision will depend on whether the site is a potential candidate for excavation, and if not, whether the nature of contamination is such that a streamlined risk evaluation can be conducted.* A site generally is eligible for a streamlined risk evaluation if groundwater contaminant concentrations clearly exceed chemical-specific standards or the Agency's level of risk or if other conditions exist that provide a justification for action (e.g., direct contact with landfill contents due to unstable slopes). If these conditions do not exist, a quantitative risk assessment that addresses all exposure pathways will be necessary to determine whether action is needed. Before work on the RI/FS workplan is initiated, the community and state should be notified that a presumptive remedy is being considered for the site. It is important for all stakeholders to understand completely how the presumptive remedy process varies from the usual clean-up process, and the benefits of using the presumptive remedy process.

TREATING "HOT SPOTS"

The presumptive remedy also allows for the treatment of hot spots containing military-specific (or other) waste. While the analysis, *Feasibility Study Analysis for CERCLA Municipal Landfill Sites,* that justified the selection of source containment as the presumptive remedy for municipal landfill sites did not specifically take into account high-hazard military wastes, the high-hazard materials present in some military landfills may be compared to the hazardous wastes at municipal landfills and could potentially be treated as hot spots. For further information and case studies on treatment of hot spots, see the *Presumptive Remedy for CERCLA Municipal Landfill Sites* directive.

CASE HISTORIES

The case histories below illustrate how use of the municipal landfill presumptive remedy at military landfills follows the decision framework in Highlight 4.

* See *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, which states that if MCLs or non-zero MCLGs are exceeded [a response] action generally is warranted.

The decision to use the presumptive remedy can be made for one landfill or as a part of a site-wide strategy (as in the Loring Air Force Base example below), depending on factors such as the nature of the wastes, size of the landfill, land reuse potential, and public acceptance.

The following case histories present examples of where the containment presumptive remedy was or was not applied, based on site-specific conditions.

Disposal of Municipal-Type Wastes

The **Naval Reactor Facility (NRF)** site in Idaho Falls, Idaho, was established in 1949 as a testing site for the nuclear propulsion program. The three landfill units at the site received solid wastes similar to municipal landfills. These wastes included petroleum and paint products, construction debris, and cafeteria wastes. Historical records do not indicate that any radioactive wastes were disposed of in these landfill units. The selected remedy for the landfills at the site included the installation of a 24-inch native soil cover designed to incorporate erosion control measures to reduce the effects from rain and wind. The remedy also provided for maintenance of the landfill covers, including subsidence correction and erosion control. Monitoring of the landfills will include sampling of soil gas to assess the effectiveness of the cover and sampling of the groundwater to ensure that the remedy remains protective. Institutional controls will also be implemented to prevent direct exposure to the landfill. The NRF site is an example of where the streamlining principles of the presumptive remedy process, including a streamlined risk assessment and a focused feasibility study, were successfully employed.

Co-Disposal of High-Hazard Wastes

At the **Massachusetts Military Reservation**, in Cape Cod, Massachusetts, anecdotal information indicated that munitions had been disposed of at an unidentified location in a landfill that primarily contained municipal-type waste. Ground penetrating radar was utilized to determine if there were any discrete disposal areas containing potential hot spots at this site and found none. Because the munitions waste was not in a known discrete and accessible area, it could not be treated as a hot spot. Consequently, without excavating or treating the munitions waste as a hot spot, the authorities decided to cap the landfill. In this case, the streamlining principles of the presumptive remedy process were applied. For example, site investigation was limited and treatment options were not considered.

Land Reuse Considerations

At **Loring Air Force Base**, a closing base in Limestone, Maine, base landfills 2 and 3 (9 and 17 acres, respectively) consisted primarily of municipal and flightline wastes. The selected remedy for these landfills included a multi-layer cap, passive venting system, and institutional controls. The RODs for the landfills, signed in September 1994, required placing a RCRA Subtitle C cap on the landfills. To construct the RCRA cap, the designers estimated that 400,000 to 600,000 cyds of material would have to be placed on the landfills prior to construction of the cap to ensure proper drainage and slopes.

At Loring, the streamlining principles of the containment remedy, a focused feasibility study, and a streamlined risk assessment were applied for landfills 2 and 3. Additionally, the RODs signed for these landfills specified that excavated material from other parts of the base would be used at the landfills to meet subgrade design specifications. To date, more than 500,000 cyds of contaminated soils have been excavated and used as subgrade for the landfills (after demonstrating compliance with RCRA Land Disposal Restrictions). In addition to cost savings realized by providing subgrade, other benefits have been realized, such as limiting the number of parcels requiring deed restrictions and minimizing locations requiring operation and maintenance. At this base, the landfill consolidation efforts resulted in an estimated total cost savings of $12–20 million while incorporating future land use considerations into the decision process.

The Brunswick Naval Air Station in Brunswick, Maine, contained several landfill sites. One of the first RODs signed, for Sites 1 and 3, called for construction of a 12-acre RCRA Subtitle C cap and a slurry wall, as well as for groundwater extraction and treatment. Subsequently, during the remedy selection process for Site 8, the public objected to containment as the proposed remedy for this relatively small (0.6 acre) site on the grounds that should the base eventually close, containment would create several useless parcels of land. After public comment, the Navy reconsidered, proposing instead to excavate Site 8 and consolidate the removed materials (which consisted of construction debris and soil contaminated with nonhazardous levels of polycyclic aromatic hydrocarbons) as part of the necessary subgrade fill for the landfill cap to be constructed at Sites 1 and 3. In this case, land reuse considerations preempted the selection of a containment remedy.

PRESUMPTIVE REMEDY ADMINISTRATIVE RECORD DOCUMENTATION REQUIREMENTS

As stated earlier, it must be determined whether the military landfill in question contains military-specific wastes, as described in Highlight 3. This should be followed by a determination of whether anything about these wastes would make the engineering controls specified in the presumptive remedy for municipal landfills less suitable at that site. These determinations must be documented in the administrative record, which supports the final decision. This information, in turn, will assist the public in understanding the evaluation of the site as a candidate for use of the presumptive remedy and the advantage it provides. For further reference, the administrative record requirements for all Superfund sites including military landfills are explained in the *Final Guidance on Administrative Records for Selecting CERCLA Response Actions.*

The administrative record must contain the following generic and site-specific information, which documents the selection or non-selection of the containment presumptive remedy.

Generic Information

A. **Generic Documents.** These documents should be placed in the docket for each federal facility site where the containment presumptive remedy is selected. Each EPA Regional Office has copies of the following presumptive remedy documents:
   - *Presumptive Remedy: Policy and Procedures*
   - *Presumptive Remedy for CERCLA Municipal Landfill Sites*
   - *Application of the Municipal Landfill Presumptive Remedy to Military Landfills*
   - *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*

B. **Notice Regarding Backup File.** The docket should include a notice specifying the location of and times when public access is available to the generic file of backup materials used in developing the *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*. This file contains background materials such as technical references and portions of the feasibility studies used in the generic study. Each EPA Regional Office has a copy of this file.

Site-specific Information

Focused FS or EE/CA. Military-specific wastes need to be addressed in site-specific analyses when determining the applicability of the containment presumptive remedy to military landfills. High-hazard military-specific waste materials (e.g., military munitions) require special consideration when applying the presumptive remedy.

As noted on pages 1 and 2 of this directive, the presumptive remedy approach allows you to streamline and focus the FS or EE/CA by eliminating the technology screening step from the feasibility study process. EPA has already conducted this step on a generic basis in the *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*. Thus, the FS analyzes only alternatives comprised of components of the containment remedy identified in Highlight 1. In addition, the focused FS or EE/CA should include a site-specific explanation of how the application of the presumptive remedy satisfies the National Contingency Plan's three site-specific remedy selection criteria (i.e., compliance with state applicable or relevant and appropriate requirements, state acceptance, and community acceptance).

CONCLUSION

This directive provides guidance for the use of the containment presumptive remedy at appropriate military landfills. The remedies selected at numerous military installations indicate that source containment is applicable to a significant number of military landfills. These landfills need not be identical to municipal landfills in all regards. Key factors determining whether the containment presumptive remedy should be applied to a specific military landfill include the size of the landfill; volume and the type of landfill contents; future land use of the area; and the presence, proportion, and distribution of military-specific wastes.

REFERENCES

California Base Closure Environmental Committee, *Integrating Land Use and Cleanup Planning at Closing Bases*, December 1994.

Federal Register, 1996. Volume 61, No. 85, May 1, 1996; *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities, Advance Notice of Proposed Rulemaking.*

Federal Register, 1990. Volume 55, No. 145, July 27, 1990; 40 CFR Parts 264, 265, 270 and 271; *Corrective Action for Solid Waste Management Units at Hazardous Waste Facilities; Proposed* (proposed Subpart S regulations).

U.S. Environmental Protection Agency, OSWER Directive 93557-04, *Land Use in the CERCLA Remedy Selection*, May 25, 1995.

U.S. Environmental Protection Agency, OSWER Directive 9356.0-03, EPA/540/R-94/081, *Feasibility Study Analysis for CERCLA Municipal Landfill Sites*, August 1994.

U.S. Environmental Protection Agency, OSWER Directive 9902.3-2A, EPA/520/R-94/004, *RCRA Corrective Action Plan*, May 1994.

U.S. Environmental Protection Agency, OSWER Directive 9355.0-49FS, *Presumptive Remedy for CERCLA Municipal Landfill Sites*, September 1993.

U.S. Environmental Protection Agency, OSWER Directive 9355.0-47FS, EPA/540/F-93/047, *Presumptive Remedy: Policy and Procedures*, September, 1993.

U.S. Environmental Protection Agency, OSWER Publication 9380.3-06FS, *Guide to Principal Threat and Low Level Threat Wastes*, November 1991.

U.S. Environmental Protection Agency, OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, April 22, 1991.

U.S. Environmental Protection Agency, OERR, EPA/540/P-91/001, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, February 1991.

U.S. Environmental Protection Agency, OSWER Directive 9833.3A.1, *Final Guidance on Administrative Records for Selecting CERCLA Response Actions*, December 3, 1990.

U.S. Environmental Protection Agency, OSWER Directive 9355.3-11FS, *Streamlining the RI/FS for CERCLA Municipal Landfill Sites*, September 1990.

U.S. Department of Navy, *Interservice Responsibilities for Explosive Ordnance Disposal* OPNAVINST 8027.1G (also known as MCO 8027.1D, AR 75-14; or AFR 32-3002), February 14, 1992.

NOTICE

The policies set out in this document are intended solely as guidance to the EPA personnel; they are not final EPA actions and do not constitute rulemaking. These policies are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances. EPA also reserves the right to change this guidance at any time without public notice.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Brunswick NAS, Sites 1 and 3 (OU1), ME, Region 1 6/16/92	Site 1, 8.5 acres; Site 3, 1.5 acres. Sites are in close proximity and not easily distinguishable; the combined volume of Sites 1 and 3 is 300,000 cy	Household refuse, waste oil, solvents, pesticides, paints, isopropyl alcohol	Metals, VOCs, PAHs, PCBs, pesticides	**Remedy:** Capping (permanent, low-permeability, RCRA Subtitle C cap), of 12 acres with a slurry wall and pump and treat ground water within cap and slurry wall.
Brunswick NAS, Sites 5 and 6 (OU3), ME, Region 1 8/31/93	Site 5, 0.25 acres, 12 cy	Asbestos-covered pipes	Asbestos	**Remedy:** Excavation, containerization, and transport to landfill Sites 1 and 3 for use as fill under cap.
Brunswick NAS, Sites 5 and 6 (OU3), ME, Region 1 8/31/93	Site 6, 1.0 acre, 8,800 - 18,700 cy	Construction debris, and aircraft parts, asbestos pipes	Asbestos	**Remedy:** Excavation, containerization, and transport to Sites 1 and 3 landfill for use as fill under cap.
Brunswick NAS, Site 8 (OU4), ME, Region 1 8/31/93	Site 8, 0.6 acres, 5,600 - 14,000 cy	Rubble, debris, trash, and possibly solvents	Metals, pesticides, PCBs[1]	**Remedy:** Excavation, containerization, and transport to landfill Sites 1 and 3 for use as fill under cap.
Loring AFB, Landfills 2 and 3 (OU2), ME, Region 1 9/30/94	Landfill 2, 9 acres	Domestic waste, construction debris, flightline wastes, sewage sludge and oil-filled switches	PCBs, VOCs, SVOCs, metals, DDT[1]	**Remedy:** Capping (low-permeability cover system which meets RCRA Subtitle C and Maine hazardous waste landfill cap requirements), passive gas venting system and controls, and institutional controls.
Loring AFB, Landfills 2 and 3 (OU2), ME, Region 1 9/30/94	Landfill 3, 17 acres	Waste oil/fuels, solvents, paints, thinners, and hydraulic fluids	VOCs, SVOCs, DDT, PCBs, metals[1]	**Remedy:** Capping (low-permeability cover system which meets RCRA Subtitle C and Maine hazardous waste landfill cap requirements), passive gas venting system and controls, and institutional controls.

1 Contaminants of Potential Concern

DATA SUMMARY TABLE FOR MILITARY LANDFILLS APPENDIX (CONT.)

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Newport Naval Education and Training Center, McAllister Point Landfill, RI, Region 1 9/27/93	McAllister Point Landfill, 11.5 acres	Domestic refuse, spent acids, paints, solvents, waste oils, and PCB-contaminated transformer oil	VOCs, PAHs, PCBs, pesticides, phenols, metals	**Remedy:** Capping (RCRA Subtitle C, multi-layer cap), landfill gas management, surface controls, and institutional controls.
Otis Air National Guard, Camp Edwards, Massachusetts Military Reservation, MA, Region 1 1/14/93	Landfill Number 1 (LF-1), 100 acres	General refuse, fuel tank sludge, herbicides, blank ammunition, paints, paint thinners, batteries, DDT, hospital wastes, sewage sludge, coal ash, possibly live ordnance	VOCs, SVOCs, inorganics	**Remedy:** Capping (composite-low-permeability cover system), institutional controls. soil cover inspection, and ground water monitoring.
Pease AFB (OU1), NH, Region 1 9/27/93	LF-5, 23 acres	Domestic and industrial wastes, waste oils and solvents, and industrial wastewater treatment plant sludge	VOCs, PAHs, arsenic and other metals	**Remedy:** Excavation, dewatering and consolidation and regrading of waste under a composite-barrier type cap, institutional controls, and extraction and treatment of ground water with discharge to base wastewater treatment facility.
Fort Dix Landfill Site, NJ, Region 2 9/24/91	Main area, 126 acres	Domestic waste, paints and paint thinners, demolition debris, ash, and solvents	VOCs, metals	**Remedy:** Capping 50-acre portion (New Jersey Administrative Code 7:26 closure plan for hazardous waste), installing gas venting system and an air monitoring system, ground water, surface water, and air monitoring, and institutional controls.
Naval Air Engineering Center (OU3), NJ, Region 2 9/16/91	Site 26, 1500 sq. ft., volume not reported	Oil, roofing materials, building debris	No contamination was detected	**Remedy:** Source: No action.
Naval Air Engineering Center (OU3), NJ, Region 2 9/16/91	Site 27, 6.4 acres	Scrap steel cable	No contamination was detected	**Remedy:** Source: No action.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Naval Air Engineering Center (OU17), NJ, Region 2 9/26/94	Site 29, 20 acres	Construction debris, metal, asbestos, solvents, other miscellaneous wastes	VOCs, SVOCs, metals	**Remedy:** Source: No action.
Plattsburgh AFB, LF-022, NY, Region 2 9/30/92	LF-022, approx. 13.7 acres, approx. 524,000 cy	Household refuse	Metals, pesticides	**Remedy:** Capping (NY State requirements for solid waste landfills, 12 inch soil cap), and institutional controls.
Plattsburgh AFB, LF-023, NY, Region 2 9/30/92	LF-023, approx. 9 acres, approx. 406,000 cy	Household refuse, debris, car parts	Metals, VOCs, SVOCs, PCB, pesticides	**Remedy:** Capping (NY State requirements for solid waste landfills, low permeability cap), and institutional controls.
U.S. Army Aberdeen Proving Grounds (OU 1), MD, Region 3 6/30/92	Michaelsville Landfill, 20 acres, greater than 100,000 cy	Household refuse, limited quantities of industrial waste, burned sludges, pesticide containers, paint, asbestos shingles, solvents, waste motor oils, grease, PCB transformer oils, possible pesticides	Metals, pesticides, VOCs, PCBs, PAHs	**Remedy:** Capping (multi-layer cap in accordance with MDE requirements for sanitary landfills, using a geosynthetic membrane, 0-2 feet compacted earth material), surface water controls, and gas venting system.
Marine Corps Base, Camp Lejeune (OU1), NC, Region 4 9/15/94	Site 24, 100 acres, volume not reported	Fly ash, cinders, solvents, used paint stripping compounds, sewage sludge, spirator sludge, construction debris	Pesticides, metals, SVOCs, PCBs	**Remedy:** Source: No action.
Robins AFB (OU1), GA, Region 4 6/25/91	Main area (Landfill No. 4), 45 acres, greater than 100,000 cy	Household refuse, industrial waste	VOCs, metals	**Remedy:** Capping (to maintain a minimum 2-foot cover over the waste materials), renovation of current soil cover including clearing, filling, regrading, adding soil and clay cover material and seeding to maintain a minimum 2-foot cover over the waste material.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Twin Cities AFB Reserve, MN, Region 5 3/31/92	Main area, approx. 2 acres, volume not reported	Household refuse, small amounts of industrial; some burned waste	VOCs, metals	**Remedy:** Source: Institutional controls, natural attenuation, ground water and surface water monitoring.
Wright-Patterson AFB, (Source Control Operable Unit) OH, Region 5 7/15/93	LF-8, 11 acres, 187,300 cy	General refuse and hazardous materials	PAHs, pesticides, PCBs, VOCs, metals, inorganics	**Remedy:** Capping (low-permeability clay cap that complies with Ohio EPA regulations for sanitary landfills which meet or exceed RCRA Subtitle D requirements), institutional controls, ground water treatment and monitoring.
Wright-Patterson AFB, (Source Control Operable Unit) OH, Region 5 7/15/93	LF-10, 8 acres, 171,600 cy	General refuse and hazardous materials	PAHs, pesticides, PCBs, VOCs, metals, inorganics	**Remedy:** Capping (low-permeability clay cap that complies with Ohio EPA regulations for sanitary landfills which meet or exceed RCRA Subtitle D requirements), institutional controls, ground water treatment and monitoring.
Hill AFB (OU4), UT, Region 8 6/14/94	Landfill 1, 3.5 acres, 140,000 cy	Burned solid waste, small amounts of waste oils and solvents (from vehicle maintenance facility).	VOCs (TCE)	**Remedy:** Capping (clay or multi-media cap), pumping, treating, and discharging ground water to POTW, treating contaminated surface water, soil vapor extraction, implementing institutional controls and access restrictions.
Defense Depot, Ogden (OU1), UT, Region 8 6/26/92	Plain City Canal Backfill Area, 4,000 cy	Electrical wire, glass, ash, charcoal, asphalt, wood, concrete, plastic and metal fragments	Metals, PCBs, dioxins, furans, VOCs	**Remedy:** Excavation, sorting, and off-site disposal in a RCRA permitted facility.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Chemical Warfare Agent Identification Kit Burial Area, 100 cy	Vials of chemical surety agents, broken glass	Metals, chemical warfare agents	**Remedy:** Excavation, sorting, and off-site disposal in a RCRA permitted facility.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Riot Control and Smoke Grenade Burial Area, 90 cy	Unfused grenades and grenade fragments, as well as riot control grenades	No contaminants identified	**Remedy:** Excavation, sorting, and off-site disposal in a RCRA permitted facility.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Compressed Gas Cylinder Reburial Area	Two compressed gas cylinders and four smaller steel tanks removed from the Chemical Warfare Agent Identification Kit and Riot Control and Smoke Grenade burial areas	Unknown, possible chemical warfare agents	**Remedy:** Excavation of compressed gas cylinders and disposal by a commercial operator.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Burial Site 3-A: Miscellaneous Items Burial Area, 230 cy	Chemical Warfare Agent Identification Kits containing no CWAs, World War II gas mask canisters, paint, broken glass, wooden boxes, and pieces of iron	No contaminants identified	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted hazardous waste landfill.
Defense Depot, Ogden (OU3), UT, Region 8 9/28/92	Water Purification Tablet Burial Area, 110 cy	Bottles containing halazone water purification tablets	No contaminants identified	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted industrial waste landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-A, 7500, sq. ft., 3000 cy	Wood, crating materials, paper, greases, debris, medical waste, oils, some burned waste	Pesticides, VOCs, PCBs	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted hazardous waste landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-B, (inside 4-E), less than 7,500, sq. ft.	Fluorescent tubes	No contaminants identified	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-C, 6,000 sq. ft	Food products, sanitary landfill waste	Pesticides, VOCs, PCBs	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted landfill.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-D, 2,000 sq. ft.	Methyl bromide cylinders, halazone tablets (jars)	Possibly methyl bromide	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted industrial landfill.
Defense Depot, Ogden (OU4), UT, Region 8 9/28/92	4-E, 7,500 sq. ft., volume not reported	Oils, spent solvents, industrial waste	PCBs, VOCs, pesticides	**Remedy:** Excavation and transportation for off-site disposal in a RCRA permitted hazardous landfill.
Rocky Mountain Arsenal, Shell Section 36 Trenches (OU23), CO, Region 8 5/3/90	Shell Trench Area, 8 acres	Rags, plastic and metal cans, glass jars, piping, pipe fittings, insulation, refuse, insulation, liquid and solid wastes generated from the manufacture of pesticides	VOCs, SVOCs, pesticides[2]	**Remedy:** Capping (physical barrier with a soil and vegetative cover).
Fort Ord Landfills (OU2), CA, Region 9 8/23/94	Landfills, 150 acres	Household and commercial refuse, dried sewage sludge, construction debris, small amounts of chemical waste including paint, oil, pesticides, and epoxy adhesive, electrical equipment	VOCs	**Remedy:** Capping (California Code of Regulations for non-hazardous waste), institutional controls, extraction, treatment, and recharge of ground water.
Riverbank Army Ammunition Plant Site, CA, Region 9 3/24/94	Landfill, 4.5 acres	Paper, oils, greases, solvents, hospital wastes, construction debris, and industrial sludges	Metals	**Remedy:** Capping (a multi-layer cap as specified in Dispute Resolution Agreement), pump and treat ground water, discharge treated water to on-site ponds.

[2] Contaminants identified as emanating from the trenches but not contaminants of concern

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Williams AFB (OU1), AZ, Region 9 5/18/94	Landfill LF-04, 90 acres, 59,000 cy	Dried sewage sludge, domestic trash and garbage, wood, metal, brush, construction debris, some solvents and chemicals	Soil, pesticides, SVOCs, inorganics, including beryllium, lead, zinc	**Remedy:** Capping (a permeable cap with a 24 inch soil cover), stormwater runoff controls, institutional actions, and soil and ground water monitoring.
Williams AFB (OU1), AZ, Region 9 5/18/94	Pesticide Burial Area (DP-13), 0.4 acre	Pesticides	Pesticides, VOCs, metals	**Remedy:** Source: No action.
Williams AFB (OU1), AZ, Region 9 5/18/94	Radioactive Instrumentation Burial Area (RW-11), 100 sq. ft.	Cement; radioactive instruments	Radium (background levels)	**Remedy:** Source: No action.
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF05, 17 acres	General refuse, scrap metal, used chemicals and other scrap material	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF07, 35 acres	Base generated refuse, scrap metal, construction rubble, drums of asphalt, empty pesticide containers, small amounts of shop wastes, and asbestos wastes	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF13, 2 acres	Empty drums, metal piping, drums of asphalt, and small quantities of quicklime	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.

DATA SUMMARY TABLE FOR MILITARY LANDFILLS APPENDIX (CONT.)

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Elmendorf AFB (OU1), AK, Region 10 9/29/94	LF59, 2 landfills (.5 acres each)	General refuse and construction debris, and tar seep	VOCs, PCBs, metals, PAHs	**Remedy:** Source: No action.
Fairchild AFB (OU1), WA, Region 10 2/13/93	Southwest area, 12.6 acres, 407,300 cy	Coal ash, solvents, dry cleaning filters, paints, thinners, possibly electrical transformers.	VOCs	**Remedy:** Capping (low-permeability cap designed to meet the closure requirements of Washington State's Minimum Functional Standards for Solid Waste handling and of federal RCRA Subtitle D), SVE/ treatment system, extracting contaminated ground water and treating by air stripping and granular activated carbon, disposal off-site, monitoring off-site water supply wells.
Fairchild AFB (OU1), WA, Region 10 2/13/93	Northeast area, 6 acres, 291,000 cy	Coal ash, solvents, dry cleaning filters, paints, thinners, possibly electrical transformers.	VOCs	**Remedy:** Capping (low-permeability cap designed to meet the closure requirements of Washington State's Minimum Functional Standards for Solid Waste handling and of federal RCRA Subtitle D), SVE/ treatment system, extracting contaminated ground water and treating by air stripping and granular activated carbon, disposal off-site, monitoring off-site water supply wells.
Fort Lewis Military Reservation, Landfill 4 and the Solvent Refined Coal Pilot Plant, WA, Region 10 9/24/93	LF4, 52 acres	Domestic and light industrial solid waste (no landfill records were maintained).	VOCs, metals	**Remedy:** Source: Institutional controls, treat ground water and soil using SVE and air sparging system.
Naval Air Station, Whidbey Island, Ault Field (OU1), WA, Region 10 12/20/93	Area 6 Landfill, 40 acres. Within Area 6 there are 2 distinct areas where wastes were disposed.	Household waste, construction debris, and yard waste	VOCs	**Remedy:** Capping (low-permeability cap to meet Washington State Minimum Functional Standards for non-hazardous closure), air stripping ground water, ground water monitoring, and institutional controls.
Naval Air Station, Whidbey Island, Ault Field (OU2), WA, Region 10 12/20/93	Area 2, 13 acres; Area 3, 1.5 acres. Both treated together due to close proximity.	Solid waste from the base, industrial wastes, and construction and demolition debris	Metals, PAHs	**Remedy:** Source: Institutional controls, ground water monitoring.

ROD / Site Name, State, Region, ROD Sign Date	Disposal Area, Size, Volume of Waste	Type of Waste Deposited	Contaminants of Concern	Remedy
Naval Reactor Facility, ID, Region 10 9/27/94	Landfill Unit 8-05-1, (350 ft. by 450 ft. by 4-25 ft.)	Construction debris, small quantities of paints, solvents, cafeteria wastes, and petroleum products	Metals, VOCs	**Remedy:** Capping (24-inch native soil cover), institutional controls.
Naval Reactor Facility, ID, Region 10 9/27/94	Landfill Unit 8-05-51, (450 ft. by 100 -175 ft. by 10-15 ft.)	Construction debris, small quantities of paints, solvents, cafeteria wastes, and petroleum products	Metals, VOCs	**Remedy:** Capping (24-inch native soil cover), institutional controls.
Naval Reactor Facility, ID, Region 10 9/27/94	Landfill Unit 8-06-53, (900 ft. by 1200 ft. by 7- 10 ft.)	Construction debris, small quantities of paints, solvents, cafeteria wastes, and petroleum products	Metals, VOCs	**Remedy:** Capping (24-inch native soil cover), institutional controls.

United States
Environmental Protection
Agency
Washington, D.C. 20460

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Conducting Remedial Investigations/ Feasibility Studies for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, D.C. 20460

EXECUTIVE SUMMARY

A broad framework for the Remedial Investigation/Feasibility Study (RI/FS) and selection of remedy process has been created through the National Contingency Plan (NCP) and the *U.S. EPA RI/FS Guidance* (U.S. EPA 1988d). With this framework now in place, the Office of Emergency and Remedial Response's efforts are being focused on streamlining the RI/FS and selection of remedy process for specific classes of sites with similar characteristics. One such class of sites is the municipal landfills which compose approximately 20 percent of the sites on the Superfund Program's National Priorities List (NPL). Landfill sites currently on the NPL typically contain a combination of principally municipal and to a lesser extent hazardous waste and range in size from 1 acre to 640 acres. Potential threats to human health and the environment resulting from municipal landfills may include:

- Leachate generation and groundwater contamination
- Soil contamination
- Landfill contents
- Landfill gas
- Contamination of surface waters, sediments, and adjacent wetlands

Because these sites share similar characteristics, they lend themselves to remediation by similar technologies. The NCP contains the expectation that containment technologies will generally be appropriate remedies for wastes that pose a relatively low low-level threat or where treatment is impracticable. Containment has been identified as the most likely response action at these sites because (1) CERCLA municipal landfills are primarily composed of municipal, and to a lesser extent hazardous wastes; therefore, they often pose a low-level threat rather than a principal threat; and (2) the volume and heterogeneity of waste within CERCLA municipal landfills will often make treatment impractical. The NCP also contains an expectation that treatment should be considered for identifiable areas of highly toxic and/or mobile material (hot spots) that pose potential principal threats. Treatment of hot spots within a landfill will therefore be considered and evaluated.

With these expectations in mind, a study of municipal landfills was conducted with the intent of developing methodologies and tools to assist in streamlining the RI/FS and selection of remedy process. Streamlining may be viewed as a mechanism to enhance the efficiency and effectiveness of decision-making at these sites. The goals of this study to meet this objective include: (1) developing tools to assist in scoping the RI/FS for municipal landfill sites, (2) defining strategies for characterizing municipal landfill sites that are on the NPL, and (3) identifying practicable remedial action alternatives for addressing these types of sites.

Streamlining Scoping

The primary purpose of scoping an RI/FS is to divide the broad project goals into manageable tasks that can be performed within a reasonable period of time. The broad project goals of any Superfund site are to provide the information necessary to characterize the site, define site dynamics, define risks, and develop a remedial program to mitigate current and potential threats to human health and the environment. Scoping of municipal landfill sites can be streamlined by focusing the RI/FS tasks on just the data required to evaluate alternatives that are most practicable for municipal landfill sites. Section 2 of this document describes the activities that must take place to plan an RI/FS and provides guidelines for establishing a project's scope. To summarize, scoping of the RI/FS tasks can be streamlined by:

- Developing preliminary remedial objectives and alternatives based on the NCP expectations and focusing on alternatives successfully implemented at other sites
- Using a conceptual site model (see Figure 2-4 for a generic model devel-

oped for municipal landfill sites based on their similarities) to help define site conditions and to scope future field tasks

- Conducting limited field investigations to assist in targeting future fieldwork

- Identifying clear, concise RI objectives in the form of field tasks to ensure sufficient data are collected to adequately characterize the site, perform the necessary risk assessment(s), and evaluate the practicable remedial action alternatives

- Identifying data quality objectives (DQOs) that result in a well-defined sampling and analysis plan, ensure the quality of the data collected, and integrate the information required in the RI/FS process

- Limiting the scope of the baseline risk assessment as discussed below

Streamlining the Baseline Risk Assessment

The baseline risk assessment may be used to determine whether a site poses risks to human health and the environment that are significant enough to warrant remedial action. Because options for remedial action at municipal landfill sites are limited, it may be possible to streamline or limit the scope of the baseline risk assessment by (1) using the conceptual site model and RI-generated data to perform a qualitative risk assessment that identifies the contaminants of concern in the affected media, their concentrations, and their hazardous properties that may pose a risk through the various routes of exposure and (2) identifying pathways that are an obvious threat to human health or the environment by comparing RI-derived contaminant concentration levels to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. (When potential ARARs do not exist for a specific contaminant, risk-based chemical concentrations should be used.)

Where established standards for one or more contaminants in a given medium are clearly exceeded, the basis for taking remedial action is generally warranted (quantitative assessments that consider all chemicals, their potential additive effects, or additivity of multiple exposure pathways are not necessary to initiate remedial action). In cases where standards are not clearly exceeded, a more thorough risk assessment may be necessary before initiating remedial action.

This streamlined approach may facilitate early action on the most obvious landfill problems (groundwater and leachate, landfill gas, and the landfill contents) while analysis continues on other problems such as affected wetlands and stream sediments. Dividing a site into operable units and performing early or interim actions is often desirable for these types of sites. This is because performing certain early actions (e.g., capping a landfill) can reduce the impact to other parts of a site while the RI/FS continues. Additionally, early actions must be consistent with the site's final remedy and therefore help to speed up the clean-up process.

Ultimately, it will be necessary to demonstrate that the final remedy, once implemented, will in fact address all pathways and contaminants of concern, not just those that triggered the remedial action. The approach outlined above facilitates rapid implementation of protective remedial measures for the major problems at a municipal landfill site.

Streamlining Site Characterization

Site characterization for municipal landfills can be expedited by focusing field activities on the information needed to sufficiently assess risks posed by the site, and to evaluate practicable remedial actions. Recommendations to help streamline site characterization of media typically affected by landfills are discussed in Section 3 of this report. A summary of the site characterization strategies is presented below.

Leachate/Groundwater Contamination

Characterization of a site's geology and hydrogeology will affect decisions on capping options as well as on extraction and treatment systems for leachate and groundwater. Data gathered during the hydrogeologic investigation are similar to those gathered during investigations at other types of NPL sites. Groundwater contamination at municipal landfill sites may, however, vary in composition from that at other types of sites in that it often contains high levels of organic matter and metals.

Leachate generation is of special concern when characterizing municipal landfill sites. The main factors contributing to leachate quantity are precipitation and recharge from groundwater and surface water. Leachate is characteristically high in organic matter as measured by chemical oxygen demand (COD) or biochemical oxygen demand (BOD). In many landfills, leachate is perched within the landfill contents, above the water table. Placing a limited number of leachate wells in the landfill is an efficient means of gathering information regarding the depth, thickness, and types of the waste; the moisture content and degree of decomposition of the waste; leachate head levels and the composition of landfill leachate; and the elevation of the underlying natural soil layer. Additionally, leachate wells provide good locations for landfill gas sampling. It should be noted, however, that without the proper precautions, placing wells into the landfill contents may create health and safety risks. Also, installation of wells through the landfill base may create conduits through which leachate can migrate to lower geologic strata, and the installation of wells into landfill contents may make it difficult to ensure the reliability of the sampling locations.

Landfill Contents

Characterization of a landfill's contents is generally not necessary because containment of the landfill contents, which is often the most practicable technology, does not require such information. Certain data, however, are necessary to evaluate capping alternatives and should be collected in the field. For instance, certain landfill properties such as the fill thickness, lateral extent, and age will influence landfill settlement and gas generation rates, which will thereby have an influence on the cover type at a site. Also, characterization of a landfill's contents may provide valuable information for PRP determination. A records review can also be valuable in gathering data concerning disposal history, thus reducing the need for field sampling of contents.

Hot Spots

More extensive characterization activities and development of remedial alternatives (such as thermal treatment or stabilization) may be appropriate for hot spots. Hot spots consist of highly toxic and/or highly mobile material and present a potential principal threat to human health or the environment. Excavation or treatment of hot spots is generally practicable where the waste type or mixture of wastes is in a discrete, accessible location of a landfill. A hot spot should be large enough that its remediation would significantly reduce the risk posed by the overall site, but small enough that it is reasonable to consider removal or treatment. It may generally be appropriate to consider excavation and/or treatment of the contents of a landfill where a low to moderate volume of toxic/mobile waste (for example, 100,000 cubic yards or less) poses a principal threat to human health and the environment.

Hot spots should be characterized if documentation and/or physical evidence exists to indicate the presence and approximate location of the hot spots. Hot spots may be delineated using geophysical techniques or soil gas surveys and typically are confirmed by excavating test pits or drilling exploratory borings. When characterizing hot spots, soil samples should be collected to determine the waste characteristics; treatability or pilot testing may be required to evaluate treatment alternatives.

Landfill Gas

Several gases typically are generated by decomposition of organic materials in a landfill. The composition, quantity, and generation rates of the gases depend on such factors as refuse quantity and composition, placement characteristics, landfill depth, refuse moisture content, and amount of oxygen present. The principal gases generated (by volume) are carbon dioxide, methane, trace thiols, and occasionally, hydrogen sulfide. Volatile organic compounds may also be present in landfill gases, particularly at co-disposal facilities. Data generated during the site characterization of landfill gas should include landfill gas characteristics as well as the role of onsite and offsite surface emissions, and the geologic and hydrologic conditions of the site.

Streamlining the Development of Alternatives

Section 4 of this document describes the remedial technologies that are generally appropriate to CERCLA landfill sites. Inclusion of these technologies is based on experience at landfill sites and expectations inherent in the NCP. To streamline the development of remedial action alternatives for landfill contents, hot spots, landfill gas, contaminated groundwater. and leachate, the following points should be considered:

- The most practicable remedial alternative for landfills is containment. Such containment may be achieved by installing a cap to prevent vertical infiltration of surface water. Lateral infiltration of water or gases into the landfill can be prevented by a perimeter trench-type barrier. Caps and perimeter barriers sometimes are used in combination. The type of cap would likely be either a native soil cover, single-barrier cap, or composite-barrier cap. The appropriate type of cap to be considered will be based on remedial objectives for the site. For example, a soil cover may be sufficient if the primary objective is to prevent direct contact and minimize erosion. A single barrier or composite cap may be necessary where infiltration is also a significant concern. Similarly, the type of trench will be dependent on the nature of the contaminant to be contained. Impermeable trenches may be constructed to contain liquids while permeable trenches may be used to collect gases. Compliance with ARARs may also affect the type of containment system to be considered.

- Treatment of soils and wastes may be practicable for hot spots. Consolidation of hot spot materials under a landfill cap is a potential alternative in cases when treatment is not practicable or necessary. Consolidation-related differential settlements may be large enough to require placement of an interim cap during the consolidation phase. Once the rate of settlement is observed to decrease, then a final cap can be placed over the waste.

- Extraction and treatment of contaminated groundwater and leachate may be required to control offsite migration of wastes. Additionally, extraction and treatment of leachate from landfill contents may be required. Collection and treatment may be necessary indefinitely because of continued contaminant loadings from the landfill.

- Constructing an active landfill gas collection and treatment system should be considered where (1) existing or planned homes or buildings may be adversely affected through either explosion or inhalation hazards, (2) final use of the site includes allowing public access, (3) the landfill produces excessive odors, or (4) it is necessary to comply with ARARs. Most landfills will require at least a passive gas collection system (that is, venting) to prevent buildup of pressure below the cap and to prevent damage to the vegetative cover.

Conclusions

Evaluation and selection of appropriate remedial action alternatives for CERCLA municipal landfill sites is a function of a number of factors including:

- Sources and pathways of potential risks to human health and the environment

- Potential ARARs for the site (significant ARARs might include RCRA and/or state closure requirements, and federal or state requirements pertaining to landfill gas emissions.)

- Waste characteristics

- Site characteristics (including surrounding area)

- Regional surface water (including wetlands) and groundwater characteristics and potential uses

Because these factors are similar for many CERCLA municipal landfill sites, it is possible to focus the RI/FS and selection of remedy process. In general, the remedial actions implemented at most CERCLA municipal landfill sites include:

- Containment of landfill contents (i.e., landfill cap)
- Remediation of hot spots
- Control and treatment of contaminated groundwater and leachate
- Control and treatment of landfill gas

Other areas that may require remediation include surface waters, sediments, and adjacent wetlands.

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Office of
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Emergency Response

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EPA

Landfill Presumptive Remedy Saves Time and Cost

Office of Emergency and Remedial Response (5202G)

Intermittent Bulletin
Volume 1 Number 1

Since Superfund's inception in 1980, the removal and remedial programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, past industrial use, or environmental media affected. Based on a wealth of information acquired from evaluating and cleaning up these sites, Superfund undertook the presumptive remedy initiative to develop remedies that are appropriate for specific site types and/or contaminants. One site category for which EPA developed a presumptive remedy is municipal landfills. This bulletin summarizes the results of implementing the containment presumptive remedy at three CERCLA municipal landfill sites. At each of the sites, both time and costs were saved in conducting the RI/FS. When compared to similar "control" sites, EPA estimates time savings ranging from 36 to 56 percent, and cost savings up to 60 percent. In addition to demonstrating significant time and cost savings, the pilots also indicate that municipal landfill sites are good candidate sites for implementing the presumptive remedy as an early action, such as a non-time-critical removal. The combination of this presumptive remedy with an early action resulted in significant savings at one pilot site.

Introduction

EPA expects that the use of presumptive remedies will streamline removal actions, site studies, and cleanup actions while improving consistency, reducing costs, and increasing the speed with which hazardous waste sites are remediated. EPA has developed several presumptive remedies to date; a list of presumptive remedy directives is provided at the end of this document. The results of implementing the *containment presumptive remedy* at three CERCLA municipal landfill sites are discussed in this bulletin.

The Containment Presumptive Remedy

EPA established containment as the presumptive remedy for municipal landfills in September 1993. The containment presumptive remedy includes the following components, as appropriate on a site-specific basis:

- Landfill cap;
- Source area ground-water control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment;
- Institutional controls to supplement engineering controls.

The presumptive remedy does not address exposure pathways outside the source area (landfill), nor does it include long-term ground-water response actions.

The Pilot Sites

Prior to establishing the presumptive remedy, EPA initiated a pilot project at three sites to assess the effectiveness of the containment remedy in streamlining the remedial investigation/feasibility study (RI/FS) process for municipal landfills. The pilots implemented the streamlining principles outlined in the document, "Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites," February 1991, Directive No. EPA/540/P-91001 (hereafter referred to as the "1991 MLF RI/FS guidance"). This 1991 MLF RI/FS guidance provides the implementation framework of the containment presumptive remedy.

EPA found the containment remedy to be a very effective tool for streamlining the RI/FS at municipal landfills. This bulletin describes the pilot sites, the ways in which each RI/FS was streamlined, and the time and cost savings realized at each of the sites. See Attachment A at the end of this bulletin for brief site summaries.

Who Can Use The Presumptive Remedy?

If you are the manager of a municipal landfill site, it is likely that **the presumptive remedy can help you save time and money on the RI/FS at your site.** Although the presumptive remedy is most beneficial when incorporated at the scoping stage of the RI/FS, if your site has progressed beyond that point, you may still be able to streamline your site characterization sampling strategy, baseline risk assessment, and/or feasibility study.

EPA piloted the containment remedy at the following municipal landfills beginning in the Spring of 1992:

- Albion-Sheridan Township Landfill, Michigan
- Lexington County Landfill, South Carolina
- BFI/Rockingham Landfill, Vermont

These sites were selected as pilots because they were in the scoping phase of the RI/FS at the time. The biggest savings in time and cost can be realized if streamlining is incorporated at the very beginning of the scoping phase of the RI/FS. All of these sites now have signed Records of Decision (RODs), with containment selected as part of the remedy at each of the sites.

EPA evaluated the impact of the containment remedy as a streamlining tool at the three pilot sites by estimating time and cost savings. The sites were evaluated in a paired analysis, comparing the pilot sites to the three "control" sites listed in Highlight 1. Remedy selection at the control sites was based on the results of conventional RI/FSs.

The factors considered in selecting the "control" sites included (listed in order of priority): (1) the state in which the landfill is located since State closure requirements often affect aspects of remedy selection; (2) the lead for the site (e.g., Fund-lead); and (3) the size of the landfill (in acres). Summary information on the pilot and control sites is provided in Highlight 1.

Highlight 1
Pilot/Control Site Characteristics

PILOT SITES				CORRESPONDING CONTROL SITES			
Name	State	Lead	Size	Name	State	Lead	Size
Albion-Sheridan	MI	F	30	West KL	MI	F	87
BFI	VT	PRP	19	Parker	VT	PRP	19
Lexington Co.	SC	PRP	70	Cedar-town LF	GA	PRP	6.8

Pilot Results

Two areas of the RI/FS process presented the greatest opportunity for streamlining at the pilot sites: 1) a phased approach to site characterization, and 2) streamlining the risk assessment.

Phased Approach to Site Characterization

The containment presumptive remedy emphasizes the use of existing data to the degree possible, and discourages characterization of landfill contents since it is presumed that the landfill will be contained, unless information is available indicating the need to investigate and potentially remove or treat hot spots. In keeping with these principles, a **phased approach** to sampling is recommended.

The phased approach to site characterization is a site-specific strategy that frames the data collection effort within the context of determining whether a risk is present at a site rather than characterizing the nature and extent of all contamination in a landfill.[1] A site-specific determination is made as to the environmental medium most likely to present a risk based upon any existing data available, and sampling of that pathway is conducted first.

At many landfill sites, ground-water contamination is likely to present a significant risk, and thus trigger the need for action.[2] At the pilot sites, ground water was the first medium sampled, and at each of the pilot sites, ground-water contamination supported the need for a response action. In two cases, soil sampling of the landfill source area was never conducted; sampling was limited to determining risk from the ground water. At one site, the State conducted additional sampling of the landfill area.

If ground-water data had not clearly demonstrated a risk at the pilot sites, additional sampling would have been conducted (in sequence) to determine whether a risk was present from other media or exposure pathways, such as contaminated soil and/or landfill gas. At the pilot sites, additional sampling was not necessary to determine risk, and since containment of the landfill was presumed, sampling and analysis was not required for the purpose of site characterization.

Streamlined Risk Assessment

For many landfill sites, it will be possible to streamline the risk assessment portion of the RI/FS. This is possible because the containment remedy addresses all migration pathways presented by the landfill source. The basis of the streamlined risk assessment process to be employed at MLFs is the conceptual site model (discussed in Section 2.5 of the 1991 RI/FS MLF guidance), which is used to identify all exposure pathways associated with the landfill source (i.e., direct contact with soil, exposure to contaminated ground water, contaminated

[1]This phased approach applies to the landfill source only. Contamination that has migrated away from the landfill source must be characterized, and the associated risk estimated.

[2]See OSWER Directive 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [a response] action generally is warranted.

leachate, and/or landfill gas). The exposure pathways are then compared to those addressed by the containment remedy, as follows:

- direct contact with soil and/or debris prevented by landfill cap;
- exposure to contaminated ground water prevented by ground-water control;
- exposure to contaminated leachate prevented by leachate collection and treatment; and
- exposure to landfill gas addressed by gas collection and treatment, as appropriate.

This comparison reveals that the containment remedy addresses all pathways associated with the landfill source. The phased approach can be implemented at landfill sites using the conceptual site model because it demonstrates that all exposure pathways are addressed by the containment remedy, and field sampling is therefore not required to characterize the nature and extent of contamination once it has been demonstrated that the site presents a risk and warrants action.

A streamlined risk evaluation was successfully conducted at the three pilot sites, with contaminated ground water presenting the justification for a response action. Sampling, analysis, and a conventional risk assessment were required to characterize contamination, if any, that had migrated away from the source areas.

Quantitative Results

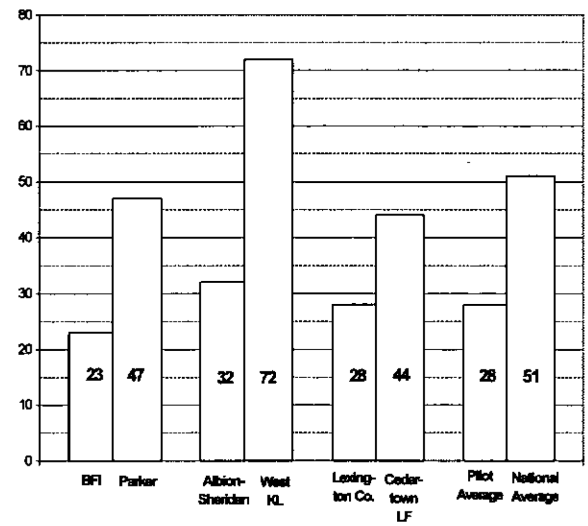
As illustrated in Highlight 2, the RI/FS durations for the pilot sites ranged from 23 to 32 months, compared to 44 to 72 months for the control sites. The average pilot RI/FS duration was 28 months, as compared to the national average of 51 months. The RI/FS durations for the pilot sites represent a time savings ranging from 16 to 40 months when compared to the control sites, and 23 months when compared to the national average. These results translate into an estimated time savings ranging from 36-56 percent when comparing the pilots to the control sites, and an estimated 45 percent when comparing the average pilot duration to the national average.

The figures for the BFI/Rockingham site include completion of an Engineering Evaluation/Cost Analysis (EE/CA) to support implementation of source control (i.e., cap, leachate and gas collection) as a non-time-critical removal action. The EE/CA was completed in 12 months, which is a subset of the 23 months indicated in Highlight 2. The 23 months was the time required to complete the RI/FS for the entire site, including ground-water contamination.

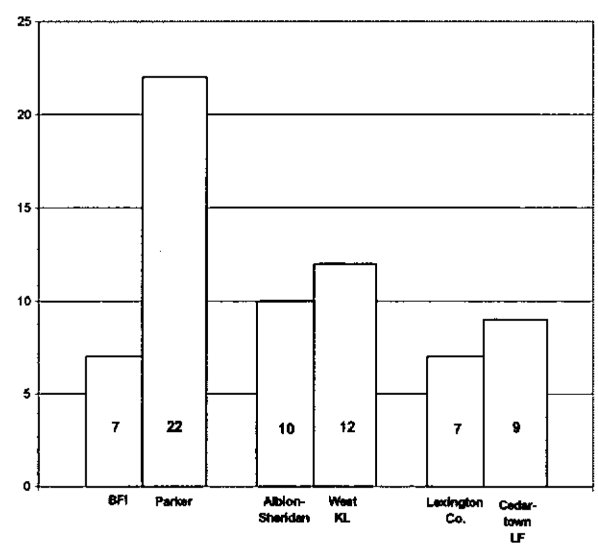
The pilot results for the BFI/Rockingham site are particularly noteworthy because the source control action was initiated just 12 months after the RI/FS start, and construction of the cap was completed in July 1995, just three years after the RI/FS start.

A savings in time was also realized as a result of the streamlined risk evaluations conducted at the pilot sites, as illustrated in Highlight 3. The time required to complete the risk assessments at the pilot sites ranged from 7 to 10 months, as compared to 9 to 22 months for the controls, which represents a savings ranging from 17 to 68 percent when compared to the control sites.

Highlight 2
RI/FS Durations (Months) for Pilot/Control Site and National Averages



Highlight 3
Risk Assessment Durations (Months) for Pilot/Control Sites



Cost savings were estimated in one of two ways for the pilot sites.

The RI/FS costs for Albion-Sheridan Landfill and Lexington County were compared to the national average RI/FS cost of $1 million, resulting in an estimated 10 percent and 1 percent savings, respectively, for those sites. The cost savings estimate for the BFI/Rockingham site was developed by the PRP, and was based upon a comparison with their costs for RI/FSs conducted at other similar sites. A savings of 60 percent was estimated for the RI/FS, which included the source area and areas of migration, and an engineering evaluation/cost analysis (EE/CA) to support the non-time-critical removal action on the landfill cap.

Conclusion

EPA found that the containment presumptive remedy resulted in a savings of time and costs at each of the pilot sites. The savings were the result of implementing a phased approach to site characterization and streamlining the risk assessment, both of which were possible because the landfill contents were contained.

The savings in time and costs were most significant at the BFI/Rockingham site, where the cap was completed three years after initiation of the RI/FS, and an estimated $3 million was saved. This significant savings was the result of combining the containment presumptive remedy with an early action accomplished as a non-time-critical removal action. Based on these results, municipal landfill sites appear to be well suited to the combined application of these streamlining and acceleration tools.

Next Steps

Since establishment of the presumptive remedy, EPA has tracked implementation at two additional landfill sites (demonstration sites): (1) Bennington Landfill, Vermont, and (2) Tomah Municipal Landfill, Wisconsin. EPA will summarize findings from the demonstration sites upon signature of their respective Records of Decision (RODs).

Presumptive Remedy Directives

To date, EPA has issued the following presumptive remedy directives:

(1) "Presumptive Remedies: Policy and Procedures," September 1993, Directive No. 9355.0-47FS;

(2) "Conducting Remedial Investigations/Feasibilities Studies for CERCLA Municipal Landfill Sites," EPA/540/P-91/001, February 1991.

(3) "Presumptive Remedy for CERCLA Municipal Landfill Sites," September 1993, Directive No. 9355.0-49FS;

(4) "CERCLA Landfill Caps RI/FS Data Collection Guide," August 1995, Directive No. 9355.3-18FS;

(5) "Site Characterization and Technology Selection for Volatile Organic Compounds in Soil/Sludge," September 1993, Directive No. 9355.4-048FS;

(6) "Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites," December 1995, Directive No. 9200.5-162.

(7) "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites," EPA/540/R-96/023, October 1996.

In addition, presumptive remedies directives for the following types of sites or contaminants are forthcoming:

(1) PCBs

(2) Manufactured gas plants

(3) Grain storage sites

(4) Metals in soils (in cooperation with the U.S. Department of Energy).

Additional Information

For additional information on the pilot sites or the presumptive remedy for municipal landfills, please call Andrea McLaughlin, Office of Emergency and Remedial Response, 703-603-8793.

Attachment A: Pilot Case Studies

Albion-Sheridan Landfill

Anecdotal evidence indicated that some quantity of industrial wastes were disposed of at the 30-acre Albion-Sheridan Landfill, but the location, volume and identity of wastes were unknown. No data were available for the site at the beginning of the RI/FS. EPA implemented the streamlining principles of the 1991 MLF RI/FS guidance, and scoped a phased approach to characterization of the Albion-Sheridan site with the goal of implementing the containment remedy. The draft work plan was revised to incorporate the phased investigation, focusing first on ground-water contamination to establish whether there was a basis for a response action.

Ground-water contamination did support the need for action at the site, so it was not necessary to quantify additional exposure pathways for this purpose. The remainder of the risk assessment was streamlined by using a conceptual site model to demonstrate that the other potential pathways of concern (e.g. direct contact) would be addressed by the components of the presumptive remedy (e.g. landfill cap).

EPA conducted a geophysical survey of the site to identify potential drum storage areas. Based on the results of the geophysics, EPA concluded that while there were anomalies in the results, there were no areas that appeared to consist of large numbers of drummed waste, thereby warranting further investigation. Because the State had remaining concerns with EPA's approach to hot spots, the State conducted its own geophysical survey and dug test pits at 12 locations. At one location approximately 300-400 drums were uncovered, and EPA reiterated its agreement to send any drums of hazardous waste off-site for disposal. Of the 300-400 drums, the number containing hazardous waste is unknown at this time.

Lexington County Landfill

Ground-water data were available for this 70-acre landfill prior to initiation of the RI, which indicated exceedences of MCLs, and therefore a basis for a response action. The strategy for the Lexington County Landfill RI was similar to the Albion-Sheridan Landfill, in that a phased approach was implemented. Sampling focused on further characterization of ground-water contamination, and the risk assessment was streamlined, focusing also on the ground-water pathway. Planned soil sampling and analysis to estimate direct contact threats was eliminated, and it was demonstrated (using a conceptual site model) that other potential pathways of concern would be addressed by components of the presumptive remedy.

A planned drum search of the 70-acre landfill was eliminated based on the guidelines for hot spot characterization contained in the 1991 MLF RI/FS guidance. At Lexington County Landfill, as at Albion Sheridan Landfill, it is likely that some industrial waste was disposed of at the site, but the location, quantity and identity of the wastes were unknown. Because there was no evidence to guide such a search, EPA decided that the best approach was to contain the landfill, accounting for uncertainties in the nature of the wastes during the design.

The selected remedy includes consolidation and capping of the waste areas, landfill gas collection and venting; extraction of contaminated groundwater/leachate with discharge to POTW; additional sampling of surface water and sediment to characterize any off-site contamination; and monitoring of ground water, surface water, sediment and landfill gas. Additionally, to address a plume, a ground-water pump and treat remedy was put in place.

BFI/Rockingham

Extensive ground-water data were available for this site at the initiation of the RI, and the first step in implementation of the presumptive remedy was to evaluate the potential for using the data. The data were found to be useable to establish an initial basis for action, which allowed streamlining of the risk assessment and RI. Only confirmational ground-water sampling was conducted during the RI; characterization of the landfill surface soil and debris mass did not occur. Geotechnical information regarding settlement, cover quality, and stability was also collected. The knowledge that containment was the likely remedy allowed the RI to become primarily a design-related investigation. In addition, based on historical information, hot spots were not of concern at this site.

Levels of volatile organic compounds (VOCs) and certain metals clearly indicated that a ground-water risk was present. The existence of ground-water risk confirmed that a "No Action" decision was unlikely, and that a landfill cap would be a component of the source control action. The risk assessment was streamlined by quantifying the ground-water risk and qualitatively discussing the other pathways that would be addressed by the source control action. All pathways outside the landfill, which included off-site ground water and off-site soils, were fully quantified. An early action was conducted as a non-time-critical removal at this site in order to begin construction of the landfill cap. The combination of the presumptive remedy with the early action resulted in a significant time savings in the remedy selection and construction processes.

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Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide

Office of Emergency and Remedial Response
Hazardous Site Control Division (5203G)
Quick Reference Fact Sheet

Municipal landfills constitute approximately 20 percent of all sites on the Superfund National Priorities List. Approximately 75 percent of all CERCLA Municipal Solid Waste Landfill (MSWLF) Remedial Actions call for installation of a landfill cap. The remedy selection process for MSWLFs is the basis of a U.S. Environmental Protection Agency (EPA) guidance, *Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites* (U.S. EPA, 1991), which establishes the framework for containment (including landfill cap construction, leachate collection and treatment, ground water treatment, and landfill gas collection and treatment) as the presumptive remedy for MSWLFs.

In 1992, EPA introduced the *Superfund Accelerated Cleanup Model (SACM)* to accelerate all phases of the remedial process. The presumptive remedy initiative is one tool for speeding up cleanups within SACM. One way that presumptive remedies can streamline the remedial process is through early identification of data collection needs for the remedial design. By collecting design data prior to issuance of the Record of Decision (ROD), the need for additional field investigations during the remedial design (RD) will be reduced, thereby accelerating the overall remedial process for these sites. Data needed for design also can be useful in better defining the scope of the remedy and in improving the accuracy of the cost estimate in the ROD. Since containment is the presumptive remedy for MSWLFs, the Remedial Project Manager (RPM) can begin making arrangements to collect landfill cap design data as soon as a basis for remedial action is established (e.g., ground water contaminant concentrations exceeding maximum contaminant levels [MCLs]).

This fact sheet identifies the data pertinent to landfill cap design that will be required for most sites. These data are organized within six categories: (1) waste area delineation; (2) slope stability and settlement; (3) gas generation/migration; (4) existing cover assessment; (5) surface water run-on/run-off management; and (6) clay sources. For reference, all data requirements and data collection methods discussed in this document are summarized in a table at the end of this document (Table 2). In addition to the following guidance provided in this fact sheet, RPMs should enlist the aid of technical experts familiar with landfill cap design in establishing data collection needs for specific sites.

TECHNICAL AREA 1: WASTE AREA DELINEATION

The area of a landfill cap is determined by the horizontal extent of previous waste disposal. One of the major causes of cost escalation for MSWLF sites has been the failure to establish the actual boundaries of the waste. Costly construction change orders have been required to increase the area of the cap because wastes have been found to extend well beyond the edges of the intended cap. Waste boundaries should be identified as accurately as practicable prior to initiation of the design.

Aerial photographs, maps, and a local newspaper subject search may provide a historical record of the extent and type of disposal activities conducted at the site. If appropriate, residents could be interviewed to confirm or supplement available information.

Field investigation should be used to confirm records and to collect data to delineate the outer boundaries of the waste. Field investigations normally include surface, subsurface, and noninvasive geophysical explorations. Field investigation methods that provide information on the surface and shallow subsurface extent of waste include excavating shallow test pits, using direct-push exploration techniques, and drilling bore-holes. Additional subsurface investigation methods are used to provide information on the vertical extent of waste.

Borings can be used to estimate waste thickness and condition of existing cover soils adjacent to or underlying the waste.

However, drilling into or through the waste and into the underlying soils and/or bedrock should be performed only if necessary, and only if the driller is experienced in the methods used to prevent cross-contamination. Additional health and safety concerns (especially exposure to methane gas) must be addressed in the health and safety plan when borings are located in the waste.

Visual evidence of the waste boundary or subsurface contamination from these field investigation activities should be recorded and, if necessary, verification samples should be collected and shipped for laboratory analyses.

Surface geophysical methods also may be useful in delineating the waste boundary. Each method has limitations, and the selection of an appropriate method should be based on landfill characteristics and data needs. The most commonly employed geophysical methods include:

- Magnetometry (measures minor changes in earth's magnetic field)--location of waste boundary and distribution of metallic waste

- Electromagnetic Conductivity (response to artificially induced magnetic field)--location of areas of contrasting conductivity, such as a landfill or natural deposits

- Ground-Penetrating Radar (reflection of electromagnetic waves)--determination of horizontal extent and depth of disturbed soils and buried objects (often used to confirm magnetometry)

- Electrical Resistivity (measures earth's response to electrical current)--determination of edge of landfill by subsurface resistivity difference

- Seismic Refraction (natural or induced compression waves)--estimation of depth to geologic strata and bedrock adjacent to the landfill.

These noninvasive surface geophysical methods should be performed prior to invasive explorations (e.g., borings or test pits). This will allow for the more limited intrusion activities to verify the findings of the noninvasive exploration methods.

TECHNICAL AREA 2: SLOPE STABILITY AND SETTLEMENT

Waste settlement and/or slope failure of the waste and existing cover soils can occur during construction of, or after completion of, the cap. Waste settlement or slope failure (see Figure 1) may expose waste and require costly repairs. Data are needed on degree of slope, existing cover materials, and existing cover soils to create cross-sectional diagrams for use in evaluating landfill slope stability and the potential for settlement damage.

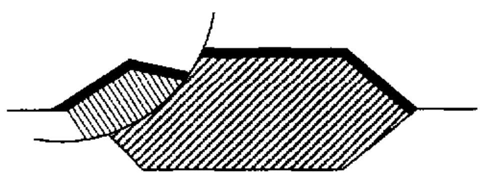

Figure 1. Typical slope failure at MSWLF site.

Settlement in a landfill can be caused by factors such as: biodegradation of wastes, consolidation of waste under the weight of waste material and cap, deterioration of partially filled containers (e.g., drums), or compaction of material during landfill operation or cap installations. Possible consequences of settlement include instability in the waste or cover soil, which can damage the cap. In fact, a recent article on cap design reports that "The center of a 20-foot diameter section of a landfill cover, for instance, could settle only 0.5 to 1.5 feet before significant cracking [of the composite clay liner] could be expected." (Koerner and Daniel, 1992) For this reason, settlement potential and stability of the landfill system should be evaluated concurrently.

The weight of the new cap can be significant enough to cause additional waste settlement and compaction. The effect of this additional weight may initiate differential settlement across the cap, thus compromising the integrity of the cap, or create stability problems such as slippage failures in the waste and/or existing cover soil. Differential settlement occurs when one area of waste settles more readily than another because of differences in moisture content, waste compaction, or waste composition. Settlement (magnitudes typically range from 5 to 25 percent of the initial waste thickness), and especially differential settlement, may create cracks in the cap and allow rainwater to reach the waste. Changes in the topography of the landfill because of settlement may also create areas on the cap surface where rainwater can pond.

In creating the conceptual landfill cap design, three separate calculations are conducted

- Stability of waste--largely depends on how well the waste was compacted when placed, waste layer thicknesses, and waste composition

- Stability of the cap (existing and proposed)

- Settlement of waste—largely depends on how well the waste was compacted when placed, waste layer thicknesses, age, rate of waste degradation, and waste composition.

Because of their heterogeneous nature, the settlement and stability of municipal wastes are difficult to predict. Settlement rates of selected areas of the waste can be measured by placing survey monuments on top of the waste and taking periodic measurements to determine the change in elevation of the monuments. Because settlement generally occurs slowly, it is important to begin measurement early, preferably during the remedial investigation.

The settlement of the waste depends on thickness and general composition of the waste and existing topography. Compressibility characteristics are derived from preload tests and empirical correlations to data in the published literature. Data from surveying monuments, settlement plates, and topographic surveys can be used to determine surface settlement rates across the landfill.

The stability of waste can be determined by evaluating the following:

- Potentiometric surface and perched water table information--can be determined using water level measurements from piezometers and monitoring wells
- Thickness of waste
- Existing topography-can be determined from site reconnaissance and topographic surveys.

Ground motions induced by earthquakes (seismic events) can also affect cap performance through a decrease in slope stability. This fact sheet does not address the additional data required for cap designs for landfills located in seismic impact zones.

The waste thickness and composition can be determined by observing and sampling (during completion of test pits, borings, and hand-augered holes with an experienced driller) and by searching through historical records.

The existing cover soil should also be evaluated to determine its stability and potential for settlement. Studies for the stability of the existing cover soil could include:

- Maximum Slope
- Soil classification
- Potentiometric surface
- Shear strength
- Thickness
- Density

Slope measurements and potentiometric surface derivations can be obtained using the same procedures used to determine waste characteristics. The remaining data can be obtained by boring, piezocone penetrometer (PCPT), geophysical techniques, and test pits. Existing cover soils should be classified by grain size and hydrometer analysis, as well as by Atterberg limits performed on borings and test pit samples. See the summary table at the end of this fact sheet (Table 2) for recommended tests to determine the shear strength for fine- and coarse-grained soils.

The stability and settlement estimates for existing cover soil depend largely on the complexity of the landfill site. Investigations necessary to evaluate physical properties of the existing cover soils will depend on the type(s) of soils encountered. If the existing cover soils are soft silts and clays, the settlement and stability evaluations will be more complex than for sands and gravels. These soil samples should be collected during drilling of monitoring wells to save time and money, usually during the remedial investigation (RI).

Additional slope stability evaluations will be performed during landfill cap design. Slopes greater than 3:1 (3 horizontal/ 1 vertical) and landfills that have been constructed within or adjacent to wetlands or low-strength soils are of particular concern. These areas of concern should be identified during RI/FS data collection to the extent possible.

TECHNICAL AREA 3: GAS GENERATION/MIGRATION

Assessment of the rate and composition of gas generated in the landfill will determine whether or not a gas collection layer should be included as a component of the cap. Dangers of gas generation and uncontrolled migration include vegetative kill, health risks from exposure, and explosive or lethal gas buildup within and outside of the landfill (see Figure 2). Field monitoring for the presence of landfill gases is also important in developing safety parameters and reducing health risks to personnel working on site.

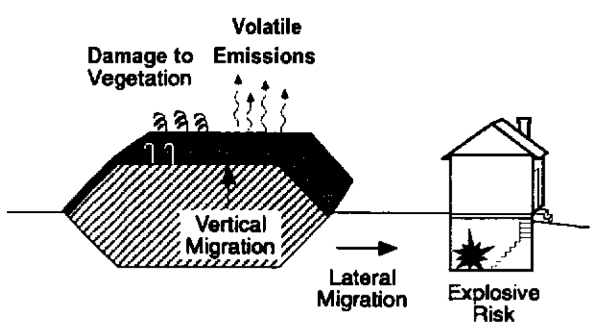

Figure 2. Vertical and lateral migration of generated gas from MSWLF site.

Generation of gas typically results from the biological decomposition of organic material in the wastes. The rate and process of gas generation are dependent on the availability of moisture, temperature, organic content of the waste, waste particle size, and waste compaction.

Data immediately available in the field for assessing gas generation are landfill gas composition and gas pressure. Gas composition in soils usually is evaluated in the field by monitoring or sampling through gas probes using a methane meter, explosimeter, or organic vapor analyzer. Air samples should be analyzed for the presence of volatile organic compounds (VOCs) or semivolatile organic compounds

(SVOCs). Moisture and heat content also can be determined by the laboratory or in the field with hand-held instruments. This information may be necessary to assess possible treatment alternatives for collected gas.

Gas migration is a function of site geology, chemical concentration, and pressure and density gradients. Gases migrate through the path of least resistance (e.g., coarse and porous soils, bedding stone along nearby water and sewer lines). Data for evaluating gas migration control and treatment methods include the composition of any existing landfill liners, soil stratigraphy, depth to water table, proximity of human/ecological receptors, and the locations of buried utilities and other backfilled excavations and structures.

Gas migration pathways may be identified based on knowledge of the site geology, hydrogeology, and surrounding soil characteristics and by review of water and sewer maps. Some of these data may be obtained by collecting and evaluating samples from test pits, borings, or hand-augered holes. Piezocone data also may be cost-effective for characterizing the surrounding subsurface soils at larger MSWLF sites.

Potential receptors of landfill gas emissions may be identified through site reconnaissance, and receptor locations should be monitored to assess possible accumulation of migrant landfill gases. Atmospheric monitoring at receptor locations may be done using a flame ionization detector (FID), a photoionization detector (PID), or a gas monitoring station; however, a PID will not detect methane and thus cannot be used to assess explosion risk. An oxygen meter using the Lower Explosive Limit (LEL) indicator may be used to detect explosive levels of gas.

Gas control is accomplished through either passive or active gas collection. Treatment of collected gas may be required depending on the concentration of hazardous constituents. The gas control system required will depend on the proximity of receptors, permeability of migration pathways, State and Federal regulations and guidelines, and level and rate of gas generation. Effective gas disposal methods include flaring, processing and sale, and/or sorption.

Active gas collection may be necessary to control gas migration when receptors are, or are expected to be, at risk. Active gas collection generally is required when measurements exceed either

- 5% methane at the property line or cap edge, or
- 25% methane LEL in/at on-site structures. (This subject is further addressed in the U.S. EPA Technology Brief *Data Requirements for Selecting Remedial Action Technology* [U.S. EPA, 1987].)

A gas pumping test can be used to improve the estimate of the gas permeability of the waste materials and unsaturated soils, number of collection wells required, piping size and configuration, and blower requirements. However, gas pumping tests should not be relied on without further measurement and adjustment during construction.

TECHNICAL AREA 4: EXISTING COVER ASSESSMENT

Existing landfill caps should be evaluated to determine whether or not any components can be reused in the construction of a new cap. Use of existing components could save both time and money.

Data on existing components can be readily collected because only materials above the waste need be sampled. Sampling locations and procedures that will minimize damage to geosynthetic materials should be used. Sampling holes should, at a minimum, be refilled with bentonite if the existing cap is composed of clay. Geosynthetics should be patched with materials of equal properties following manufacturer's guidelines.

Additionally, the site reconnaissance should be used to evaluate, in general, the need for regrading the landfill surface to achieve proper side slopes. Appropriate limits to the steepness of slopes can be determined from preliminary slope stability calculations. Excavation into landfill waste materials may be required to reduce slope steepness to acceptable limits.

Table 1 provides recommended guidelines for final cover designs. The assessment of the existing cover should include an evaluation of the potential for any components to meet final cover guidelines.

Table 1. Existing Cover Assessment Data Requirements and Recommended Guidelines

Data Requirements	Recommended Guidelines[a] (for Final Cover)
Slope (top)	3% to 5% minimum for drainage
Cap Area	Covers horizontal waste limits
Vegetative/Soil Layer	Vegetative soil supporting healthy low shrubs or grass, no erosion, gullies or deep-rooted plants, no unacceptable frost heaves or settlement
Drainage Layer	Permeability $>1 x 10^{-2}$ cm/s (sand, gravel, or geosynthetic)
Barrier Layer	Two-component (geomembrane atop compacted clay[b]) composite liner below the frost zone
Gas Venting System	Either passive vents located at high points (not clogged, no settlement) or extraction and treatment system working properly

[a] Refer to EPA's Technical Guidance Document: *Final Covers on Hazardous Waste Landfills and Surface Impoundments* (U.S. EPA, 1989).

[b] Clay compacted to a permeability $\leq 1 x 10^{-7}$ cm/s, geomembrane thickness $\geq$ 20 mil.

TECHNICAL AREA 5: SURFACE WATER RUN-ON/RUN-OFF MANAGEMENT

The surface area and gradient of landfill slopes will affect surface water control measures. For the protection of both the landfill cap and adjacent areas (see Figure 3), the design of the final remedy should ensure that the site layout will provide adequate space for surface water diversion and containment/retention impoundments.

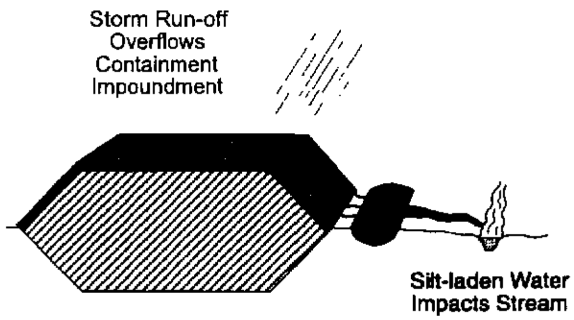

Figure 3. Storm run-off impact from an MSWLF site.

RCRA Subtitle D minimum requirements for MSWLFs (40 CFR Section 258.26) include providing a run-on control system capable of preventing flow onto the active portion of a landfill during the peak discharge from a 25-year rain storm. The regulation also requires providing run-off control systems to collect, at a minimum, the water volume resulting from a 24-hour, 25-year rainstorm. RCRA Subtitle D regulations apply to the closure of active MSWLFs and may be Applicable or Relevant and Appropriate Requirements (ARARs) for certain landfills at CERCLA sites as well.

The method for estimating run-on and run-off design discharges should be based on engineering judgment and on-site conditions (e.g., the Rational Method used by hydrologists to determine overland flow). Detailed storm flow calculations usually are done during the design phase. However, data for preliminary calculations should be collected early enough to prepare an estimate of the cost of run-on/run-off control measures as part of the remedy estimate for the ROD.

Because run-on and run-off control is required for operating landfills, some landfills may already have surface water diversion or containment impoundments that allow sediment to settle out of the run-off and that control discharge for a 25-year storm. Depending on when the landfill was designed (with respect to applicable Federal and State regulations), existing control structures may not have adequate capacity. In addition, the RI/FS should identify areas for temporary surface water controls for use during cap construction activities.

A review of the original design or site records available for a landfill may provide information on design criteria for the surface water control structures. Site reconnaissance should be conducted to evaluate the physical condition of the system. If there are no existing diversion or containment impoundments, adequate space should be located on or off site to accommodate them. Property acquisition may be necessary if on-site space is not available.

Prior to cap installation, collected or diverted run-on surface waters often can be discharged to a nearby surface waterbody or to a recharge basin. Discharge to surface water is considered a point source discharge and must comply with the National Pollution Discharge Elimination System (NPDES) requirements of the Clean Water Act. Because many States have jurisdiction for the discharge of pollutants to surface waters, permit requirements may vary depending on location, although an NPDES permit is always needed. Other factors to consider are the water quality and soil type, which can be determined by analysis of surface water samples, visual and sieve analyses of the soil, and review of NPDES compliance data (if applicable).

After the cover is installed, the collected or diverted surface water is not contaminated; therefore, diversion or containment impoundment maintenance usually is limited to control of vegetation and debris and sediment removal. Discharge to a recharge basin is not considered a point source discharge and, generally, regulators evaluate these basins for permit compliance on a case-by-case basis.

TECHNICAL AREA 6: CLAY SOURCES

A compacted clay layer is normally one of the primary components of an effective cap, provided that sources of clay (low-permeability soil) are available at or near the landfill. Data-gathering activities should include looking for potential on-site/local clay deposits for the cap construction. Manufactured geosynthetic clay liners should be considered if the required volume or physical properties are not available in nearby soils. A comparison of geosynthetic clay liner material cost versus clay excavation and transport cost should be completed before design commences.

Investigation of potential sources for clay should be initiated prior to the preliminary conceptual cap design (which defines the components of the cover). For information on clay deposits, the Soil Conservation Service (SCS) of the U.S. Department of Agriculture (USDA) publishes soil maps and classifications by county. Additional information on the availability of clay soils may be obtained from State natural resource inventory programs; local contractors or engineering firms practicing in the area; State and local highway officials, shallow borings, test pits, and hand-augered holes; and geotechnical laboratory testing.

After potential sources of clay are identified, a site reconnaissance may be conducted. The site reconnaissance should include sample collection via hand-augered holes or shovels to verify the availability of clay over the site.

Subsurface soil samples of the source area should be collected later to determine resource quality (shear testing of layer interfaces) and quantity. Procedures used to characterize clay sources generally include:

- Excavation of at least one test pit for every 25,000 to 50,000 cubic yards
- Collection of soil samples from test pits for laboratory characterization
- Shallow borings to confirm soil type, volume, and, in certain instances, depth to ground water
- Laboratory testing of samples collected including: grain size analysis, Atterberg limits, permeability testing, moisture content, and compaction testing. Detailed compaction requirements to meet construction quality assurance objectives are provided in *Quality Assurance and Quality Control for Waste Containment Facilities* (U.S. EPA, 1993 b).

If sufficient quantities of soil cover materials with appropriate engineering properties are not available within an economically practicable distance from the project site, geosynthetics or processed natural materials should be considered. Geosynthetic clay liners are generally manufactured by either sandwiching bentonitic clays between geotextiles or affixing the bentonitic clay to the bottom surface of a membrane. Thus, if clay is not readily available, low-permeability layers of the cap may be comprised of either available soil that is processed by adding bentonite to reduce the permeability or geosynthetic clay liners. For cap drainage layers, geosynthetic drainage nets may also be used, in lieu of coarse sand and gravel, to meet performance requirements. Information on geosynthetic clay liners and drainage nets can be obtained from manufacturer catalogues.

CONCLUSION

For each MSWLF site where capping is clearly a preferred remedy, the RPM should assemble a technical review team to determine the design data to be collected. This team should include experienced RPMs and technical experts familiar with data collection needs for cap design. The team can help the RPM in defining the field work required and its timing and in reviewing the design data submitted by the contractor. In the event that the contractor is changed (i.e., the RI/FS is Fund-led and the design is switched to Potentially Responsible Party [PRP]-led), the technical review team can assist the RPM in transferring the pertinent collected design data to the new contractor.

Table 2 summarizes the data needs and collection methods presented in this fact sheet. This table should be used as a reference when determining necessary design data collection activities.

Table 2. Data Requirements and Collection Methods

Data Requirements	Data Collection Methods
Waste Area Delineation	
Design/historical information	Historical records, personal interviews
Horizontal extent of waste	Test pits, probes, hand-augered holes, magnetometry, electromagnetic conductivity, ground-penetrating radar, electrical resistivity, seismic refraction
Depth and thickness of waste	Borings, geophysical surveys
Slope Stability and Settlement*	
Waste Evaluation	
Slope measurement (A)	Slope inclinometers, topographic survey
Potentiometric surface (A)	Piezometers/monitoring wells
Compressibility characteristics (C)	Preload testing, empirical correlations to published literature
Settlement rate (C)	Survey monuments, settlement plates, topographic survey
Thickness of waste (A,C)	Observation and sampling during test pits, borings, hand-augered holes, historical records, geophysical surveys
General waste composition (A,C)	Observation and sampling during test pits, borings, hand-augered holes, historical records, geophysical surveys
Existing topography (A,C)	Site reconnaissance, topographic survey, historical photographs

(continued)

Table 2 (continued)

Data Requirements	Data Collation Methods
Existing Cover Soil Evaluation*	
Slope measurement (A,B)	Topographic survey, slope inclinometers
Soil classification (B)	Grain size analysis, hydrometer analysis, Atterberg limits performed on borings/test pit samples
Potentiometric surface (A,C)	Piezometers/monitoring wells
Shear strength (B)	Fine-grained soil (cohesion): Field and/or lab vane shear test, torvane, pocket penetrometer, piezocone penetrometer, unconfined compressive strength, empirical correlations to Standard Penetration Test (S-P-T) Coarse grained soil (friction angle): Empirical correlations to S-P-T, direct shear test, triaxial shear test, piezocone penetrometer
Compressibility characteristics (C)	Consolidation tests performed on undisturbed tube samples collected from borings. Empirical correlations to index properties (water content, plasticity).
Density (B)	Empirical correlations to S-P-T data, bulk density determination from undisturbed tube samples (fine-grained soils only)
Gas Generation/Migration	
Gas composition and gas pressure	Gas probes, monitoring wells, laboratory samples
Moisture and heat content	Laboratory samples or handheld instruments in the field
Migration pathways	Water and sewer maps, piezocone, test pits, borings, hand-augered holes
Receptors	Site reconnaissance, photoionization detector, flame ionization detector, air monitoring station, oxygen meter
Existing Cover Assessment	
Slope-top	Site reconnaissance, topographic survey
Cap area	Site reconnaissance, borings, test pits, geophysical survey
Vegetative/soil layer	Site reconnaissance, topographic survey, test pits
Drainage layer	Site reconnaissance, borings, test pits, hand-augered holes, field infiltrometer or laboratory samples for hydraulic conductivity
Barrier layer	Test pits, borings, hand-augered holes, Shelby tubes for permeability, laboratory samples/analysis for shear strength, compaction curve, atterberg limits, freeze/thaw cycling, water content
Gas venting system	Site reconnaissance, gas character sampling, gas pumping tests
Run-on/Run-off Management	
Estimated discharge, size of control structures, treatment requirements	Review of design records, National Pollutant Discharge Elimination System (NPDES) permit, detailed storm flow calculations
Climatic data	National Oceanographic and Atmospheric Administration (NOAA)
Run-on/run-off areas (% vegetated, % paved)	Site reconnaissance, topographic surveys, aerial photographs
Water quality	Surface water sampling and analysis
Soil types	Visual, aerial photographs, and soil maps from the Soil Conservation Service (SCS)
Clay Sources	
Soil properties	Soil maps from the SCS, local contractors or engineering firms, state/local transportation officials, natural resource inventory programs, shallow borings, hand-augered holes, test pits, and geotechnical laboratory testing
Subsurface resource adequacy and quantity (shear testing)	Grain size analysis, Atterberg limits, permeability test, moisture content, compaction test, shallow borings, test pits, laboratory testing
Geosynthetic clay liner properties	Manufacturer catalogs, literature, EPA studies/guidance

*The letters following the slope stability and settlement and existing cover soil evaluation data requirements are referenced to the data needed to perform the three separate calculations used to evaluate slope stability and settlement of the landfill cover (see Technical Area 2):

A = Stability of waste. B = Stability of cap components. C = Settlement of waste.

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Office of Solid Waste and Emergency Response

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PB 93-963339
September 1993

EPA

Presumptive Remedy for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
Hazardous Site Control Division 5203G

Quick Reference Fact Sheet

Since Superfund's inception in 1980, the remedial and removal programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, types of disposal practices, or how environmental media are affected. Based on information acquired from evaluating and cleaning up these sites, the Superfund program is undertaking an initiative to develop presumptive remedies to accelerate future cleanups at these types of sites. The presumptive remedy approach is one tool of acceleration within the **Superfund Accelerated Cleanup Model (SACM).**

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions. Over time presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

This directive establishes **containment** as the presumptive remedy for CERCLA municipal landfills. The framework for the presumptive remedy for these sites is presented in a streamlining manual entitled *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites,* February 1991 (OSWER Directive 9355. 3-11). This directive highlights and emphasizes the importance of certain streamlining principles related to the scoping (planning) stages of the remedial investigation/feasibility study (RI/FS) that were identified in the manual. The directive also provides clarification of and additional guidance in the following areas: (1) the level of detail appropriate for risk assessment of source areas at municipal landfills and (2) the characterization of hot spots.

BACKGROUND

Superfund has conducted pilot projects at four municipal landfill sites[1] on the National Priorities List (NPL) to evaluate the effectiveness of the manual *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (hereafter referred to as "the manual") as a streamlining tool and as the framework for the municipal landfill presumptive remedy. Consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (or NCP), EPA's expectation was that containment technologies generally would be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable. The results of the pilots support this expectation and demonstrate that the manual is an effective tool for streamlining the RI/FS process for municipal landfills.

Since the manual's development, the expectation to contain wastes at municipal landfills has evolved into a presumptive remedy for these sites.[2] Implementation of the streamlining principles outlined in the manual at the four pilot sites helped to highlight issues requiring further clarification, such as the degree to which risk assessments can be streamlined for source areas and the characterization and remediation of hot spots. The pilots also demonstrated the value of focusing streamlining efforts at the scoping stage, recognizing that the biggest savings in time and money can be realized if streamlining is incorporated at the beginning of the RI/FS process. Accordingly, this directive addresses those issues identified during the pilots and highlights streamlining opportunities to be considered during the scoping component of the RI/FS.

[1] Municipal landfill sites typically contain a combination of principally municipal and to a lesser extent hazardous wastes.

[2] See EPA Publication 9203.1-02I, SACM Bulletins, *Presumptive Remedies for Municipal Landfill Sites,* April 1992, Vol. 1, No. 1, and February 1993, Vol. 2, No. 1, and SACM Bulletin *Presumptive Remedies,* August 1992, Vol. 1, No. 3.

Finally, while the primary focus of the municipal landfill manual is on streamlining the RI/FS, Superfund's goal under SACM is to accelerate the entire clean-up process. Other guidance issued under the municipal landfill presumptive remedy initiative identifies design data that may be collected during the RI/FS to streamline the overall response process for these sites (see Publication No. 9355.3-18FS, *Presumptive Remedies:* CERCLA *Landfill Caps Data Collection Guide,* to be published in October 1993).

CONTAINMENT AS A PRESUMPTIVE REMEDY

Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment usually is impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy," for the source areas of municipal landfill sites.

The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected ground water at the perimeter of the landfill, and/or upgradient ground-water that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy.

The presumptive remedy does not address exposure pathways outside the source area (landfill), nor does it include the long-term ground-water response action. Additional RI/FS activities, including a risk assessment, will need to be performed, as appropriate, to address those exposure pathways outside the source area. It is expected that RI/FS activities addressing exposure pathways outside the source generally will reconducted concurrently with the streamlined RI/FS for the landfill source presumptive remedy. A response action for exposure pathways outside the source (if any) may be selected together with the presumptive remedy (thereby developing a comprehensive site response), or as an operable unit separate from the presumptive remedy.

Highlight 1 identifies the components of the presumptive remedy. Response actions selected for individual sites will include only those components that are necessary, based on site-specific conditions.

Highlight 1: Components of the Presumptive Remedy: Source Containment

- Landfill cap;
- Source area ground-water control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment; and/or
- Institutional controls to supplement engineering controls.

The EPA (or State) site manager will make the initial decision of whether a particular municipal landfill site is suitable for the presumptive remedy or whether a more comprehensive RI/FS is required. Generally, this determination will depend on whether the site is suitable for a streamlined risk evaluation, as described on page 4. The community, state, and potentially responsible parties (PRPs) should be notified that a presumptive remedy is being considered for the site before work on the RI/FS work plan is initiated. The notification may take the form of a fact sheet, a notoice in a local newspaper, and/or a public meeting.

Use of the presumptive remedy eliminates the need for the initial identification and screening of alternatives during the feasibility study (FS). Section 300.430(e)(1) of the NCP states that, "... the lead agency shall include art alternatives screening step, <u>when needed,</u> (emphasis added) to select a reasonable number of alternatives for detailed analysis."

EPA conducted an analysis of potentially available technologies for municipal landfills and found that certain technologies are routinely and appropriately screened out on the basis of effectiveness, feasibility, or cost (NCP Section 300.430(e)(7)). (See Appendix A to this directive and "Feasibility Study Analysis for CERCLA Municipal Landfills," September 1993 available at EPA Headquarters and Regional Offices.) Based on this analysis, the universe of alternatives that will be analyzed in detail may be limited to the components of the containment remedy identified in Highlight 1, unless site-specific conditions dictate otherwise or alternatives are considered that were not addressed in the FS analysis. The FS analysis document, together with this directive, must be included in the administrative record for each municipal landfill presumptive remedy site to support elimination of the initial identification and screening of site-specific alternatives. Further detailed and comprehensive supporting materials (e.g., FS reports included in analysis, technical reports) can be provided by Headquarters, as needed.

While the universe of alternatives to address the landfill source will be limited to those components identified in Highlight 1, potential alternatives that may exist for each component or combinations of components may be evaluated in the detailed analysis. For example, one component of the presumptive remedy is source area ground-water control. If appropriate, this component may be accomplished in a number of ways, including pump and treat, slurry walls, etc. These potential alternatives may then be combined with other components of the presumptive remedy to develop a range of containment alternatives suitable for site-specific conditions. Response alternatives must then be evaluated in detail against the nine criteria identified in Section 300.430(e)(g) of the NCP. The detailed analysis will identify site-specific ARARs and develop costs on the basis of the particular size and volume of the landfill.

EARLY ACTION AT MUNICIPAL LANDFILLS

EPA has identifies the presumptive remedy site categories as good candidates for early action under SACM. At municipal landfills, the upfront knowledge that the source area will be contained may facilitate such early actions as installation of a landfill cap or a ground-water containment system. Depending on the circumstances, early actions may be accomplished using either removal authority (e.g., non-time-critical removal actions) or remedial authority. In some cases, it may be appropriate for an Engineering Evaluation/Cost Analysis to replace part or all of the RI/FS if the source control component will be a non-time-critical removal action. Some factors may affect whether a specific response action would be better accomplished as a removal or remedial action including the size of the action, the associated state cost share, and/or the scope of O&M. A discussion of these factors is contained in *Early Action and Long-term Action Under SACM - Interim Guidance,* Publication No. 9203.1-05I, December 1992.

SCOPING A STREAMLINED RI/FS UNDER THE PRESUMPTIVE REMEDY FRAMEWORK

The goal of an RI/FS is to provide the information necessary to: (1) adequately characterize the site; (2) define site dynamics; (3) define risks; and (4) develop the response action. As discussed in the following sections, the process for achieving each of these goals can be streamlined for CERCLA municipal landfill sites because of the upfront presumption that landfill contents will be contained. The strategy for streamlining each of these areas should be developed early (i.e., during the scoping phase of the RI/FS).

1. Characterizing the Site

The use of existing data is especially important in conducting a streamlined RI/FS for municipal landfills. Characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites except in limited cases; rather, existing data are used to determine whether the containment presumption is appropriate. Subsequent sampling efforts should focus on characterizing areas where contaminant migration is suspected, such as leachate discharge areas or areas where surface water runoff has caused erosion. It is important to note that the decision to characterize hot spots should also be based on existing information, such as reliable anecdotal information, documentation, and/or physical evidence (see page 6).

In those limited cases where no information is available for a site, it may not be advisable to initiate use of the presumptive remedy until some data are collected. For example, if there is extensive migration of contaminants from a site located in an area with several sources, it will be necessary to have some information about the landfill source in order to make an association between on-site and off-site contamination.

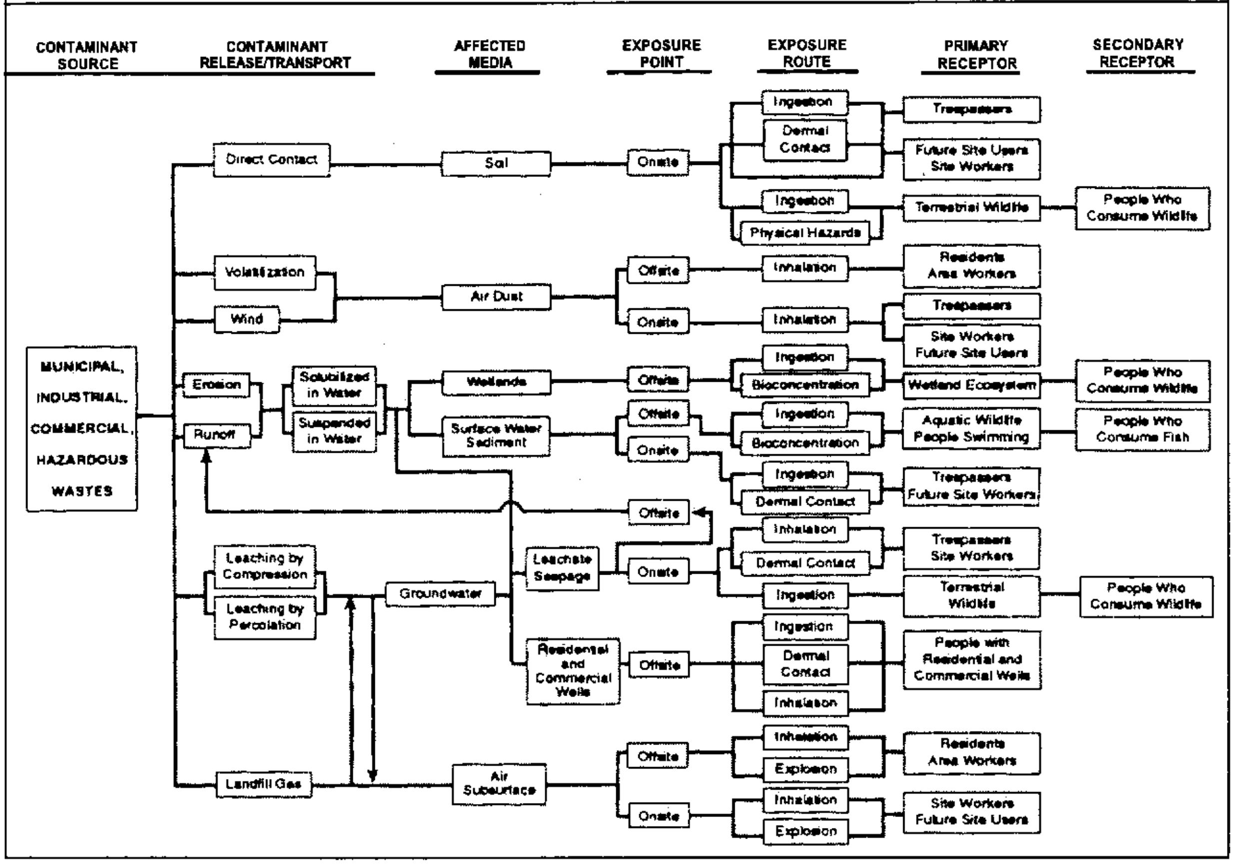
Sources of information of particular interest during scoping include records of previous ownership, state files, closure plans, etc., which may help to determine types and sources of hazardous materials present. In addition, a site visit is appropriate for several reasons, including the verification of existing data, the identification of existing site remediation systems, and to visually characterize wastes (e.g., leachate seeps). Specific information to be collected is provided in Sections 2.1 through 2.4 of the municipal landfill manual.

2. Defining Site Dynamics

The collected data are used to develop a conceptual site model, which is the key component of a streamlined RI/FS. The conceptual site model is an effective tool for defining the site dynamics, streamlining the risk evaluation, and developing the response action. Highlight 2 presents a generic conceptual site model for municipal landfill. The model is developed before any RI field activities are conducted, and its purpose is to aid in understanding and describing the site and to present hypotheses regarding:

- The suspected sources and types of contaminants present;
- Contaminant release and transport mechanisms;

Highlight 2: Generic Conceptual Site Model



- Rate of contaminant release and transport (where possible);
- Affected media;
- Known and potential routes of migration; and
- Known and potential human and environmental receptors.

After the data are evaluated and a site visit is completed, the contaminant release and transport mechanisms relevant to the site should be determined. The key element in developing the conceptual site model is to identify those aspects of the model that require more information to make a decision about response measures. Because containment of the landfill's contents is the presumed response action, the conceptual site model will be of most use in identifying areas beyond the landfill source itself that will require further study, thereby focusing site characterization away from the source area and on areas of potential contaminant migration (e.g., ground water or contaminated sediments).

3. Defining Risks

The municipal landfill manual states that a streamlined or limited baseline risk assessment will be sufficient to initiate response action on the most obvious problems at a municipal landfill (e.g., ground water, leachate, landfill contents, and landfill gas). One method for establishing risk using a streamlined approach is to compare contaminant concentration levels (if available) to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. The manual states that where established standards for one or more contaminants in a given medium are clearly exceeded, remedial action generally is warranted.[1]

It is important to note, however, that based on site-specific conditions, an active response is not required if ground-water contaminant concentrations exceed chemical-specific standards but the site risk is within the Agency's acceptable risk range (10^{-4} to 10^{-6}). For example, if it is determined that the release of

[1]See also OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [a response] action generally is warranted.

contaminants from a particular landfill is declining, and concentrations of one or more ground-water contaminants are at or barely exceed chemical-specific standards, the Agency may decide not to implement an active response. Such a decision might be based on the understanding that the landfill is no longer acting as a source of ground-water contamination, and that the landfill does not present an unacceptable risk from any other exposure pathway.

A site generally will not be eligible for a streamlined risk evaluation if ground-water contaminant concentrations do not clearly exceed chemical-specific standards or the Agency's accepted level of risk, or other conditions do not exist that provide a clear justification for action (e.g., direct contact with landfill contents resulting from unstable slopes). Under these circumstances, a quantitative risk assessment that addresses all exposure pathways will be necessary to determine whether action is needed.

Ultimately, it is necessary to demonstrate that the final remedy addresses all pathways and contaminants of concern, not just those that triggered the remedial action. As described in the following sections, the conceptual site model is an effective tool for identifying those pathways and illustrating that they have been addressed by the containment remedy.

Streamlined Risk Evaluation Of The Landfill Source

Experience from the presumptive remedy pilots supports the usefulness of a streamlined risk evaluation to initiate an early response action under certain circumstances. As a matter of policy, for the source area of municipal landfills, a quantitative risk assessment that considers all chemicals, their potential additive effects, etc., is not necessary to establish a basis for action if ground-water data are available to demonstrate that contaminants clearly exceed established standards or if other conditions exist that provide a clear justification for action.

A quantitative risk assessment also is not necessary to evaluate whether the containment remedy addresses all pathways and contaminants of concern associated with the source. Rather, all potential exposure pathways can be identified using the conceptual site model and compared to the pathways addressed by the containment presumptive remedy. Highlight 3 illustrates that the containment remedy addresses all exposure pathways associated with the source at municipal landfill sites.

Finally, a quantitative risk assessment is not required to determine clean-up levels because the type of cap will be determined by closure ARARs, and ground water that is extracted as a component of the presumptive remedy will be required to meet discharge limits, or other standards for its disposal. Calculation of clean-up levels for ground-water contamination that has migrated away from the source will not be accomplished under the presumptive remedy, since such contamination will require a conventional investigation and a risk assessment.

Highlight 3: Source Contaminant Exposure Pathways Addressed by Presumptive Remedy

1. Direct contact with soil and/or debris prevented by landfill cap;
2. Exposure to contaminated ground water within the landfill area prevented by ground-water control;
3. Exposure to contaminated leachate prevented by leachate collection and treatment; and
4. Exposure to landfill gas addressed by gas collection and treatment, as appropriate.

Streamlining the risk assessment of the source area eliminates the need for sampling and analysis to support the calculation of current or potential future risk associated with direct contact. It is important to note that because the continued effectiveness of the containment remedy depends on the integrity of the containment system, it is likely that institutional controls will be necessary to restrict future activities at a CERCLA municipal landfill after construction of the cap and associated systems. EPA has thus determined that it is not appropriate or necessary to estimate the risk associated with future residential use of the landfill source, as such use would be incompatible with the need to maintain the integrity of the containment system. (Long-term waste management areas, such as municipal landfills, may be appropriate, however, for recreational or other limited uses on a site-specific basis.) The availability and efficacy of institutional controls should be evaluated in the FS. Decision documents should include measures such as institutional controls to ensure the continued integrity of such containment systems whenever possible.

Areas of Contaminant Migration

Almost every municipal landfill site has some characteristic that may require additional study, such as leachate discharge to a wetland or significant surface water run-off caused by drainage problems. These migration pathways, as well as ground-water contamination that has migrated away from the source, generally will require characterization and a more comprehensive risk assessment to determine whether action is warranted beyond the source area and, if so, the type of action that is appropriate.

While future residential use of the landfill source area itself is not considered appropriate, the land adjacent to landfills is frequently used for residential purposes. Therefore, based on site-specific circumstances, it may be appropriate to consider future residential use for ground water and other exposure pathways when assessing risk from areas of **contaminant migration.**

4. Developing the Response Action

As a first step in developing containment alternatives, response action objectives should be developed on the basis of the pathways identified for action in the conceptual site model. Typically, the primary response action objectives for municipal landfill sites include:

<u>Presumptive Remedy</u>

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

<u>Non-Presumptive Remedy</u>

- Remediating ground water;
- Remediating contaminated surface water and sediments; and
- Remediating contaminated wetland areas.

As discussed in Section 3, "Defining Risks," the containment presumptive remedy accomplishes all but the last three of these objectives by addressing all pathways associated with the source. Therefore, the focus of the RI/FS can be shifted to characterizing the media addressed in the last three objectives (contaminated ground water, surface water and sediments, and wetland areas) and on collecting data to support design of the containment remedy.

Treatment of Hot Spots

The decision to characterize and/or treat hot spots is a site-specific judgement that should be based on the consideration of a standard set of factors. Highlight 4 lists questions that should be answered before making the decision to characterize and/or treat hot spots. The overriding question is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place. This question should be answered on the basis of what is <u>known</u> about a site (e.g., from operating records or other reliable information). An answer in the affirmative to all of the questions listed in Highlight 4 would indicate that it is likely that the integrity of the containment system would be threatened, or that excavation and treatment of hot spots would be practicable, and that a significant reduction in risk at the site would occur as a result of treating hot spots. EPA expects that few CERCLA municipal landfills will fall into this category; rather, based on the Agency's experience, the majority of sites are expected to be suitable for containment only, based on the heterogeneity of the waste, the lack of reliable information concerning disposal history, and the problems associated with excavating through refuse.

The volume of industrial and/or hazardous waste co-disposed with municipal waste at CERCLA municipal landfills varies from site to site, as does the amount of information available concerning disposal history. It is impossible to fully characterize, excavate, and/or treat the source area of municipal landfills, so uncertainty about the landfill contents is expected. Uncertainty by itself does not call into question the containment approach. However, containment remedies must be designed to take into account the possibility that hot spots are present in addition to those that have been identified and characterized. The presumptive remedy must be relied upon to contain landfill contents and prevent migration of comtaminants. This is accomplished by a combination of measures, such as a landfill cap combined with a leachate collection system. Monitoring will further ensure the continued effectiveness of the remedy.

The following examples illustrate site-specific decision making and show how these factors affect the decision whether to characterize and/or treat hot spots.

Examples of Site-Specific Decision Making Concerning Hot Spot Characterization/ Treatment

<u>**Site A**</u>

There is anecdotal information that approximately 200 drums of hazardous waste were disposed of at this 70-acre former municipal landfill, but their location and contents are unknown. The remedy includes a landfill cap and ground-water and landfill gas treatment.

A search for and characterization of hot spots is not supported at Site A based on the questions listed in

Highlight 4: Characterization of Hot Spots

If all of the following questions can be answered in the affirmative, it is likely that characterization and/or treatment of hot spots is warranted:

1. Does evidence exist to indicate the presence and approximate location of waste?
2. Is the hot spot known to be principal threat waste?*
3. Is the waste in a discrete, accessible part of the landfill?
4. Is the hot spot known to be large enough that its remediation will reduce the threat posed by the overall site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

*See *A Guide to Principal Threat and Low Level Threat Wastes,* November 1991, Superfund Publication No. 9380.3-06FS.

Highlight 4: (1) no reliable information exists to indicate the location of the waste; (2) the determination of whether the waste is principal threat waste cannot be made since the physical/chemical characteristics of the wastes are unknown; (3) since the location of the waste is unknown, the determination of whether the waste is in a discrete accessible location cannot be made; (4) in this ease, the presence of 200 drums in a 70-acre landfill is not considered to significantly affect the threat posed by the overall site. Rather, the containment system will include measures to ensure its continued effectiveness (e.g., monitoring and/or leachate collection) given the uncertainty associated with the landfill contents and suspected drums.

Site B

Approximately 35,000 drums, many containing hazardous wastes, were disposed of in two drum disposal units at this privately owned 80-acre inactive landfill, which was licensed to receive general refuse. The site is divided into two operable units. The remedy for Operable Unit 1 (OU 1) is incineration of drummed wastes in the two drum disposal units. The remedy for OU 2 consists of treatment of contaminated ground water and leachate and containment of treatment residuals (from OU 1) and remaining landfill contents, including passive gas collection and flaring.

Treatment of landfill contents is supported at Site B because all of the questions in Highlight 4 can be answered in the affirmative: (1) existing evidence from previous investigations and sampling conducted by the state (prior to the RI) indicated the presence and approximate location of wastes; (2) the wastes were considered principal threat wastes because they were liquids and (based on sampling) were believed to contain contaminants of concern; (3) the waste is located in discrete accessible parts of the landfill; and (4) the waste volume is large enough that its remediation will significantly reduce the threat posed by the overall site.

CLOSURE REQUIREMENTS

Subtitle D

In the absence of Federal Subtitle D closure regulations, State Subtitle D closure requirements generally have governed CERCLA response actions at municipal landfills as applicable or relevant and appropriate requirements (ARARs). New Federal Subtitle D closure and post-closure care regulations will be in effect on October 9, 1993 (56 FR 50978 and 40 CFR 258).[4] State closure requirements that are ARARs and that are more stringent than the Federal requirements must be attained or waived.

The new Federal regulations contain requirements related to construction and maintenance of the final cover, and leachate collection, ground-water monitoring, and gas monitoring systems. The final cover regulations will be applicable requirements for landfills that received household waste after October 9,1991. EPA expects that the final cover requirements will be applicable to few, if any, CERCLA municipal landfills, since the receipt of household wastes ceased at most CERCLA landfills before October 1991. Rather, the substantive requirements of the new Subtitle D regulations generally will be considered relevant and approptiate requirements for CERCLA response actions that occur after the effective date.

Subtitle C

RCRA Subtitle C closure requirements may be applicable or relevant and appropriate in certain circumstances. RCRA Subtitle C is applicable if the landfill received waste that is a listed or characteristic waste under RCRA, and:

1. The waste was disposed of after November 19,1980 (effective date of RCRA), or

[4] An extension of the effective date has been proposed but not finalized at this time.

2. The new response action constitutes disposal under RCRA (i.e., disposal back into the original landfill).[5]

The decision about whether a Subtitle C closure requirement is relevant and appropriate is based on a variety of factors, including the nature of the waste and its hazardous properties, the date on which it was disposed, and the nature of the requirement itself. For more information on RCRA Subtitle C closure requirements, see *RCRA ARARs:Focus on Closure Requirements,* Directive No. 9234.2-04FS, October 1989.

[5]Note that disposal of only small quantity hazardous waste and household hazardous waste does not make Subtitle C applicable.

Notice:

The policies set out in this document are intended solely as guidance to the U.S. Environmental Protection Agency (EPA) personnel; they are not final EPA actions and do not constitute rulemaking. These policies are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances. EPA also reserves the right to change the guidance at any time without public notice.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES

This Appendix summarizes the analysis that EPA conducted of feasibility study (FS) and Record of Decision (ROD) data from CERCLA municipal landfill sites which led to the establishment of containment as the presumptive remedy for these sites. The objective of the study was to identify those technologies that are consistently included in the remedies selected, those that are consistently screened out, and to identify the basis for their elimination. Results of this analysis support the decision to eliminate the initial technology identification and screening steps on a site-specific basis for this site type. The technical review found that certain technologies are appropriately screened out based on effectiveness, implementability, or excessive costs.

The methodology for this analysis entailed reviewing the technology identification and screening components of the remedy selection process for a representative sample of municipal landfill sites. The number of times each technology was either screened out or selected in each remedy was compiled. A detailed discussion of the methodology used is provided below.

METHODOLOGY

Identification of Sites for Feasibility Study Analysis

Of the 230 municipal landfill sites on the NPL, 149 sites have had a remedy selected for at least one operable unit. Of the 149 sites, 30 were selected for this study on a random basis, or slightly greater than 20 percent. The sites range in size from 8.5 acres to over 200 acres and are located primarily in Regions 1,2,3, and 5. This geographical distribution approximates the distribution of municipal landfills on the NPL.

Technology Secrming and Remedial Alternative Analysis

The FS analysis involved a review of the technology identification and screening phase, including any pre-screening steps, followed by a review of the detailed analysis and comparative analysis phases. Information derived from each review was documented on site-specific data collection forms, which are available for evaluation as part of the Administrative Record for this presumptive remedy directive. The review focused on the landfill source contamination only; ground-water technologies and alternatives were not included in the analysis.

For the screening phase, the full range of technologies considered was listed on the data collection forms, along with the key reasons given for eliminating technologies from further consideration. These reasons were categorized according to the screening criteria: cost, effectiveness, or implementability. The frequency with which specific reasons were given for eliminating a technology from further consideration was then tallied and compiled into a screening phase summary table.

For the detailed analysis and comparative analysis, information on the relative performance of each technology/alternative with respect to the seven NCP criteria was documented on the site-specific data collection forms. The advantages and disadvantages associated with each clean-up option were highlighted. In some cases, a technology was combined with one or more technologies into one or more alternatives. The disadvantages of a technology/alternative were then compiled into a detailed analysis/comparative analysis summary table, under the assumption that these disadvantages contributed to non-selection. All summary tables are available for review as part of the Administrative Record.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES (continued)

RESULTS

The information from the technology screening and remedial alternative analyses is provided in Table 1. It demonstrates that containment (the presumptive remedy), was chosen as a component of the selected remedy at all thirty of the sites analyzed. No other technologies or treatments were consistently selected as a remedy or retained for consideration in a remedial alternative. However, at eight of the thirty sites, there were circumstances where technologies were included in the selected remedy to address a site-specific concern, such as principal threat wastes. These technologies are included in the column entitled "Tech. Not Primary Component of Alternative"[1] in Table 1 and include incineration at two sites, waste removal and off-site disposal at two sites, soil vapor extraction at two sites, and bioreclamation at one site.

Leachate collection and gas collection systems were also tracked as part of the detailed analysis and comparison of remedial alternatives. These types of systems generally were not considered as remediation technologies during the screening phases. At fifteen sites, leachate collection was selected as part of the overall containment remedy. At seventeen sites, gas collection systems were selected as part of the overall containment remedy.

This analysis supports the decision to eliminate the initial technology identification and screening step for municipal landfill sites. On a site-specific basis, consideration of remediation technologies may be retained as needed.

[1] This column title is used for record-keeping purposes only and is not meant to imply that these treatment technologies are not considered important components of the selected remedies.

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns 4	Community Concerns 4
Multi-layer Cap	28	25	3	0	2	2	0	18	7	1	0	0	1	3	5	3	---	---
Clay Cap	16	8	8	0	1	8	0	4	4	2	2	1	2	1	0	1	---	---
Asphalt Cap	17	0	17	0	2	14	5	0	0	0	0	0	0	0	0	0	---	---
Concrete Cap	17	0	17	0	3	14	5	0	0	0	0	0	0	0	0	0	---	---
Soil Cover	16	7	5	4	0	5	1	5	2	1	0	0	0	0	0	0	---	---
Synthetic Cap	13	3	10	0	0	10	1	2	1	1	1	1	1	1	1	1	---	---
Chemical Seal	5	0	5	0	0	4	0	0	0	0	0	0	0	0	0	0	---	---
Slurry Wall	22	5	14	3	2	8	6	2	3	3	2	2	1	2	0	2	---	---
Grout Curtain	18	0	18	0	3	15	9	0	0	0	0	0	0	0	0	0	---	---
Sheet Piling	17	1	16	0	0	13	5	0	1	0	0	0	0	0	0	0	---	---
Grout Injection	8	0	8	0	0	8	2	0	0	0	0	0	0	0	0	0	---	---
Block Displacement	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Bottom Sealing	5	0	5	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns 4	Community Concerns 4
Vibrating Beam	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Liners	2	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	---	---
Offsite Nonhazardous Landfill	3	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	---	---
Offsite RCRA Landfill	17	0	13	4	8	3	12	0	0	0	0	0	0	0	0	0	---	---
Offsite Landfill (unspecified)	9	1	8	0	5	3	5	1	0	0	0	0	0	0	0	0	---	---
Onsite Nonhazardous Landfill	2	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	---	---
Onsite RCRA Landfill	14	1	11	2	3	2	10	0	1	0	0	0	0	0	0	1	---	---
Onsite Landfill (unspecified)	7	0	6	1	3	3	6	0	0	0	0	0	0	0	0	0	---	---
Bioremediation (unspecified)	13	0	13	0	0	13	1	0	0	0	0	0	0	0	0	0	---	---
Bioremediation Ex-situ	10	0	10	0	0	7	7	0	0	0	0	0	0	0	0	0	---	---
Bioremediation In-situ	15	1	14	0	1	13	7	1	0	0	0	0	0	0	0	0	---	---
Dechlorinization/ APEG	6	0	5	1	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Oxidation/ Reduction	12	0	12	0	1	8	5	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Neutralization	4	0	3	1	0	2	1	0	0	0	0	0	0	0	0	0	---	---
Thermal Destruction (unspecified)	6	0	6	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---
Offsite Incineration (unspecified)	19	2	14	3	9	5	10	1	1	0	0	0	0	1	1	0	---	---
Onsite Incineration (unspecified)	12	0	8	3	5	5	6	0	1	0	0	0	0	1	1	1	---	---
Fluidized Bed	9	0	9	0	5	6	4	0	0	0	0	0	0	0	0	0	---	---
Infrared	8	0	7	1	6	3	3	0	0	0	0	0	0	0	0	0	---	---
Pyrolysis	5	2	3	1	2	2	1	0	1	0	1	0	0	1	1	1	---	---
Multiple Hearth	4	0	4	0	2	2	1	0	0	0	0	0	0	0	0	0	---	---
Rotary Kiln	10	0	9	1	6	5	4	0	0	0	0	0	0	0	0	0	---	---
Vitrification	21	0	21	0	8	15	11	0	0	0	0	0	0	0	0	0	---	---
Low Temperature Thermal Desorp/ Stripping	13	1	11	1	2	9	3	0	1	0	0	0	0	0	1	0	---	---
In-situ Steam Stripping	5	0	5	0	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Soil Flushing	16	2	14	0	2	9	10	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out[3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Soil Washing	12	2	9	1	1	8	6	0	0	0	0	0	0	0	0	0	---	---
Soil Vapor Extraction (SVE)	14	1	11	2	2	9	5	1	0	0	0	0	0	0	0	0	---	---
Fixation	7	1	5	1	0	4	2	2	0	0	0	0	0	0	0	0	---	---
Stabilization/ Solidification	20	0	19	2	1	13	6	0	0	0	0	0	0	0	0	0	---	---
Aeration	7	0	7	0	0	5	3	0	0	0	0	0	0	0	0	0	---	---

[1] The study was conducted on 30 RODs and their corresponding FSs.

[2] This does not include the no-action or institutional control only alternatives. No RODs selected either of these as remedies.

[3] FSs and RODs may contain more than one criterion for screening or non-selection of technology. Also, some FSs did not fully explain the criteria for screening out a technology. Thus, the totals for screening and non-selection criteria are not equal to the number of FSs and RODs considered.

[4] Information on State and community concerns was not included in this analysis because FSs do not contain this information and RODs generally only reference supporting documentation (i.e., State concurrence letter and responsiveness summary).

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out [3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns [4]	Community Concerns [4]
Multi-layer Cap	28	25	3	0	2	2	0	18	7	1	0	0	1	3	5	3	---	---
Clay Cap	16	8	8	0	1	8	0	4	4	2	2	1	2	1	0	1	---	---
Asphalt Cap	17	0	17	0	2	14	5	0	0	0	0	0	0	0	0	0	---	---
Concrete Cap	17	0	17	0	3	14	5	0	0	0	0	0	0	0	0	0	---	---
Soil Cover	16	7	5	4	0	5	1	5	2	1	0	0	0	0	0	0	---	---
Synthetic Cap	13	3	10	0	0	10	1	2	1	1	1	1	1	1	1	1	---	---
Chemical Seal	5	0	5	0	0	4	0	0	0	0	0	0	0	0	0	0	---	---
Slurry Wall	22	5	14	3	2	8	6	2	3	3	2	2	1	2	0	2	---	---
Grout Curtain	18	0	18	0	3	15	9	0	0	0	0	0	0	0	0	0	---	---
Sheet Piling	17	1	16	0	0	13	5	0	1	0	0	0	0	0	0	0	---	---
Grout Injection	8	0	8	0	0	8	2	0	0	0	0	0	0	0	0	0	---	---
Block Displacement	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Bottom Sealing	5	0	5	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

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Vibrating Beam	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Liners	2	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	---	---
Offsite Nonhazardous Landfill	3	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	---	---
Offsite RCRA Landfill	17	0	13	4	8	3	12	0	0	0	0	0	0	0	0	0	---	---
Offsite Landfill (unspecified)	9	1	8	0	5	3	5	1	0	0	0	0	0	0	0	0	---	---
Onsite Nonhazardous Landfill	2	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	---	---
Onsite RCRA Landfill	14	1	11	2	3	2	10	0	1	0	0	0	0	0	0	1	---	---
Onsite Landfill (unspecified)	7	0	6	1	3	3	6	0	0	0	0	0	0	0	0	0	---	---
Bioremediation (unspecified)	13	0	13	0	0	13	1	0	0	0	0	0	0	0	0	0	---	---
Bioremediation Ex-situ	10	0	10	0	0	7	7	0	0	0	0	0	0	0	0	0	---	---
Bioremediation In-situ	15	1	14	0	1	13	7	1	0	0	0	0	0	0	0	0	---	---
Dechlorinization/ APEG	6	0	5	1	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Oxidation/ Reduction	12	0	12	0	1	8	5	0	0	0	0	0	0	0	0	0	---	---

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Neutralization	4	0	3	1	0	2	1	0	0	0	0	0	0	0	0	0	---	---
Thermal Destruction (unspecified)	6	0	6	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---
Offsite Incineration (unspecified)	19	2	14	3	9	5	10	1	1	0	0	0	0	1	1	0	---	---
Onsite Incineration (unspecified)	12	0	8	3	5	5	6	0	1	0	0	0	0	1	1	1	---	---
Fluidized Bed	9	0	9	0	5	6	4	0	0	0	0	0	0	0	0	0	---	---
Infrared	8	0	7	1	6	3	3	0	0	0	0	0	0	0	0	0	---	---
Pyrolysis	5	2	3	1	2	2	1	0	1	0	1	0	0	1	1	1	---	---
Multiple Hearth	4	0	4	0	2	2	1	0	0	0	0	0	0	0	0	0	---	---
Rotary Kiln	10	0	9	1	6	5	4	0	0	0	0	0	0	0	0	0	---	---
Vitrification	21	0	21	0	8	15	11	0	0	0	0	0	0	0	0	0	---	---
Low Temperature Thermal Desorp/ Stripping	13	1	11	1	2	9	3	0	1	0	0	0	0	0	1	0	---	---
In-situ Steam Stripping	5	0	5	0	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Soil Flushing	16	2	14	0	2	9	10	0	0	0	0	0	0	0	0	0	---	---

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Soil Washing	12	2	9	1	1	8	6	0	0	0	0	0	0	0	0	0	---	---
Soil Vapor Extraction (SVE)	14	1	11	2	2	9	5	1	0	0	0	0	0	0	0	0	---	---
Fixation	7	1	5	1	0	4	2	2	0	0	0	0	0	0	0	0	---	---
Stabilization/ Solidification	20	0	19	2	1	13	6	0	0	0	0	0	0	0	0	0	---	---
Aeration	7	0	7	0	0	5	3	0	0	0	0	0	0	0	0	0	---	---

[1] The study was conducted on 30 RODs and their corresponding FSs.

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United States Environmental Protection Agency

Office of Emergency and Remedial Response (5202G)

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OSWER 9375.3-05P
PB99-963319
September 1999

Reuse of CERCLA Landfill and Containment Sites

Through the "Superfund Redevelopment Initiative," EPA is helping communities restore properties, once restricted from use due to risk to human health and the environment, to productive uses. These uses may include a range of activities, such as commercial businesses, recreational facilities, and ecologically enhanced areas. This fact sheet is designed to assist Remedial Project Managers (RPMs), On-Scene Coordinators (OSCs), and State agencies in working with communities to incorporate reuse options into on-site containment remedies, such as the municipal landfill presumptive remedy, when possible. The fact sheet does not establish new policy, but rather illustrates how reuse of property has been accomplished successfully under the existing program at several sites. In addition, the fact sheet describes design considerations that were creatively implemented at the sites, identifies techniques to facilitate land use, and discusses potential reuse limitations.

Softball is played at an outdoor recreation complex developed at the Chisman Creek Superfund Site.

INTRODUCTION

For over eighteen years EPA has characterized and remediated municipal landfills under its Superfund program. Based on the wealth of information acquired and the lessons learned from evaluating and cleaning up these sites, the Agency developed a presumptive remedy for CERCLA municipal landfill sites (see OSWER Directive No. 9355.0-49FS). This presumptive remedy calls for containment of the landfill mass, and collection or treatment of landfill gas and/or leachate, as appropriate. The effectiveness of the remedy is dependent on a containment system that is properly operated and maintained, and institutional controls that provide for the continued integrity of the containment system, thereby ensuring long-term protection of future site users. EPA uses similar containment strategies at other sites where a decision is made to leave some contaminated material onsite. In either case, the containment system used at the site is designed to provide protection of human health and the environment for both current and future users of the site.

The Superfund Redevelopment Initiative reflects the Agency's belief that EPA's responsibility to local communities to clean up contaminated properties in a manner that protects human health and the environment, generally should be carried out such that cleanups are protective for reasonably anticipated future land use. Superfund sites can be recycled in a variety of forms, including redevelopment of the site (e.g., construction of a new facility), reuse of existing resources on the site (e.g., a new business in pre-existing buildings), or enhancing the ecosystem on and around the site. **EPA does not favor one type of reuse over another, as land use is a local decision.** Instead, EPA is working with community leaders to determine remedial action objectives for cleanups that will allow for reasonably anticipated future land uses, where possible. Although the landfill presumptive remedy and other containment requirements may limit future uses, EPA believes that a significant number of sites using containment strategies may be appropriate for future ecological, recreational, or commercial/industrial reuse. EPA believes that reuse should help to ensure proper maintenance of the remedy while providing tangible benefits to key stakeholders, especially the surrounding community. The possible benefits of reuse include:

- Positive economic impacts for communities living around the site including new employment opportunities, increased property values, and catalysts for additional redevelopment activities;
- Stakeholder acceptance of the municipal landfill presumptive remedy because of potential time and cost savings, and increased involvement in the restoration and redevelopment process;
- Enhanced day-to-day attention, potentially resulting in improved maintenance of remedy integrity and institutional controls; and
- Improved aesthetic quality of the area through discouragement of illegal waste disposal or trespassing on restricted portions of the site, as well as increased upkeep of the site by future site occupants.

This fact sheet provides information on reuse projects that have been implemented successfully at landfills and other sites using similar containment remedies. It identifies features to be considered during the design phase, and highlights examples of project designs that incorporated creative solutions to facilitate reuse. In addition, this fact sheet addresses reuse issues—such as transfer of operation and maintenance (O&M) responsibilities and implementation of institutional controls—that are crucial to the continued protection of human health and the environment. Finally, the fact sheet delineates EPA guidance and tools for stakeholders interested in reusing a landfill site.

IDENTIFYING REASONABLY ANTICIPATED FUTURE LAND USE

To ensure that a containment remedy is protective for the reasonably anticipated use(s) of a site, RPMs and/or OSCs should involve stakeholders as early in the Superfund decision-making process as possible. Discussions with local land use planning authorities, appropriate State and local officials, property owners, and the public, as appropriate, should be conducted as early as possible in the scoping phase of the Remedial Investigation/Feasibility Study (RI/FS).

To identify reasonably anticipated future land uses, the following types of information, much of which typically is available from local planning authorities, may be evaluated: current land use; zoning laws; zoning maps; comprehensive community master plans; population growth patterns and projections (e.g., Bureau of Census projections); accessibility of site to existing infrastructure (e.g., transportation and public utilities); institutional controls currently in place; site location in relation to urban, residential, commercial, industrial, agricultural and recreational areas; Federal/State land use designation (Federal/State control over designated lands range from established uses for the general public, such as national parks or State recreational areas, to governmental facilities, which often have extensive site access restrictions, such as Department of Defense facilities); historical or recent development patterns; cultural factors (e.g., historical sites, Native American religious sites); natural resources information; potential vulnerability of groundwater to contaminants that might migrate from soil; environmental justice issues; location of on-site or nearby wetlands; proximity of site to a floodplain; proximity of site to critical habitats of endangered or threatened species; geographic and geologic information; and location of Wellhead Protection areas, recharge areas, and other areas identified in a State's Comprehensive Groundwater Protection Program.

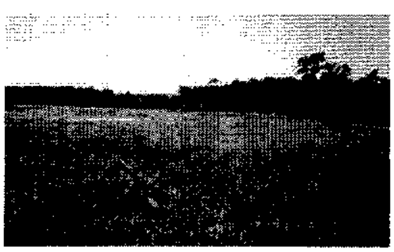
Early discussions with stakeholders will assist EPA in understanding the reasonably anticipated future uses of the site and in identifying specific institutional and engineering controls that may be necessary. Three categories of land reuse have been employed at former municipal landfills—ecological enhancement, recreational reuse, and commercial/industrial reuse. Each of these categories is discussed in the sections that follow. Case studies are used throughout this fact sheet to illustrate engineering and policy considerations, and protective, feasible solutions for integrating site reuse with a containment remedy. Exhibit One summarizes key characteristics of the case studies included in this fact sheet. Detailed case studies of these sites are available on the Superfund homepage located at http://www.epa.gov/superfund.

Ecological Enhancement

The historical practice of siting landfills in remote areas often allows all or part of a landfill site to be used for future ecological use. Wildlife enhancement areas and wetlands provide green space and habitat for indigenous species, and often serve as a cost-effective and design-friendly means of returning landfills to beneficial use. Historically, EPA has accommodated restoration of ecologically significant areas, when possible, including landfills located in areas with significant, existing habitat. The first step is to consult with other Federal and State agencies, such as the U.S. Fish and Wildlife Service, to target specific indigenous birds and wildlife that are in need of habitat. Once this information has been gathered, it may be possible to conduct the cleanup in a manner that will support plant and animal species while ensuring that the selected vegetation and engineering controls will protect the landfill cover and maintain the effectiveness of the remedy.

Army Creek Landfill Superfund Site before cleanup and ecological restoration.

One example of ecological restoration is at the Army Creek Landfill in New Castle County, Delaware. At this site, EPA and the potentially responsible parties (PRPs) turned a sixty-acre abandoned landfill into a wildlife enhancement area. This remedy and reuse project provided protective habitat for various native terrestrial and aquatic wildlife species. Additionally, various grains, wildflowers, and custom vegetation were planted on the site cap to encourage migratory birds to stop, nest, and feed on the land. Revegetation of the site and reconstruction of the wetlands were completed at no additional cost to the Agency.

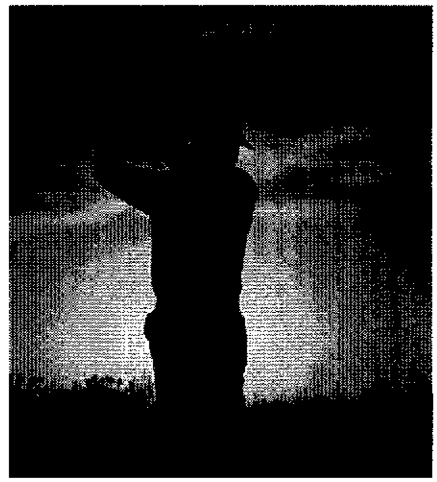


The Army Creek Landfill Superfund Site after cleanup and ecological restoration. Today the area supports various terrestrial and aquatic species of wildlife.

Another example of ecological restoration is the remedy implemented at the Bower's Landfill site in Pickaway County, Ohio. Knowing that part of the site was flooded an average of 29 days a year, EPA determined that converting a portion of the site into a wetlands would be both cost-effective and beneficial to the surrounding ecosystem. To make ecological restoration a reality, the RPM consulted with the Ohio Division of Wildlife and the U.S. Fish and Wildlife Service to design the wetlands area. EPA used clay from a portion of the site to build the cap over the landfill. The area that was excavated was then graded to provide waterways and retention ponds and to promote the growth of plants and wildlife with minimal maintenance. The seven-acre wetlands that were constructed now effectively control flooding of the landfill source, and provide food, shelter, and habitat for a variety of plants and animals.

Recreational Reuse

Former municipal landfills can also find new life as low-impact recreational areas. Landfills are a natural fit for this type of activity because they typically have a large surface area and the cap can be contoured to meet the specifications for ball fields or golf courses. In addition, communities are generally hospitable to new recreational areas because they have a tendency to increase property values and enhance the quality of life in the immediate area.



Sunset at the Old Works Golf Course, Deer Lodge County, Montana. In 1997, 25,000 rounds of golf were played at the course.

For instance, at the Chisman Creek Landfill in York County, Virginia, the cleanup plan developed by EPA and the PRPs was based on local residents' desire for a sports complex in the community. The site cap was engineered to serve as a foundation for future playing fields and graded to allow for park structures such as bleachers and fences. The Chisman Creek site is now a 41-acre complex that contains two lighted softball fields, four soccer fields, parking, vending facilities, and facility equipment storage.

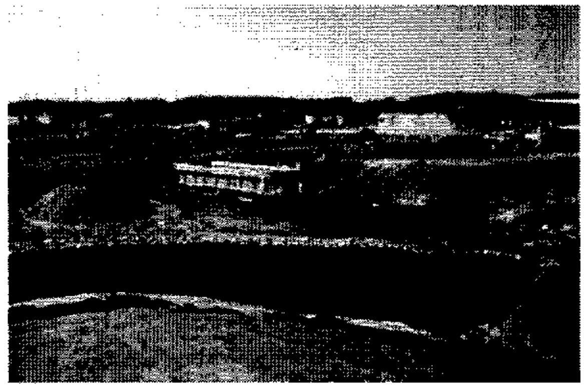
Another case of recreational reuse at a site implementing a containment remedy is the Old Works/East Anaconda Smelter Superfund Site in Deer Lodge County, Montana. After extensive discussions with both the PRP and the local community, EPA approved a cleanup plan that accommodated the development of a golf course over a portion of the property. In order to construct the golf course, the PRPs utilized many unique design features that not only facilitated redevelopment, but also allowed for the protection of future golfers and a nearby trout stream, and future development around the golf course.

For landfills and other sites with mounds or sloped areas, the DuPage County Landfill/Blackwell Forest Preserve illustrates a recreational use that makes the most of this fairly common feature. Solid waste materials at the former landfill were deposited to a height of over 188 feet above ground level. After the site was closed, the town saw a need for a recreational resource, and decided to convert the former landfill and surrounding area into a multi-use area featuring hiking trails, camping facilities, and picnic areas for warmer months and a sledding/toboggan hill in winter months.

Industrial/Commercial Reuse

Some landfills, because of their locale or surroundings, may not be suitable for ecological or recreational reuse. These sites are generally located in industrialized areas that lack significant wildlife and/or habitat acreage. However, other factors, such as proximity to major transportation routes and suppliers or customers make these sites a potential setting for industrial or commercial redevelopment.

The remediation of the Raymark site in Fairfield County, Connecticut, is one of the first cases in which effective consideration of the reasonably anticipated future land use in developing a cleanup plan helped reuse occur. From 1995 through 1997, Region 1 and the Connecticut Department of Environmental Protection (CDEP) decontaminated and demolished all site buildings and structures, consolidated contaminated soils, addressed highly concentrated pockets of contaminated groundwater, installed a gas collection system, and capped the entire 33-acre property so that future development could occur. A partnership was formed among EPA, CDEP, the Town of Stratford, and a local developer, which ultimately will allow for the construction of a 300,000 square foot retail shopping complex on the site.



Remediation underway at the Raymark Superfund Site. The site will support a 300,000 square foot shopping complex.

The Delaware Sand and Gravel site in New Castle County, Delaware, is another example of industrial redevelopment of a former landfill. Although construction of a low-permeability landfill cap was required, the owner was interested in reusing a portion of the site for temporary storage of heavy equipment. Region 3 allowed PRP construction of a "wear surface" over a 5-acre portion of the RCRA landfill cap. The wear surface was designed and constructed to withstand daily use by a sixteen-ton load—the weight of the heaviest piece of equipment that was going to be used on the site in its new capacity. Similarly, the containment remedy at the Mid-Atlantic Wood Preserver site in Anne Arundel County, Maryland, allowed the site to be paved as a parking lot for the use of the adjacent business.

Another example of commercial/industrial redevelopment is the Industri-Plex site, which is located in a dense commercial and industrial area in Middlesex County, Massachusetts. Remediation of the site included PRP construction of permeable and/or impermeable caps and other covers (e.g., concrete foundations, asphalt parking lots, etc.) over approximately 110 acres of contaminated soils. Development projects planned or underway include construction of a Regional Transportation Center (RTC), a retail store on 19 acres, and up to 750,000 square feet of office and hotel space.

REMEDY CONSIDERATIONS

Pursuant to Section 121(d)(2) of CERCLA, remedial actions must meet or waive all applicable or relevant and appropriate requirements (ARARs) identified for a response. For landfills, ARARs generally include closure requirements in compliance with Subtitle D or Subtitle C of the Resource Conservation and Recovery Act (RCRA) (for more information on closure requirements as ARARs, see "Presumptive Remedy for CERCLA Municipal Landfill Sites, September 1993, Directive No. 9355.0-49FS). Whatever the intended future use of the site, the integrity of the cap and other components of the containment remedy must be protected and maintained. The following sections identify remedy considerations that have been addressed at sites where it has been possible to accommodate reasonably anticipated land uses in the remedy. These considerations include design components for the containment remedies, implementation of appropriate institutional controls, and ongoing O&M activities.

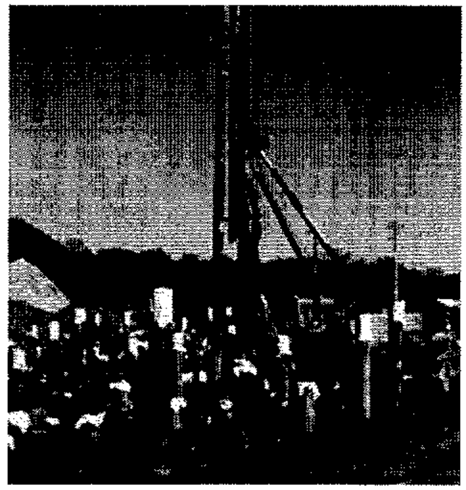
Design Components

Plans and specifications for a landfill or other containment cap system generally provide the following components, regardless of the intended future use of the site: cap design and integrity; runoff collection system design and safety; monitoring well location and design; leachate/gas collection system design and safety; and vegetative choices. When a particular reuse of a site is anticipated, in general, EPA will attempt to conduct site activities in a manner that will be protective for the anticipated future use. The following sections provide examples of sites where remedial actions were conducted in such a way that desired future uses were successfully incorporated into the remedial design.

Exhibit One: Case Study Site Characteristics					
Site Name	**Land Use**	**Design Considerations**	**Operation & Maintenance**	**Objectives of Institutional Controls**	**RPM Information**
Army Creek Landfill, DE Region 3 PRP lead	Wildlife refuge	Vegetative cover (species); O&M Schedule Burrowing animal control	PRP inspects and mows cap on rotating schedule; removes penetrating trees and other plants; monitors gas vents; removes nuisance reeds from wetlands; runs humane capture and release program; collects and treats groundwater and monitors air and groundwater	Ensure that any future use is consistent with, and protective of, the site remedy. Any activities performed at the site must be done in an environmentally and otherwise acceptable manner consistent with all laws, regulations, ordinances, zoning requirements, or other rules imposed by Federal, State, County, or Local government bodies.	Debra Rossi (215) 814-3228 rossi.debra@epa.gov
Bower's Landfill Site, OH Region 5 Fund lead	Wetlands habitat creation	Flood and erosion control Monitoring well integrity	State O&M program includes quarterly inspection for leachate and gas formation, groundwater monitoring, mowing cap vegetation, inspecting and repairing the cap, and repairing the fencing.	Prohibit groundwater extraction in west field and restricting disturbance of the landfill surface. If necessary, farming will be prohibited on land west of site.	David Wilson (312) 886-1476 wilson.david@epa.gov
Chisman Creek Site, VA Region 3 PRP lead	Soccer and softball fields	Wetlands preservation Prevention future direct contact	Routine O&M transferred to York County Parks and Recreation; PRP responsible for O&M of engineering control equipment. Post closure monitoring program for ground and surface water down gradient of the fly ash pits.	Prohibit excavation of soil, restrict building, and restrict groundwater use under and down gradient of the pits.	Andrew C. Palestini, (215) 814-3233 palestini.andrew@epa.go v
Anaconda Smelter Site, MT Region 8 PRP lead	18-hole golf course	Runoff and irrigation control Materials recycling	O&M and monitoring transferred to Deer Lodge County; O&M requirements include monitoring and maintenance of the vegetative cover and installation and maintenance of a fence around the perimeter of the site; Future transfer of site ownership will transfer O&M responsibilities.	Short-term institutional controls to control access and land use will be implemented throughout the area of the site. County responsible for land use decisions and issuing redevelopment permits.	Charles Coleman (406) 441-1150 Ext. 261 coleman.charles@epa.go v

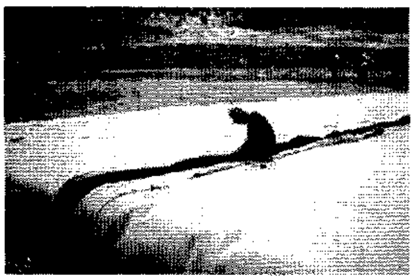
Exhibit One: Case Study Site Characteristics					
Site Name	**Land Use**	**Design Considerations**	**Operation & Maintenance**	**Objectives of Institutional Controls**	**RPM Information**
Raymark Site, CT Region 1 Fund lead	Retail shopping plaza	Designed to allow future development on top of cap such that no penetration of cap will be necessary	O&M program includes conducting routine monitoring of groundwater and surface water, O&M of DNAPL collection system, O&M of soil gas collection system, and O&M of enhanced gas collection system.	Some use restrictions on types of businesses that can operate on property and restrictions on excavating below impermeable layer.	Mike Hill (617) 918-1398 hill.michael@epa.gov
Delaware Sand & Gravel Site, DE Region 3 PRP lead	Storage facility for light industrial equipment	Load bearing; gas collection with vents located outside work area	Owner inspects RCRA cap; monitors gas vents; mows	Use of the surface area barrier is restricted by weight, spillage, storage, excavation, and other measures.	Phil Rotstein (215) 814-3232 rotstein.phil@epa.gov
Mid-Atlantic Wood Preserver Site, MD Region 3 PRP Lead	Parking lot for adjacent business	Wear surface over cap	Developer inspects and maintains asphalt paving and carries out environmental (air, surface water, sediments, & groundwater) monitoring.	Ensure the integrity of containment structure is not compromised by future use of the property.	Eric Newman (215) 814-3237 newman.eric@.epa.gov
Industri-Plex Site, MA Region 1 PRP lead	Transportation center; retail store; office and hotel space	Design permeable and impermeable covers to prevent direct contact with soils contaminated with heavy metals. The design considers long-term protectiveness/ effectiveness and freeze-thaw action.	Air, surface, and ground-water quality monitoring and post-closure care consistent with RCRA regulations.	Under development. The institutional controls will preserve the continued effectiveness of the remedy, which ensures the protection of human health and the environment, while allowing property owners greatest possible use of the site.	Joseph LeMay, P.E. (617) 918-1323 lemay.joe@epa.gov
DuPage County Landfill/Blackwell Forest Preserve, IL Region 5 PRP Lead	Natural recreation area; hiking and camping facilities; sledding hill; lake	Minimized tree removal over footprint of site. If existing landfill gas system is incapable of meeting recreational uses, system will go from passive to active (designed to be upgraded), additional gas collection wells will be added, and/or thermal treatment device will be added.	Forest Preserve District will handle all operation and maintenance. Rigorous inspections of cap integrity (i.e., after weather events, look for excessive wear in recreational areas)	Prohibit excavation of soil, restricting building and ground-water use. However, have petition flexibility to accommodate non-invasive improvements	Michael Bellot Region 5 312-353-6425 bellot.michael@epa.gov

Cap design and integrity



At the Raymark Superfund Site in Connecticut, foundation pilings were engineered into the protective cap, which will support a 300,000 square foot retail complex.

Basic considerations in cap design include material, thickness, permeability and slope stability. However, the future use of the site may require design components that incorporate specific reuse considerations. At the Chisman Creek site, the cap was engineered to serve as a foundation for future playing fields and graded to allow for park structures such as bleachers and fences. Precautions, such as placing underground utilities in oversized clay trenches, were taken to protect future workers from coming into contact with fly ash. At the Delaware Sand and Gravel site, the wear surface was constructed to withstand daily use by a sixteen-ton load—the weight of the heaviest piece of equipment onsite, an eight-ton forklift with a maximum front-end load of eight tons. Other design considerations may take into account unique site characteristics; for example, sledding at the DuPage Landfill site slope is limited to days during which there are at least three inches of snow on the ground. Caps can also be designed to accommodate large commercial buildings. For example, underlying soils and waste were compacted through surcharging and dynamic compaction, and in one area of the site, steel pilings were installed below the protective cap at the Raymark Industries site to support the loads of the cap, parking lot, and a 300,000 square foot retail shopping complex. Through a Prospective Purchaser Agreement (PPA) (see page 13 for a discussion of PPAs), the developer agreed to reimburse EPA for the additional costs associated with the soil stabilization techniques implemented in preparation for the future shopping complex, and agreed to avoid actions that could disrupt the protective cover.



Capping underway at the Summitville Mine Superfund Site, Rio Grande County, Colorado.

Runoff collection system design and safety

Surface water runoff controls typically are used to prevent the migration of leachate or contaminant plumes with lateral drainage features. Again, site reuse may entail modifications of system designs to contain or treat the flow prior to release. Under EPA supervision, the PRP installed a state-of- the-art drainage system at the Old Works/East Anaconda Smelter site. This system directs runoff from the hills which surround the course into a large holding pond. The design of this unit protects the overall integrity of the cap, minimizes stormwater runoff to a nearby trout stream, and allows the water to be used as an irrigation source. At the Army Creek Landfill site, concerns of flooding in low lying areas where treated water feeds into the adjacent Army Creek resulted in modifications to the slope and discharge layout of several existing onsite sediment basins to create a standing wetlands area. One of the sediment basins, already colonized with native wetland plant species, was left in its natural state. The second basin was replanted with plant species typical to riparian wetlands in the area. At the Chisman Creek Landfill site, the surface water collection system was so efficient that the York County Parks and Recreation Department had to re-sod the support layer to slow rainwater drainage in order to maintain grass on the fields.

Monitoring well location and design

Containment remedies generally include monitoring wells to ensure that leachate from the contained mass does not migrate to underlying groundwater. The location and design of these wells can be planned so that site reuse does not affect use of the wells. At the Bower's Landfill site, monitoring wells in the constructed wetland area were fitted with risers and the surrounding earth was mounded to minimize water intrusion through the wells and to make access easier during flood conditions.

Leachate/Gas collection system design and safety

Leachate and gas collection and treatment systems are also design considerations that may be integrated with future land use. Both the placement of collection equipment and treatment options (e.g., vents and flares) can be planned to accommodate future reuse. Gas vents at the Delaware Sand and Gravel site were installed horizontally, away from the reuse area, and towards an unobstructed five acres. This portion of the property will not be reused due to unsuitable slope. Engineers at the Chisman Creek site discovered that the original design of the groundwater collection system would significantly impact the stability of the land under the highway bisecting the site and several nearby homes. To avoid these impacts, a series of horizontal drains were drilled laterally into the base of the ash pit. This lower-cost and more efficient design was adapted from highway construction projects and required the use of a specially constructed drill rig. At the Army Creek site, gooseberry was planted around the gas vents to provide a food source for animals as well as visual cover of the vent pipes. At the DuPage County Landfill site, the Forest Preserve District agreed to conduct breathing zone ambient monitoring that includes different seasonal variations and atmospheric changes. If the existing landfill gas system does not meet recreational use safety requirements, the Record of Decision is written to change the gas collection system from passive to active (the system was designed to be upgraded), to add additional gas collection wells, and/or to add a thermal treatment device.

Vegetation Choice

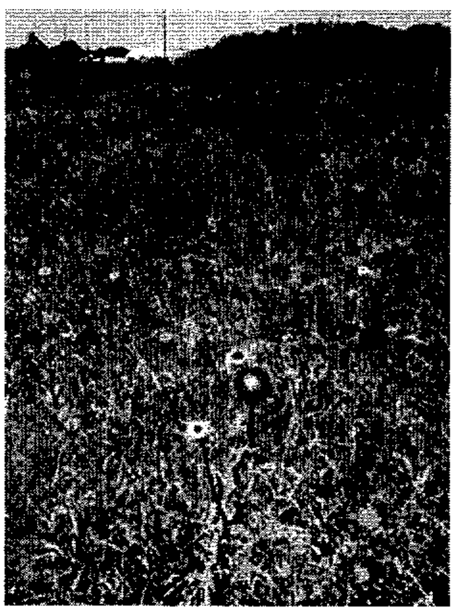
The vegetation selected for containment remedies generally will help reduce erosion and water penetration and enhance evapotranspiration. Vegetative support layers usually are organic silty loam topsoil, and vegetation generally has shallow roots and may be selected based on a low possibility of bioaccumulation. At the DuPage County Landfill site, the Forest Preserve District conducted an Arboreal Study to determine if the trees and brush were detrimental to the cap. Although some trees were eliminated to allow for the footprint of the planned site cap, every effort was made to remove as few trees as possible. At the Army Creek landfill site, EPA consulted with ecologists to identify specific grains, wildflowers, and vegetation that would attract migratory birds. The selected seed mixture provided the land coverage and erosion control needed to maintain the integrity of the cap, while providing food and habitat to a variety of plant and animal species. A similar revegetation strategy was used at the Delaware Sand and Gravel site for those portions of the property that were unusable for redevelopment because of slope or other terrain-related factors. One significant change in the seed mix used to revegetate the Delaware Sand and Gravel site was the absence of red clover seed, as previous experience at the Army Creek site indicated that this plant attracted unwanted burrowing animals.

Institutional Controls

Remedies that involve on-site containment of waste often incorporate institutional controls to prevent an unanticipated change in land use that could result in unacceptable exposures to contamination, or at a minimum, alert future users to the residual risks and monitor for any changes in use. Examples of institutional controls include land use regulations imposed by local governments, property law devices such as easements and covenants that restrict future land or resource use, and informational devices such as deed notices that inform prospective purchasers of residual on-site contamination. For example, a local ordinance might prohibit the use of contaminated groundwater or require periodic maintenance of a parking lot or other engineered barrier.

Jack Nicklaus testing out a sand trap at the Old Works Golf Course developed over a 120-acre capped area at the Anaconda Superfund Site. The 14,000 cubic yards of black sand in the course sand traps is finely ground inert smelting slag.

Institutional controls play a key role in ensuring long-term protectiveness, and should be evaluated and implemented with the same degree of care as is given to other elements of a remedy. In developing remedial alternatives that include institutional controls, EPA determines the type of institutional control to be used, the existence of the authority to implement the institutional control, and the appropriate entity's resolve and ability to implement the institutional control. An alternative may anticipate two or more options for establishing institutional controls, but should fully evaluate all such options. Because of their importance in restricting future land uses, it is best to identify the need for institutional controls as early in the remedy selection process as possible to identify implementation and long-term enforcement issues. It also is vital that stakeholders be informed whenever institutional controls are added or modified so that future development can accommodate existing or altered land-use restrictions.



Native grasses and flowers at the restored Army Creek Landfill Site.

EPA personnel working at the Old Works/East Anaconda site crafted a creative solution for ensuring compliance with institutional controls while allowing for continued redevelopment at the site. Citizens, the PRP, and local, state, and federal government officials formed the Old Works/East Anaconda Development Area (OW/EADA) to promote redevelopment of a 1,300 acre area of the site. The Anaconda-Deer Lodge County Comprehensive Master Plan was then prepared to provide guidance for accommodating future development and its possible effects on the environment and surrounding land uses. The Master Plan incorporates a Development Permit System (DPS), which regulates proposed development activity or land use located anywhere on the site, such as drilling wells, excavation, or new construction, irrespective of land ownership, to ensure it is consistent with environmental and safety guidelines. Other institutional controls such as land use and groundwater restrictions, private land ownership controls, dedicated developments, covenants, and easements, will be implemented to complement the DPS and ensure overall compliance with the Master Plan.

The DuPage Landfill site has institutional controls in place that prohibit construction of buildings on the site; however, language does provide the flexibility to petition for non-invasive improvements. For example, the Forest Preserve District successfully petitioned to put a temporary building at the top of the hill during the winter months for the purpose of renting toboggans.

Operation and Maintenance

Operation and Maintenance (O&M) activities protect the integrity of the selected remedy for a site. O&M measures are initiated after the remedy has achieved the action objectives and goals outlined in the Record of Decision (ROD), and after the remedy is determined to be operational and functional (O&F) based on State and Federal agreement. Typically, remedies are considered O&F either one year after construction is complete or when the remedy is functioning properly and performing as designed—whichever is earlier. Remedies requiring O&M measures include landfill caps, gas collection systems, groundwater extraction/treatment systems, groundwater monitoring, and/or surface water treatment. Once the O&M period begins, the State or PRP is responsible for maintaining the protectiveness of the remedy in perpetuity. O&M monitoring typically includes four components: inspection; sampling and analysis; routine maintenance; and reporting. Although O&M activities may be transferred through a rental or purchase agreement to a new owner, the State or PRP is still ultimately responsible for the protectiveness of O&M activities. However, the costs for O&M activities can often be offset through reuse or redevelopment at a site.

For example, the softball fields and recreational sports complex created as part of the redevelopment of the Chisman Creek Superfund site are operated by York County. The O&M activities at the site, such as mowing the grass, preventing cap deterioration, and routine repairs, are now handled by the County as part of their normal park operations. This has, in effect, eliminated the costs for O&M at the site. Another example is the result of the redevelopment that took place at the Army Creek Landfill site. EPA determined that converting the site into a wildlife enhancement area would provide a much needed protective habitat for various birds and wildlife. Various grains, wildflowers and custom vegetation were planted on the site cap to encourage migratory birds to stop and feed on the land. Bird boxes also were installed along the riparian wetlands of Army Creek to encourage nesting. The site is mowed once a year before the nesting season to provide food and shelter for migratory birds. Additionally, the site is mowed on alternating years in vertical or horizontal grids that leave straight stands of protective, vegetative cover for terrestrial animals. Gooseberry was planted around the gas vents to provide a food source for animals as well as visual cover of the vent pipes. Cap integrity is maintained through removal of deep-rooting, woody plants from the capped area and a humane trapping and relocation of woodchucks that may burrow into the cap. O&M at this site also includes activities to minimize invasion of non-native reeds into the wetlands area. Revegetation of the site and reconstruction of the wetlands was completed at no additional cost to the Agency, has not significantly increased operation activities at the site, and has decreased some maintenance activities, such as mowing the site, to once per year.

REUSE CONSIDERATIONS

The following sections summarize select EPA guidance and tools for stakeholders interested in reusing a site at which containment is part of the remedy. These sections include discussions on early involvement of stakeholders, confirmation of reuse viability, and use of redevelopment tools that are available in the event that reuse is desired.

Solicit Input from Stakeholders

The actual reuse of a site is driven by many factors, including the local business climate, real estate and land prices, and natural site features. However, the most important aspect when determining the reasonably anticipated future land reuse is the early involvement of all interested parties. Throughout the cleanup process, from site discovery to construction completion, EPA encourages open dialogue with the community to determine the reasonably anticipated future land reuse. Reuse can create many benefits that productively impact local communities, including new jobs, higher property values, and better quality of life through the preservation of open space and recreational areas. If all stakeholders, including the community, state, and, if applicable, PRPs, should reach an agreement on what they believe reuse may be as early as possible in the RI/FS process if a containment remedy is being considered for the site, EPA can be reasonably confident about the future use. For municipal landfill sites, the presumptive remedy allows for an up-front assumption regarding the appropriate remedial alternatives in the RI/FS process (i.e., scoping).

Fact sheets, notices in local newspapers and/or public meetings are appropriate notification tools for beginning the dialogue concerning reasonably anticipated future uses of the site. In addition, a letter, phone call or other appropriate communication to the local land use planning authority associated with the site may be made prior to such notifications. More focused communications, such as letters or fact sheets may be mailed or hand delivered to adjacent property owners, especially when a residential neighborhood is situated in close proximity to the site. This is especially important because in some instances the local residents near the Superfund site may feel disenfranchised from the local land use planning and development process. Also, if the site is located in a community that is likely to have environmental justice concerns, extra efforts may be made to reach out to and confer with segments of the community that are not necessarily reached by conventional communication vehicles or through local officials and planning commissions.

A critical component of the notification and discussion process is a clear explanation of the limits of reasonably anticipated future land uses. For example, reuse of municipal landfills as residential developments is discouraged. In addition, site managers should begin a dialogue with PRPs so that they continue the process if they assume responsibility for the RI/FS and future site remediation activities. Through early and open dialogue with stakeholders, EPA believes that realistic land-use scenarios can be developed that will facilitate the RI/FS, and expedite the cleanup and ultimately the redevelopment of the site.

Confirm Reuse Viability during RI/FS Process

Once the reasonably anticipated future land use(s) of a site is identified, it is important to confirm the viability of planned uses by analyzing data collected during the RI/FS, such as the nature and extent of contamination, containment alternatives, site topography, and other factors presented previously. Any combination of unrestricted uses, restricted uses, or use for long-term waste management may result, but it is important to confirm that the reuse options desired by the community are viable given the characteristics of the site. By maintaining an active role in site planning, EPA can attempt to accommodate site reuse, where possible, ensure that reuse options are consistent with the presumptive remedy or other containment design, and verify that any institutional controls ensure protection of human health and the environment and enforce limitations on reuse.

Redevelopment Tools

Once community outreach has been initiated and EPA has gathered information on possible reuse options, the Agency can attempt to ensure that the remedy is protective for the reasonably anticipated reuse. EPA has worked with States and localities to develop and issue guidance that will clarify the liability of prospective purchasers, lenders, property owners, and others regarding their association with activities at a site. These guidance documents state EPA's decision to use its enforcement discretion not to pursue such parties in specific situations. EPA anticipates that these clear statements will alleviate concerns these parties may have, and will facilitate their involvement in cleanup and redevelopment. Three guidance documents of particular interest are described in greater detail below.

Prospective Purchaser Agreements

The prospective purchaser agreement (PPA) is a tool that EPA may use to facilitate cleanup and redevelopment of contaminated property, with over 90 PPAs signed through the end of fiscal year (FY) 1998. Through PPAs, EPA provides parties interested in acquiring contaminated property with CERCLA covenants not to sue for cleanup of preexisting environmental conditions. PPAs also shield purchasers from contribution claims by liable parties who may seek to recover some of their cleanup expenses from purchasers. PPAs may relieve the liability concerns of prospective purchasers, and, therefore, facilitate the cleanup and reuse of contaminated properties.

In 1995, EPA issued guidance expanding the circumstances under which the Agency will provide covenants not to sue to prospective purchasers of contaminated properties. The *Guidance on Agreements with Prospective Purchasers of Contaminated Property* gives the Agency greater flexibility to enter into agreements under which EPA agrees not to sue the purchaser for contamination that existed at the time of the purchase. Included in the guidance is a model PPA to streamline and facilitate negotiations with prospective purchasers.

PPAs ensure continued protection of the site after it is passed along to a purchaser. Through PPAs, a prospective purchaser must commit that the continued operation of the facility or redevelopment will not aggravate or contribute to the existing contamination or interfere with EPA's response action. The prospective purchaser also must agree that the future use of the property will not pose health risks to the community and those persons likely to be present at the site. Under the appropriate sections of the settlement document, EPA can include provisions to ensure that the remedy design specifications are not violated; that long-term O&M activities at the site are attended to; and that there is compliance with institutional controls. EPA and developers have entered into PPAs at the Anaconda Smelter, Mid-Atlantic Wood Preservers, Raymark, and Industri-Plex sites.

Partial Deletion from the National Priorities List (NPL)

Where there is substantial agreement among local residents, land use planning agencies, owners, and developers, EPA can be reasonably confident about the future use of the site. In such cases, site managers may consider the feasibility of deleting a parcel of land from the NPL. Site size and the extent of contamination are factors to consider in a decision to partially delete. If the site can realistically accommodate the entire remedial footprint, an appropriate buffer zone and the planned reuse option, then partial deletion of the site may be possible. EPA has used its partial deletion authority at 14 sites through the end of FY98.

The National Contingency Plan (NCP) establishes the criteria that EPA uses to delete sites from the National Priorities List. In accordance with 40 CFR § 300.425(e), sites may be deleted from the NPL where no further response is appropriate to protect public health or the environment. In making such a determination, EPA considers, in consultation with the State, whether any of the following criteria have been met:

- Section 300.425(e)(1)(I). Responsible parties or other persons have implemented all appropriate response actions required;

- Section 300.425(e)(1)(ii). All appropriate Fund-financed response under CERCLA has been implemented, and no further response action by responsible parties is appropriate; and

- Section 300.425(e)(1)(iii). The remedial investigation has shown that the release poses no significant threat to public health or the environment and, therefore, taking of remedial measures is not appropriate.

Partial deletion of an NPL site is initiated when EPA prepares and publishes relevant documents, which are made available in the Deletion Docket at an official information repository. The State, with respect to the NPL site and applicable operable units, is asked to concur on EPA's final determination regarding the partial deletion. Concurrent with a Notice of Intent in the *Federal Register,* a notice is published in a newspaper of record and is distributed to appropriate Federal, Tribal, State, and local government officials, and other interested parties. These notices announce a thirty (30) day public comment period on the deletion package, which commences on the date of publication of the notice in the Federal Register and the newspaper of record. If, after review of all public comments, EPA determines that the partial deletion from the NPL is appropriate, EPA will publish a final notice of partial deletion in the *Federal Register*. Site managers should explicitly state from the initiation of this scenario that EPA cannot participate in any activities associated with the deleted portion of the site.

Comfort/Status Letters

In order to minimize stakeholder liability concerns associated with a potentially reusable site, Regional staff may issue a comfort letter. These letters provide potential buyers with as much information as possible from which to draw their own conclusions of the potential risk of Superfund liability. Three types of letters can be issued to parties who purchase, develop or operate a restored property:

- *No Current Federal Superfund Interest Letter* - a letter sent at a site that EPA deleted from the NPL or that EPA no longer includes on its list of potential Superfund sites;

- *Federal Interest Letter* - a letter indicating the status of EPA's involvement, where EPA anticipates or has already begun a response at the site; and

- *State Action Letter* - a letter stating that the corresponding state has assumed response action at the site.

By establishing early contact with potential stakeholders, defining realistic beneficial reuse options, and using the full range of redevelopment tools, site managers may be able to accommodate reasonably anticipated land uses at municipal landfills and other sites using containment remedies.

Limits to Betterment Activities

At sites with reuse potential, stakeholders may propose an action that is beyond the authority of the Agency. EPA may modify a remedial action if EPA finds that the proposed change or expansion is necessary and appropriate to the EPA-selected remedial action. In this case, any additional costs would be paid as part of the remedial action. If EPA finds that the proposed change or expansion is not necessary to the selected remedial action, but would not conflict or be inconsistent with the EPA-selected remedy, EPA may agree to integrate the proposed change or expansion into the planned CERCLA remedial work if:

- The state, PRP, or developer agrees to fund the entire additional cost associated with the change or expansion; and

- The state, PRP, or developer agrees to assume the lead for supervising that component of the remedy, or if EPA determines that component cannot be conducted as a separate phase or activity, for supervising the remedial design and construction of the entire remedy.

- If a state does not concur in a remedial action selected by EPA, and the state desires to have the remedial action conform to an ARAR that has been waived under § 300.430(f)(1)(ii)(C), a state may seek to have that remedial action so conform in accordance with the procedures set out in CERCLA section 121(f)(2).

The Raymark site is an example of a remedy that included an enhancement. EPA worked closely with the developer to incorporate redevelopment plans into the containment strategy for the site. The developer requested that a series of soil stabilization techniques be used, including the installation of steel pilings below the cap to support the planned retail shopping complex. EPA signed a PPA with the developer that ensured that the company paid for the installation of the steel pilings and other enhancements.

CONCLUSIONS

The Superfund Redevelopment Initiative, which is aimed at choosing cleanups consistent with reasonably anticipated reuse where possible, is a program that can yield positive economic, environmental, and social benefits for communities with Superfund sites. The keys to a successful reuse effort are: remedies that are protective for reasonably anticipated future land uses, institutional controls that impose necessary reuse limitations, early and active participation from all stakeholders, and appropriate enforcement tools for redevelopment.

The essential step to success is to incorporate the plan to reuse the site with the plan to clean up the site. With the municipal landfill presumptive remedy, it may be possible to accommodate ecological, recreational, or commercial/industrial reuses in the cleanup plan. Whatever the intended future use of the site, all landfill remedies must first be designed to protect the integrity of the cap. EPA must maintain an active role in reuse planning to ensure that reasonably anticipated future reuse options are consistent with the presumptive remedy or other containment design, and that institutional controls and O&M activities are managed properly. Additional keys to success require the early and active participation of all stakeholders, including EPA, the appropriate state and local authorities, any PRPs, and the site neighbors and surrounding community. EPA can help facilitate the reuse of a site, but cannot accomplish this goal on its own. Therefore, it is imperative that site managers take the appropriate steps to involve these stakeholders as early as possible in the process. Early discussions with stakeholders will help ensure that the interests of all involved and affected parties are properly represented. Also, if the need arises based on these discussions, it may be appropriate for EPA to use legal tools like PPAs and model comfort letters to clarify potential issues of liability. By following these steps, EPA believes that realistic land-use scenarios may be accommodated in cleanup and redevelopment of sites, where possible.

FOR FURTHER INFORMATION

- Presumptive Remedy for CERCLA Municipal Landfill Sites. September 1993. 14 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/F-93/035, OSWER-9355.0-49FS, PB93-963339. Washington, DC. Quick Reference Fact Sheet.

- Presumptive Remedies: CERCLA Landfill Caps RI/FS Data Collection Guide. 1995. 8 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/F-95/009, OSWER-9355.3-18FS, PB95-963412.

- Presumptive Remedies and NCP Compliance. June 14, 1995. 12 pp. (EPA) U.S. Environmental Protection Agency, CERCLA Administrative Records Workgroup ORC Region IV, Solid Waste and Emergency Response Division. Washington, DC.

- Rules of Thumb for Superfund Remedy Selection. 1997. 23 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-97/013, OSWER 9355.0-69, PB97-963301. Washington, DC.

- Land Use in the CERCLA Remedy Selection Process. 1995. 13 pp. (EPA) U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-95/052, OSWER 9355.7-04, PB95-963234/HDM. Directive. Washington, DC.

- Procedures for Partial Deletions at NPL Sites. 1996. 9 pp. (EPA) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-96/014, OERR Directive 9320.2-11, PB96-963222. Washington, DC.

- Guidance on Settlements with Prospective Purchasers of Contaminated Property. 1995. 24 pp. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. PB96-105044. Washington, DC.

- Policy on the Issuance of Comfort/Status Letters. PB97-123921. November, 1997.

- Handbook of Tools for Managing Federal Superfund Liability Risks at Brownfields and Other Sites, November 1998, EPA330-B-98-001, Office of Enforcement and Compliance Assurance.

landfills is frequently used for residential purposes. Therefore, based on site-specific circumstances, it may be appropriate to consider future residential use for ground water and other exposure pathways when assessing risk from areas of **contaminant migration.**

4. Developing the Response Action

As a first step in developing containment alternatives, response action objectives should be developed on the basis of the pathways identified for action in the conceptual site model. Typically, the primary response action objectives for municipal landfill sites include:

Presumptive Remedy

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

Non-Presumptive Remedy

- Remediating ground water;
- Remediating contaminated surface water and sediments; and
- Remediating contaminated wetland areas.

As discussed in Section 3, "Defining Risks," the containment presumptive remedy accomplishes all but the last three of these objectives by addressing all pathways associated with the source. Therefore, the focus of the RI/FS can be shifted to characterizing the media addressed in the last three objectives (contaminated ground water, surface water and sediments, and wetland areas) and on collecting data to support design of the containment remedy.

Treatment of Hot Spots

The decision to characterize and/or treat hot spots is a site-specific judgement that should be based on the consideration of a standard set of factors. Highlight 4 lists questions that should be answered before making the decision to characterize and/or treat hot spots. The overriding question is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place. This question should be answered on the basis of what is known about a site (e.g., from operating records or other reliable information). An answer in the affirmative to all of the questions listed in Highlight 4 would indicate that it is likely that the integrity of the containment system would be threatened, or that excavation and treatment of hot spots would be practicable, and that a significant reduction in risk at the site would occur as a result of treating hot spots. EPA expects that few CERCLA municipal landfills will fall into this category; rather, based on the Agency's experience, the majority of sites are expected to be suitable for containment only, based on the heterogeneity of the waste, the lack of reliable information concerning disposal history, and the problems associated with excavating through refuse.

The volume of industrial and/or hazardous waste co-disposed with municipal waste at CERCLA municipal landfills varies from site to site, as does the amount of information available concerning disposal history. It is impossible to fully characterize, excavate, and/or treat the source area of municipal landfills, so uncertainty about the landfill contents is expected. Uncertainty by itself does not call into question the containment approach. However, containment remedies must be designed to take into account the possibility that hot spots are present in addition to those that have been identified and characterized. The presumptive remedy must be relied upon to contain landfill contents and prevent migration of comtaminants. This is accomplished by a combination of measures, such as a landfill cap combined with a leachate collection system. Monitoring will further ensure the continued effectiveness of the remedy.

The following examples illustrate site-specific decision making and show how these factors affect the decision whether to characterize and/or treat hot spots.

Examples of Site-Specific Decision Making Concerning Hot Spot Characterization/ Treatment

Site A

There is anecdotal information that approximately 200 drums of hazardous waste were disposed of at this 70-acre former municipal landfill, but their location and contents are unknown. The remedy includes a landfill cap and ground-water and landfill gas treatment.

A search for and characterization of hot spots is not supported at Site A based on the questions listed in

(8) The lead agency shall notify the support agency of the alternatives that will be evaluated in detail to facilitate the identification of ARARs and, as appropriate, pertinent advisories, criteria, or guidance to be considered.

(9) *Detailed analysis of alternatives.* (i) A detailed analysis shall be conducted on the limited number of alternatives that represent viable approaches to remedial action after evaluation in the screening stage. The lead and support agencies must identify their ARARs related to specific actions in a timely manner and no later than the early stages of the comparative analysis. The lead and support agencies may also, as appropriate, identify other pertinent advisories, criteria, or guidance in a timely manner.

(ii) The detailed analysis consists of an assessment of individual alternatives against each of nine evaluation criteria and a comparative analysis that focuses upon the relative performance of each alternative against those criteria.

(iii) *Nine criteria for evaluation.* The analysis of alternatives under review shall reflect the scope and complexity of site problems and alternatives being evaluated and consider the relative significance of the factors within each criteria. The nine evaluation criteria are as follows:

(A) *Overall protection of human health and the environment.* Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

(B) *Compliance with ARARs.* The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws or provide grounds for invoking one of the waivers under paragraph (f)(1)(ii)(C) of this section.

(C) *Long-term effectiveness and permanence.* Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:

(*1*) Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

(*2*) Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.

(D) *Reduction of toxicity, mobility, or volume through treatment.* The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

(*1*) The treatment or recycling processes the alternatives employ and materials they will treat;

(*2*) The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;

(*3*) The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;

(*4*) The degree to which the treatment is irreversible;

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EPA

Superfund Accelerated Cleanup Bulletin

Presumptive Remedies for Municipal Landfill Sites

Superfund Revitalization Activity
Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Intermittent Bulletin
Volume 1 Number 1

The Presumptive Remedy Selection Initiative

Since Superfund's inception in 1980, the removal and remedial programs have found that certain categories of sites have similar characteristics, such as the types of contaminants present, past industrial use, or the environmental media that are affected. Based on a wealth of information acquired from evaluating and cleaning up these sites, Superfund is undertaking an initiative to develop **presumptive remedies** that are appropriate for specific types of sites, contaminants, or both. This initiative is part of a larger program, known as the **Superfund Accelerated Cleanup Model (SACM)**, which is designed to speed all aspects of the Superfund clean-up process.

The objective of the presumptive remedies initiative is to use clean-up techniques shown to be effective in the past at similar sites in the future. The use of presumptive remedies will streamline removal actions, site studies, and clean-up actions, thereby improving consistency, reducing costs, and increasing the speed with which hazardous waste sites are remediated

The Municipal Landfill Pilot Project

Superfund kicked off a new pilot project designed to expedite the site investigation and remedy selection process for municipal landfills with a visit to Region V on March 18-20, 1992. Superfund anticipates that remedy selection may be streamlined for municipal landfills because they typically share similar characteristics and because containment and ground water cleanup frequently is the appropriate remedy for these sites.

An existing EPA manual, *Conducting Remedial Investigations/ Feasibility Studies for* CERCLA *Municipal Landfill Sites*, outlines streamlining techniques for municipal landfills. The goal of the initiative is to aid the Regions in implementing the manual, so that site characterization, the baseline risk assessment, and the number of alternatives considered will be streamlined at every municipal landfill site.

Albion Sheridan Township landfill, a municipal landfill in Michigan, was the first site to participate in the pilot Project. A team of Remedial Project Managers (RPMs) from several Regions and experts on landfill construction met with the site RPM in Grand Rapids, Michigan to develop the site strategy. As a result of the meeting, site characterization will be conducted in a phased approach, with criteria established for when additional sampling will occur. Streamlining of the baseline risk assessment will depend upon data obtained in the first phase of sampling.

Four other Superfund municipal landfill sites have been identified as candidates for participation in the project: Lexington County Landfill, Lexington County, South Carolina (Region IV); BFI/ Rockingham, Rockingham, Vermont (Region I); Sparta Landfill, Sparta Township, Michigan (Region V); and Beulah Landfill, Pensacola, Florida (Region IV). The review team anticipates meeting with the RPMs for these sites during April, May, and June 1992.

RPMs who participate in the project and implement the municipal landfill manual at their sites will become members of the team and will be available to assist other RPMs in developing streamlined RI/FSs. These RPMs will be a resource for their Regions, providing assistance in streamlining remedy selection at all future municipal landfill sites.

Questions should be addressed to Andrea McLaughlin at FTS 678-8365.

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Publication 9203.1-021 February 1993

EPA

Superfund Accelerated Cleanup Bulletin

Presumptive Remedies for Municipal Landfill Sites

Office of Emergency and Remedial Response
Office of Waste Programs Enforcement

Intermittent Bulletin
Volume 2 Number 1

The Presumptive Remedy Selection Initiative

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Purpose

The Superfund Municipal Landfill Expert Team has completed four site visits under the Municipal Landfill Pilot Project.[1] The pilot project implements a 1991 streamlining manual, "Conducting Remedial Investigations /Feasibility Studies for CERCLA Municipal Landfill Sites" (hereafter referred to as "the manual"). This bulletin presents key findings from the pilots completed to date, particularly with respect to the level of detail that was appropriate for establishing risk, and therefore a basis for remedial action, at two of the sites.

Background

The preamble to the National Contingency Plan (NCP) identifies municipal landfills as a type of site where treatment of the waste may be impracticable due to the size and heterogeneity of the contents. Because of this, containment will often be the appropriate response action for the source area of municipal landfill sites. Such containment remedies are likely to include a landfill cap; ground-water treatment or control; leachate collection and treatment; and landfill gas collection and treatment, as appropriate.

The municipal landfill manual states that baseline risk assessments at municipal landfill sites may be streamlined or limited in order to initiate early remedial action on the most obvious landfill problems (e.g., ground water/ leachate, landfill contents, and landfill gas). One method for establishing risk using a streamlined approach is to compare contaminant concentration levels (if available) to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. The manual states that where established standards for one or more contaminants in a given medium are clearly exceeded, remedial action is generally warranted.[2] The manual further states that ultimately it is necessary to demonstrate that the final remedy addresses all pathways and contaminants of concern, not just those that triggered the remedial action.

Pilot Project Findings

The experience of the expert team supports the usefulness of a limited risk assessment to initiate early action at two of the pilot sites. Specifically, for the source area of these two sites (i.e., the discrete landfill area), a quantitative risk assessment that considered all chemicals, their potential additive effects, etc., was not necessary,

[1] See "Superfund Accelerated Cleanup Bulletin, Presumptive Remedies for Municipal Landfill Sites," Publication 9203.1-02I, Volume 1, Number 1, April 1992.

[2] See also OSWER Directive 9355.0-30, "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [remedial] action generally is warranted.

either to establish a basis for action or to establish clean-up levels. For these two sites, the justification for early remedial action was based on existing ground-water data. Ground-water data are not available for the other two sites.

Sites with Ground-water Data

For the source areas of the two sites with existing ground-water data, the basis for action was ground-water contamination at levels exceeding non-zero MCLGs or MCLs; therefore, a complete quantitative risk assessment was not necessary to establish risk (and therefore a basis for action) at these sites. Furthermore, a quantitative risk assessment was not needed to evaluate whether the containment remedy addressed all pathways and contaminants of concern associated with the source. Rather, all potential migration pathways were identified (using the conceptual site model) and compared to those addressed by the containment remedy as follows:

- direct contact threat and surface water run-off addressed by capping;
- exposure to contaminated ground water (including any contaminated ground water moving off-site) addressed by ground-water treatment/control (including assessment of current exposure); and
- exposure to landfill gas addressed by gas collection and treatment, as appropriate.

This comparison revealed that the containment remedy addressed all pathways associated with the sources at these sites.

Finally, a quantitative risk assessment was not required to determine clean-up levels for the source areas, since the type of cap will be determined by closure ARARs and ground-water clean-up levels may be based on MCLs, non-zero MCLGs, or more-stringent, promulgated, state levels.

NOTE: In some cases, a risk assessment may be required to determine the risk associated with contaminants in landfill gas. Landfill gas collection will frequently be a necessary component of the remedy to insure cap integrity. There may be an additional need for treatment of the collected gas based upon the contaminants present. In some cases, state ARARs may identify clean-up levels for such contaminants, and in some cases health-based levels will be appropriate. This issue will be addressed in further detail in future guidance.

Sites with No Existing Ground-water Data

Ground-water data are not yet available for two of the pilot sites; for these sites, the following tiered approach was recommended. Once ground-water data are obtained, a clear basis for action may be established, and the remedy selection may be streamlined as described for the two sites with available ground-water data. If contaminants are not identified above MCLs or non-zero MCLGs however, additional pathways, such as surface contamination and landfill gas, will be characterized next, and a focused quantitative risk assessment conducted to establish basis for remedial action.

Areas of Contaminant Migration

One of the expert team's key findings is that almost every municipal landfill site has some unique characteristic that may require additional study. Unique characteristics encountered during the pilot visits include leachate discharge to a wetland at one site and significant surface water run-off due to drainage problems at another. These pathways will require characterization and conventional risk assessment to determine whether remedial action is warranted beyond the source area, and if so, the type of action that is appropriate.

Pilot Study Findings and Conclusions

The expert team's conclusions from the four pilots, then, are that:

(1) a quantative risk assessment was not warranted for the source areas of the two pilot sites where ground-water data were available and contamiants exceeded chemical-specific standards; justification for action was the exceedance of the standards;

Further, streamlining the risk assessment eliminated the need for sampling and analysis of these source areas to support the calculation of current or future risk;

(2) a focused risk assessment generally will be necessary for areas other than the landfill source itself (such as areas where contaminants have migrated from the source) to determine the need for additional remedial action beyond areas normally addressed by the cap; and

(3) a focused risk assessment generally will be necessary to determine the need for remedial action at sites where ground-water concentrations do not exceed MCLs or non-zero MCLGs unless other conditions provide a clear justification (e.g. unstable slopes).

These conclusions are directly applicable to the four pilot sites only; however, based on these findings, the municipal landfill expert team is developing an Agency directive that will provide additional guidance on conducting baseline risk assessments at municipal landfill sites. For additional information on the directive or the municipal landfill pilot project, please call Andrea McLaughlin at 703-603-8793.

Technical Memorandum:
Evaluation of Potential “Hot Spot” Occurrences and Removal
For Radiologically Impacted Soil
West Lake Landfill OU-1

INTRODUCTION

The West Lake Landfill Superfund Site consists of two Operable Units (OUs). OU-1 includes two areas, Areas 1 and 2, where radiologically impacted soil was mixed with municipal solid waste and construction debris. A Remedial Investigation report was previously completed for OU-1 (EMSI, 2000). A draft Feasibility Study (FS) for OU-1 was developed to identify and evaluate potential remedial alternatives for the radiological impacted soils present in Areas 1 and 2 of the West Lake Landfill (EMSI, 2000).

During the development of remedial alternatives in the FS, the Respondents considered the potential presence of “hot spots” and evaluated the potential need for consideration of hot spot removal as part of the remedial alternative evaluation for OU-1. For CERCLA municipal landfills such as the West Lake Landfill, EPA guidance indicates that “hot spots consist of highly toxic and/or highly mobile material and present a potential principal threat to human health and the environment.” (EPA, 1993). EPA guidance further states that “Hot spots at CERCLA municipal landfills typically consist of liquids, buried drums or other highly mobile and toxic wastes that are present in a discreet area or portion of the landfill.” As discussed further below, the FS concluded that there are no “hot spots” in the West Lake Landfill, and that implementation of hot spot removal as part of the remedial actions that may be undertaken for OU-1 is not warranted based on EPA guidance. Moreover, it is not practical and could potentially result in unacceptable risks to remediation workers. The additional risks involved in a hot spot removal significantly exceed the risks of leaving the waste in place as proposed in the FS.

The EPA Remedial Project Manager (RPM) requested at a June 14, 2000 meeting that the OU-1 Respondents prepare a separate technical memorandum addressing the evaluation of potential hot spots and possible removal of such hot spots. Specifically, at the June 14, 2000 meeting among EPA, a representative of the Missouri Department of Natural Resources (MDNR) and the Respondents, the EPA RPM requested the Respondents to submit a technical memorandum to evaluate potential “hot spot” removal of radiologically impacted soil present in Areas 1 and 2 of OU – 1. This memorandum responds to that request. A quantitative evaluation of the costs and risks associated with hot spot removal, however, requires that the Respondents proceed on the basis of an assumed volume of hot spot material. Because there are no “hot spots” at the West Lake Landfill, no basis exists to make such an assumption. Therefore, any such assumption would be arbitrary and the estimated costs would not be meaningful. Accordingly, the analysis that follows is primarily a qualitative analysis.

In evaluating the applicability of hot spot removal for OU-1, this memorandum summarizes the applicability to OU-1 of the use of the presumptive remedy of containment for municipal landfill sites; provides a discussion from EPA guidance regarding how "hot spots" should be addressed; includes a quantitative discussion of potential risks to workers and the public associated with excavation of filled material and removal of radionuclides within Areas 1 and 2 that are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris and other, non-impacted soil materials; and concludes that hot spot removal for OU-1 at the West Lake Landfill is not appropriate based on EPA guidance documents.

APPLICATION OF THE PRESUMPTIVE REMEDY TO OU-1 AT THE WEST LAKE LANDFILL

Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable (USEPA, 1990). The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment is usually impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites (USEPA, 1993).

Based upon EPA experiences at numerous CERCLA municipal landfill sites and as a result of the initiatives undertaken as part of the Superfund Accelerated Cleanup Model, EPA has initiated use of and developed presumptive remedies for specific types of sites, contaminants, or both, including CERCLA municipal landfill sites. Based upon its experience, EPA has identified the following components for consideration in applying the presumptive remedy approach for source area containment at CERCLA municipal landfills:

- Landfill cap;
- Source area ground-water control to contain plume;
- Leachate collection and treatment;
- Landfill gas collection and treatment, and/or
- Institutional controls to supplement engineering controls.

EPA's Remedial Project Manager (RPM) has previously indicated that the presumptive remedy for CERCLA municipal landfills should be considered in the development and evaluation of potential remedial alternatives for the West Lake Landfill. Occurrences of radionuclides within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris and other, non-impacted soil materials. Consequently, excavation of the radiologically impacted materials for possible ex situ treatment techniques or possible offsite disposal is impracticable.

Of the source containment options identified by EPA as part of the presumptive remedy approach, the landfill cap and institutional control actions are considered applicable to Areas 1 and 2. As there is no plume of groundwater contamination associated with Areas 1 and 2, source area ground-water control is not applicable to Areas 1 and 2. With the possible exception of the intermittent and highly localized seep in the southwestern portion of Area 2, no leachate discharge has been identified from Areas 1 and 2. Based on the results of the radon monitoring conducted during the RI, collection or control of radon gas is not considered necessary.

The West Lake Landfill site had been used for waste disposal and other industrial activities for approximately 50 years and will remain a waste disposal site forever regardless of any remedial actions that may be taken with respect to OU-1. As discussed in the FS, existing institutional controls will continue to be used to control current and future use of the entire West Lake Landfill and Areas 1 and 2 in particular. Institutional controls along with the existing landfill fencing are used to control and restrict access to Areas 1 and 2. The existing institutional controls consist of a deed restriction recorded in June 1997 against the entire landfill prohibiting residential use and groundwater use. An additional deed restriction was recorded in January 1998 restricting construction of buildings and underground utilities and pipes within Areas 1 and 2. These deed restrictions cannot be terminated without the written approval of the current owners, EPA, and MDNR. Also, as part of all alternatives in the FS except the No Action alternative, additional institutional controls in the form of additional deed restrictions would be implemented to prevent or control potential future uses of Areas 1 and 2 not currently expressly restricted. For example, construction of office buildings or other commercial or industrial structures could be performed in areas adjacent to Areas 1 and 2 in the future. As part of this type of development, there may be an expectation of using Areas 1 and 2 for ancillary uses such as landscaping, parking lots, or open storage. An additional deed restriction would be implemented to prevent use of Areas 1 and 2 for parking lots, employee recreation, open storage or other similar uses that may be ancillary to future commercial/industrial development of the landfill areas outside of Areas 1 and 2.

In addition, irrespective of the radiologically impacted soil present in Areas 1 and 2 of OU – 1, the entire West Lake Landfill Superfund Site is a landfill and will remain a landfill. The Missouri Solid Waste Rules (10 CSR 80) require owners of solid waste disposal areas, as part of closure of the solid waste disposal area to "Submit evidence to the department that a notice and covenant running with the land has been recorded with the recorder of deeds in the county where the sanitary landfill is located. The notice and covenant shall specify ….. that the use of the land in any manner which interferes with closure plans, and post-closure plans filed with the department, is prohibited."

EPA GUIDANCE ON "HOT SPOTS" RELATIVE TO RADIOLOGICALLY IMPACTED SOIL AT THE WEST LAKE LANDFILL

EPA's guidance for presumptive remedies at CERCLA municipal landfill sites also describes issues to be addressed related to the characterization and possible treatment of "hot spots". Hot spots consist of highly toxic and/or highly mobile material and present a potential principal threat to human health or the environment (EPA, 1993). EPA guidance (EPA, 1993) states that "The overriding question is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place." Neither the physical nor chemical characteristics of the radiologically impacted materials in OU-1 will affect the integrity of a containment system (landfill cover). Consequently, the answer to the overriding question in determining whether hot spot removal is appropriate is that the integrity of the containment remedy presumed by EPA for CERCLA municipal landfill sites would not be threatened if the radiologically impacted soil is left in place. Hot spot removal is not considered appropriate for OU-1.

Excavation or treatment of hot spots is generally practicable where the waste type or mixture of wastes is in a discrete, accessible location of a landfill. EPA guidance provides that a hot spot should be large enough that its remediation would significantly reduce the risk posed by the overall site, but small enough that it is reasonable to consider removal or treatment.

EPA guidance identifies four questions to be addressed to determine whether characterization and/or treatment of hot spots are warranted. All four of these questions must be answered in the affirmative to support a decision to characterize and treat hot spots. These four questions are as follows:

- Does evidence exist to indicate the presence and approximate location of waste?
- Is the hot spot known to be principal threat waste?
- Is the waste in a discrete accessible part of the landfill?
- Is the hot spot known to be large enough that its remediation will reduce the threat posed by the overall site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

As to the first question, reliable historic information regarding the location of the radionuclide materials does not exist. Surveys and sampling conducted as part of the RI have identified the general locations of the occurrences of the radiologically impacted materials within Areas 1 and 2. Results of the RI investigations indicate that the radiologically impacted soil material is dispersed both laterally and vertically throughout the overall, heterogeneous matrix of municipal refuse, construction and demolition debris, and unimpacted soil cover material. Therefore, the exact location, boundaries and extent of the radiologically impacted materials cannot be precisely located and can only be approximately estimated. The answer to the first question is no.

Principal threat wastes addressed by the presumptive remedy guidance for which hot spot remediation is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile material. As defined in A Guide to Principal Threat and Low Level Threat Wastes (USEPA, 1991), principal threat wastes are "those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur." "Source material" is defined in the principal threat guidance as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, to air, or act as a source for direct exposure. The guidance also states that no threshold level of toxicity/risk has been established to equate to a "principal threat", but that where toxicity and mobility of source material combine to pose a potential risk of 1×10^{-3} or greater, generally treatment alternatives should be considered.

Radiologically impacted materials at the West Lake Landfill occur in soil material, not liquids. The radionuclides are not present in a discrete area, unit, or zone of the landfill. Specifically the radiologically impacted soils are interspersed within the overall landfill matrix at depths ranging from the ground surface to over 20 feet below ground surface, making retrieval of the impacted materials impracticable. Similarly, the types of radionuclides, and the presence of the radionuclides in soil material, result in the radionuclide occurrences at the West Lake Landfill being generally immobile. Therefore, in accordance with the guidance, the radiologically impacted materials are not considered a source material or principal threat waste. The answer to the second question is no.

As the radionuclides are not located in a discrete area, the answer to the third question is no and hot spot removal is not appropriate. This conclusion is further supported by answering the "overriding question" of "whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place." (EPA, 1993) As discussed in the OU-1 Feasibility Study (EMSI, 2000), no significant risk to human health or the environment would occur if a containment remedy were implemented at the Site. There is no indication of widespread or even significant groundwater contamination from the radionuclides at the site and evaluations conducted as part of the RI report indicate that potential future migration is limited and should not significantly affect the underlying or downgradient groundwater quality. The only significant exposure pathways identified by the Baseline Risk Assessment (BRA) entailed gamma radiation from or direct contact with radiologically impacted soil. Both of these exposure pathways could be addressed through installation of a containment (landfill cover) system, supplemented with institutional controls. Radiologically impacted soil at the West Lake Site can easily and effectively be isolated through installation of a cover system. Neither the physical nor chemical characteristics of the radiologically impacted materials will affect the integrity of the landfill cover. Consequently, the answer to the overriding question in determining whether hot spot removal is appropriate is that the integrity of the containment remedy presumed by EPA for CERCLA municipal landfill sites would not be threatened if the radiologically impacted soil is left in place, and hot spot removal is not appropriate.

As to the fourth question, removal of the radionuclides would require excavation of approximately 130,000 cubic yards of refuse containing radiologically impacted soil plus an additional approximately 120,000 cubic yards of refuse present as overburden that is not expected to contain radiologically impacted soil. This combined volume of over approximately 250,000 cubic yards is substantially greater than the volume of 100,000 cubic yards or less that is considered by the guidance to be reasonable for removal. Therefore, excavation and offsite disposal of refuse containing radiologically impacted soil is not reasonable and not warranted.

As stated above, EPA guidance identifies four questions to be addressed to determine whether characterization and/or treatment of hot spots are warranted and all four of these questions must be answered in the affirmative to support a decision to characterize and treat hot spots. None of the four questions can be answered in the affirmative. Therefore, hot spot removal is not appropriate and not warranted. This conclusion is consistent with the evaluation of the overriding question of whether hot spot removal is necessary to protect the integrity of the containment remedy presumed by EPA for CERCLA municipal landfill sites.

THEORETICAL LIMITATIONS TO REMOVAL AND OFFSITE DISPOSAL OF RADIOLOGICALLY IMPACTED SOIL

As previously discussed, the radiologically impacted materials are present in soil material contained within the overall matrix of municipal refuse, construction and demolition debris and unimpacted soil, making retrieval of the impacted materials impracticable. Despite the conclusion that hot spot removal is not necessary, and to address EPA's request that hot spot removal scenarios be discussed, the following paragraphs present theoretical limitations to removal and off-site disposal of radiologically impacted soils. Excavation and offsite disposal of radiologically impacted soil would require either:

1. Excavation, loading, offsite transport via truck, offloading and transfer to railcars, and subsequent transport to an out-of-state facility for disposal of large volumes of municipal solid waste and debris that contains both radiologically impacted and non-impacted soil; or alternatively

2. Excavation of the solid waste and soil followed by screening or other physical separation of the radiologically impacted soil from the solid waste followed by loading, offsite transport via truck, off-loading and transfer to railcars, and

subsequent transport to an out-of-state facility for disposal of the soil fraction along with re-disposal onsite of the excavated refuse and debris.

If the first option were to be selected, a large volume, greater than the 100,000 cubic yard upper limit suggested in EPA's CERCLA Municipal Landfill guidance document as reasonable to consider for removal, would need to be excavated and sent for offsite disposal. This transportation would likely involve highway trucks travelling approximately 20 miles one-way or more on local roads and highways involving approximately 5,000 to 10,000 truck trips. The material would subsequently be transferred from the trucks to railcars at a truck/rail car transfer facility that would need to be built in the St. Louis area, and subsequent rail transport to an out-of-state disposal facility located in Utah, Texas, Washington or elsewhere. The rail distance to the Utah facility would be approximately 1,600 miles.

Under the second option, the radiologically impacted soil fraction would, to the maximum extent possible, initially be separated from the excavated refuse to reduce the total volume of material to be disposed offsite. Separation of the soil from the refuse and debris would be performed using a grizzly and/or vibrating screen. The act of screening would result in mixing of the more highly impacted soil with less impacted and unimpacted soil. After screening, the impacted soil would be loaded into trucks for transport to the rail transfer facility and subsequent rail transport to an out-of-state disposal facility as described above.

Removal of the highest levels of radionuclide occurrences from Area 2 would not eliminate the need for or reduce the scope of potential containment measures. It is unrealistic to assume that all of the radiologically impacted soil could be removed as portions of this soil occur at depths of 10 to 20 feet below ground surface. Consequently, there would still exist a need for implementation of a containment system. Furthermore, even if excavation of the refuse, debris and soil with attendant offsite disposal of impacted soil and refuse were to occur, it would not alleviate the need for installation of a cover system, as the site would still remain a municipal solid waste landfill. After completion of the excavation activities, the excavations would have to be filled and/or graded out, the surface of the landfill would have to be graded and contoured and a new cover system would have to be installed. Consequently, excavation of the radiologically impacted soil does not eliminate the need for or reduce the scope of installation of a new landfill cover system.

In contrast, containment measures, such as capping, can effectively address both the potential areas of higher levels of radionuclides as well as the overall extent of radionuclides in Areas 1 and 2 and the adjacent solid wastes.

POTENTIAL RISKS ASSOCIATED WITH REMOVAL OF RADIONUCLIDES

Excavation and offsite disposal of radiologically impacted soil pose potential risks to both remediation workers and other onsite workers as well as to the public at large.

Screening of the refuse to separate out the soil material would be a difficult, time- and labor-consuming and potentially hazardous activity. Screening of refuse material would necessitate use of personnel to remove plastic, wood and other material that would otherwise clog or foul the screens. In addition to the physical hazards associated with such activities (i.e., slip, trip and fall, crushing or laceration from contact with moving machinery, etc.) such workers would also be exposed to elevated levels of gamma radiation for which practical, effective protection could not be readily and/or effectively implemented.

Regardless of which two options for removal and offsite disposal of radiologically impacted soil might be considered, extensive amounts of earth and waste moving activity would be required with the attendant potential for accidents between equipment and/or between equipment and workers. Transport of wastes by such a large number of truck and railcar trips poses real and potentially severe potential for additional accidents or possibly deaths. Moving any material across the country increases the amount of traffic on public roads and railways.

It is estimated that approximately 130,000 cubic yards of material would have to be removed from the site if off-site disposal is implemented. Assuming 20 cubic yards per truckload, moving this volume of material would require approximately 6,500 trips by heavy trucks on public roads. If the distance to the railhead were 20 miles, then the total round trip distance by the hauling fleet on public roads would be about 260,000 miles. Data collected between 1988 and 1997 by the National Highway Traffic Safety Administration demonstrates that, on average, for every 1,168,310 miles a heavy truck travels on public roads, there is a chance of an accident involving injury or death (NHTSA, 1998). This implies that the risk of an injury or fatality from hauling materials to a railhead from the site is about 2×10^{-1}.

Using the same volume assumptions discussed above, it would require about 1,300 gondola railcar loads of material, or approximately 13 100-car trainloads. If the round trip rail distance to a disposal facility is about 3,200 miles, the total rail distance for off-site disposal is about 42,000 miles. Data collected by the Federal Railroad Administration shows that between 1994 and 1998, for every 42,720 miles traveled by rail, an accident involving an injury or death occurred (USDOT), 1999). This implies that the risk of injury or death for the rail transport portion of the alternative is approximately 1.0.

The combined transportation risk for this alternative is on the order of 1.0, indicating that there is a real risk of injuring or killing someone every time off-site disposal is selected as an option. This combined transportation risk is in contrast with the current no-action risk from the Baseline Risk Assessment (Auxier, 2000) of 4×10^{-5} to the groundskeeper. Future risks to a hypothetical storage yard worker, assuming no engineered controls were placed on the site were calculated to be 4×10^{-4}. Thus, the combined transportation risk of disposing the material offsite is between 2,500 and 25,000 times greater than the calculated risk associated with leaving the material in place under a no-action scenario. Implementation of a capping alternative would reduce the onsite risk and therefore further increase the difference in risks associated with offsite disposal compared to an onsite remedy.

Furthermore, due to the nature of the loading and transfer activities, it is expected that the truck and train transport would occur using covered loads; however, in the event of an accident, a real possibility exists that soil and refuse material could be exposed or possibly spilled on the roadways or rail lines.

The West Lake Landfill, as with all municipal landfills, also contains methane gas. Consequently, excavation of refuse at the landfill poses a potential risk for explosion hazard and creation of a landfill fire. In addition to potential physical and radiological hazards posed by excavation, regardless of the approach selected, removal of the impacted soil would require excavation of large volumes of the landfill and handling of large volumes of partially decomposed refuse with the attendant odor emissions. Although there are techniques that can be considered to reduce odor emissions, it unrealistic to assume that all of the odors that would emanate from decades-old refuse could be controlled. Consequently, it is highly likely that odor emissions would affect nearby properties and be a source of nuisance, discomfort and possibly even illness to adjacent receptors.

CONCLUSION

The overriding question posed by EPA guidance regarding potential hot spot removal is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place. Neither the physical nor chemical characteristics of the radiologically impacted materials will affect the integrity of the landfill cover. Consequently, the answer to the overriding question in determining whether hot spot removal is appropriate is that the integrity of the containment remedy presumed by EPA for CERCLA municipal landfill sites would not be threatened if the radiologically impacted soil is left in place, and hot spot removal is not appropriate.

Further characterization, evaluation, and excavation/offsite disposal of potential "hot spots" within Areas 1 and 2 is not warranted. The radiologically impacted materials in Areas 1 and 2 are dispersed throughout the soil material contained within the overall matrix of municipal refuse, construction and demolition debris and unimpacted soil, cannot be classified as a "hot spot" as defined in EPA guidance, and are not known to be a principal threat waste as defined by EPA. The chemical and physical characteristics of the impacted material will not adversely affect the cap called for by the presumptive remedy. Furthermore, based on the evaluation of the four factors identified by EPA, implementation of "hot spot" removal as part of the remedial actions that may be undertaken for OU-1 at the West Lake Landfill is not considered practical. In addition, as discussed above, excavation and subsequent screening of the refuse containing the soils with the elevated levels of radionuclides could potentially:

1. Expose remediation workers to physical hazards, gamma exposure and other unacceptable risks which, in the case of gamma exposure, could not easily or possibly effectively be mitigated with standard protective equipment;

2. Expose remediation workers, other onsite employees, offsite workers, and possible other nearby receptors to nuisance or noxious odor emissions; and

3. Expose remediation workers, onsite employees and the public to increased risks associated with potential accidents and possible spills associated with transportation by truck and rail of the excavated material to a distant offsite facility.

Consequently, excavation and offsite disposal of "hot spot" material is not considered practical, effective, beneficial or safe for Operable Unit 1 at the West Lake Landfill. Furthermore, excavation and offsite disposal of the radiologically impacted soil is inconsistent with EPA's established approach for CERCLA Municipal Landfill Sites, published EPA guidance and the National Contingency Plan.

REFERENCES

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U.S. Department of Transportation, 1999, Federal Railroad Administration, Railroad Safety Statistics Annual Report 1998, Chapter 1, pp. 7-8, July.

ATTACHMENTS

Attachment A: Presumptive Remedy for CERCLA Municipal Landfill Sites, EPA 540-F-93-035, OERR Directive No. 9355.0-49FS, September 1993.

Attachment B: A Guide to Principal Threat and Low Level Threat Wastes, Office of Emergency and Remedial Response, Superfund Publication 9380.3-06FS, November, 1991.

Attachment A:
Presumptive Remedy for CERCLA Municipal Landfill Sites

United States Environmental Protection Agency
Office of Solid Waste and Emergency Response
Directive No. 9355.0-49FS
EPA 540-F-93-035
PB 93-963339
September 1993

EPA

Presumptive Remedy for CERCLA Municipal Landfill Sites

Office of Emergency and Remedial Response
Hazardous Site Control Division 5203G

Quick Reference Fact Sheet

Since Superfund's inception in 1980, the remedial and removal programs have found that certain categories of sites have similar characteristics, such as types of contaminants present, types of disposal practices, or how environmental media are affected. Based on information acquired from evaluating and cleaning up these sites, the Superfund program is undertaking an initiative to develop presumptive remedies to accelerate future cleanups at these types of sites. The presumptive remedy approach is one tool of acceleration within the **Superfund Accelerated Cleanup Model (SACM).**

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program's past experience to streamline site investigation and speed up selection of cleanup actions. Over time presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

This directive establishes **containment** as the presumptive remedy for CERCLA municipal landfills. The framework for the presumptive remedy for these sites is presented in a streamlining manual entitled *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites,* February 1991 (OSWER Directive 9355. 3-11). This directive highlights and emphasizes the importance of certain streamlining principles related to the scoping (planning) stages of the remedial investigation/feasibility study (RI/FS) that were identified in the manual. The directive also provides clarification of and additional guidance in the following areas: (1) the level of detail appropriate for risk assessment of source areas at municipal landfills and (2) the characterization of hot spots.

BACKGROUND

Superfund has conducted pilot projects at four municipal landfill sites[1] on the National Priorities List (NPL) to evaluate the effectiveness of the manual *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (hereafter referred to as "the manual") as a streamlining tool and as the framework for the municipal landfill presumptive remedy. Consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (or NCP), EPA's expectation was that containment technologies generally would be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable. The results of the pilots support this expectation and demonstrate that the manual is an effective tool for streamlining the RI/FS process for municipal landfills.

Since the manual's development, the expectation to contain wastes at municipal landfills has evolved into a presumptive remedy for these sites.[2] Implementation of the streamlining principles outlined in the manual at the four pilot sites helped to highlight issues requiring further clarification, such as the degree to which risk assessments can be streamlined for source areas and the characterization and remediation of hot spots. The pilots also demonstrated the value of focusing streamlining efforts at the scoping stage, recognizing that the biggest savings in time and money can be realized if streamlining is incorporated at the beginning of the RI/FS process. Accordingly, this directive addresses those issues identified during the pilots and highlights streamlining opportunities to be considered during the scoping component of the RI/FS.

[1] Municipal landfill sites typically contain a combination of principally municipal and to a lesser extent hazardous wastes.

[2] See EPA Publication 9203.1-021, SACM Bulletins, *Presumptive Remedies for Municipal Landfill Sites,* April 1992, Vol. 1, No. 1, and February 1993, Vol. 2, No. 1, and SACM Bulletin *Presumptive Remedies,* August 1992, Vol. 1, No. 3.

Finally, while the primary focus of the municipal landfill manual is on streamlining the RI/FS, Superfund's goal under SACM is to accelerate the entire cleanup process. Other guidance issued under the municipal landfill presumptive remedy initiative identifies design data that may be collected during the RI/FS to streamline the overall response process for these sites (see Publication No. 9355.3-18FS, *Presumptive Remedies: CERCLA Landfill Caps Data Collection Guide*, to be published in October 1993).

CONTAINMENT AS A PRESUMPTIVE REMEDY

Section 300.430(a)(iii)(B) of the NCP contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment usually is impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy," for the source areas of municipal landfill sites.

The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected ground water at the perimeter of the landfill, and/or upgradient ground-water that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy.

The presumptive remedy does not address exposure pathways outside the source area (landfill), nor does it include the long-term ground-water response action. Additional RI/FS activities, including a risk assessment, will need to be performed, as appropriate, to address those exposure pathways outside the source area. It is expected that RI/FS activities addressing exposure pathways outside the source generally will be conducted concurrently with the streamlined RI/FS for the landfill source presumptive remedy. A response action for exposure pathways outside the source (if any) may be selected together with the presumptive remedy (thereby developing a comprehensive site response) or as an operable unit separate from the presumptive remedy.

Highlight 1 identifies the components of the presumptive remedy. Response actions selected for individual sites will include only those components that are necessary, based on site-specific conditions.

> **Highlight 1: Components of the Presumptive Remedy: Source Containment**
>
> - Landfill cap;
> - Source area ground-water control to contain plume;
> - Leachate collection and treatment;
> - Landfill gas collection and treatment; and/or
> - Institutional controls to supplement engineering controls.

The EPA (or State) site manager will make the initial decision of whether a particular municipal landfill site is suitable for the presumptive remedy or whether a more comprehensive RI/FS is required. Generally, this determination will depend on whether the site is suitable for a streamlined risk evaluation, as described on page 4. The community, state, and potentially responsible parties (PRPs) should be notified that a presumptive remedy is being considered for the site before work on the RI/FS work plan is initiated. The notification may take the form of a fact sheet, a notice in a local newspaper, and/or a public meeting.

Use of the presumptive remedy eliminates the need for the initial identification and screening of alternatives during the feasibility study (FS). Section 300.430(e)(1) of the NCP states that, "... the lead agency shall include an alternatives screening step, when needed, (emphasis added) to select a reasonable number of alternatives for detailed analysis."

EPA conducted an analysis of potentially available technologies for municipal landfills and found that certain technologies are routinely and appropriately screened out on the basis of effectiveness, feasibility, or cost (NCP Section 300.430(e)(7)). (See Appendix A to this directive and "Feasibility Study Analysis for CERCLA Municipal Landfills," September 1993 available at EPA Headquarters and Regional Offices.) Based on this analysis, the universe of alternatives that will be analyzed in detail may be limited to the components of the containment remedy identified in Highlight 1, unless site-specific conditions dictate otherwise or alternatives are considered that were not addressed in the FS analysis. The FS analysis document, together with this directive, must be included in the administrative record for each municipal landfill presumptive remedy site to support elimination of the initial identification and screening of site-specific alternatives. Further detailed and comprehensive supporting materials (e.g., FS reports included in analysis, technical reports) can be provided by Headquarters, as needed.

While the universe of alternatives to address the landfill source will be limited to those component identified in Highlight 1, potential alternatives that may exist for each component or combinations of components may be evaluated in the detailed analysis. For example, one component of the presumptive remedy is source area ground-water control. If appropriate, this component may be accomplished in a number of ways, including pump and treat, slurry walls, etc. These potential alternatives may then be combined with other component of the presumptive remedy to develop a range of containment alternatives suitable for site-specific conditions. Response alternatives must then be evaluated in detail against the nine criteria identified in Section 300.430(e)(g) of the NCP. The detailed analysis will identify site-specific ARARs and develop costs on the basis of the particular size and volume of the landfill.

EARLY ACTION AT MUNICIPAL LANDFILLS

EPA has identifies the presumptive remedy site categories as good candidates for early action under SACM. At municipal landfills, the upfront knowledge that the source area will be contained may facilitate such early actions as installation of a landfill cap or a ground-water containment system. Depending on the circumstances, early actions may be accomplished using either removal authority (e.g., non-time-critical removal actions) or remedial authority. In some cases, it may be appropriate for an Engineering Evaluation/Cost Analysis to replace part or all of the RI/FS if the source control component will be a non-time-critical removal action. Some factors may affect whether a specific response action would be better accomplished as a removal or remedial action including the size of the action, the associated state cost share, and/or the scope of O&M. A discussion of these factors is contained in *Early Action and Long-term Action Under SACM- Interim Guidance* Publication No. 9203.1-051, December 1992.

SCOPING A STREAMLINED RI/FS UNDER THE PRESUMPTIVE REMEDY FRAMEWORK

The goal of an RI/FS is to provide the information necessary to: (1) adequately characterize the site; (2) define site dynamics; (3) define risks; and (4) develop the response action. As discussed in the following sections, the process for achieving each of these goals can be streamlined for CERCLA municipal landfill sites because of the upfront presumption that landfill contents will be contained. The strategy for streamlining each of these areas should be developed early (i.e., during the scoping phase of the RI/FS).

1. Characterizing the Site

The use of existing data is especially important in conducting a streamlined RI/FS for municipal landfills. Characterization of a landfill's contents is not necessary or appropriate for selecting a response action for these sites except in limited cases; rather, existing data are used to determine whether the containment presumption is appropriate. Subsequent sampling efforts should focus on characterizing areas where contaminant migration is suspected, such as leachate discharge areas or areas where surface water runoff has caused erosion. It is important to note that the decision to characterize hot spots should also be based on existing information, such as reliable anecdotal information, documentation, and/or physical evidence (see page 6).

In those limited cases where no information is available for a site, it may not be advisable to initiate use of the presumptive remedy until some data are collected. For example, if there is extensive migration of contaminants from a site located in an area with several sources, it will be necessary to have some information about the landfill source in order to make an association between on-site and off-site contamination.

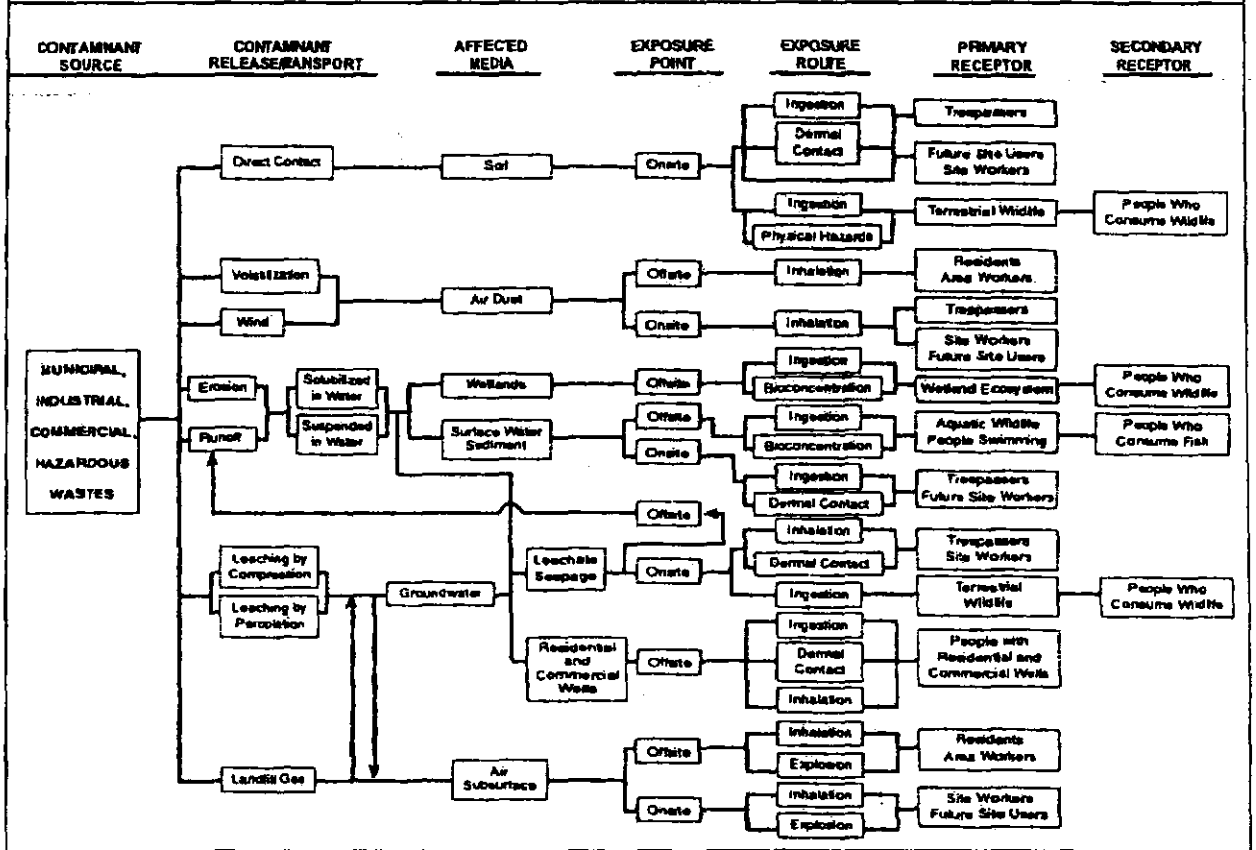
Sources of information of particular interest during scoping include records of previous ownership, state files, closure plans, etc., which may help to determine types and sources of hazardous materials present. In addition, a site visit is appropriate for several reasons, including the verification of existing data, the identification of existing site remedation systems, and to visually characterize wastes (e.g., leachate seeps). Specific information to be collected is provided in Sections 2.1 through 2.4 of the municipal landfill manual.

2. Defining Site Dynamics

The collected data are used to develop a conceptual site model, which is the key component of a streamlined RI/FS. The conceptual site model is an effective tool for defining the site dynamics, streamlining the risk evaluation, and developing the response action. Highlight 2 presents a generic conceptual site model for municipal landfill. The model is developed before any RI field activities are conducted, and its purpose is to aid in understanding and describing the site and to present hypotheses regarding:

- The suspected sources and types of contaminants present;
- Contaminant release and transport mechanisms;

Highlight 2: Generic Conceptual Site Model



- Rate of contaminant release and transport (where possible);
- Affected media;
- Known and potential routes of migration; and
- Known and potential human and environmental receptors.

After the data are evaluated and a site visit is completed, the contaminant release and transport mechanisms relevant to the site should be determined. The key element in developing the conceptual site model is to identify those aspects of the model that require more information to make a decision about response measures. Because containment of the landfill's contents is the presumed response action, the conceptual site model will be of most use in identifying areas beyond the landfill source itself that will require further study, thereby focusing site characterization away from the source area and on areas of potential contaminant migration (e.g., ground water or contaminated sediments).

3. Defining Risks

The municipal landfill manual states that a streamlined or limited baseline risk assessment will be sufficient to initiate response action on the most obvious problems at a municipal landfill (e.g., ground water, leachate, landfill contents, and landfill gas). One method for establishing risk using a streamlined approach is to compare contaminant concentration levels (if available) to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. The manual states that where established standards for one or more contaminants in a given medium are clearly exceeded, remedial action generally is warranted[3]

It is important to note, however, that based on site-specific conditions, an active response is not required if ground-water contaminant concentrations exceed chemical-specific standards but the site risk is within the Agency's acceptable risk range (10^{-4} to 10^{-6}). For example, if it is determined that the release of

[3]See also OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, April 22, 1991, which states that if MCLs or non-zero MCLGs are exceeded, [a response] action generally is warranted.

contaminants from a particular landfill is declining, and concentrations of one or more ground-water contaminants are at or barely exceed chemical-specific standards, the Agency may decide not to implement an active response. Such a decision might be based on the understanding that the landfill is no longer acting as a source of ground-water contamination, and that the landfill does not present an unacceptable risk from any other exposure pathway.

A site generally will not be eligible for a streamlined risk evaluation if ground-water contaminant concentrations do not clearly exceed chemical-specific standards or the Agency's accepted level of risk, or other conditions do not exist that provide a clear justification for action (e.g., direct contact with landfill contents resulting from unstable slopes). Under these circumstances, a quantitative risk assessment that addresses all exposure pathways will be necessary to determine whether action is needed.

Ultimately, it is necessary to demonstrate that the final remedy addresses all pathways and contaminants of concern, not just those that triggered the remedial action. As described in the following sections, the conceptual site model is an effective tool for identifying those pathways and illustrating that they have been addressed by the containment remedy.

Streamlined Risk Evaluation Of The Landfill Source

Experience from the presumptive remedy pilots supports the usefulness of a streamlined risk evaluation to initiate an early response action under certain circumstances. As a matter of policy, for the source area of municipal landfills, a quantitative risk assessment that considers all chemicals, their potential additive effects, etc., is not necessary to establish a basis for action if ground-water data are available to demonstrate that contaminants clearly exceed established standards or if other conditions exist that provide a clear justification for action.

A quantitative risk assessment also is not necessary to evaluate whether the containment remedy addresses all pathways and contaminants of concern associated with the source. Rather, all potential exposure pathways can be identified using the conceptual site model and compared to the pathways addressed by the containment presumptive remedy. Highlight 3 illustrates that the containment remedy addresses all exposure pathways associated with the source at municipal landfill sites.

Finally, a quantitative risk assessment is not required to determine clean-up levels because the type of cap will be determined by closure ARARs, and ground water that is extracted as a component of the presumptive remedy will be required to meet discharge limits, or other standards for its disposal. Calculation of cleanup levels for ground-water contamination that has migrated away from the source will not be accomplished under the presumptive remedy, since such contamination will require a conventional investigation and a risk assessment.

Highlight 3: Source Contaminant Exposure Pathways Addressed by Presumptive Remedy

1. Direct contact with soil and/or debris prevented by landfill cap;
2. Exposure to contaminated ground water within the landfill area prevented by ground-water control;
3. Exposure to contaminated leachate prevented by leachate collection and treatment; and
4. Exposure to landfill gas addressed by gas collection and treatment, as appropriate.

Streamlining the risk assessment of the source area eliminates the need for sampling and analysis to support the calculation of current or potential future risk associated with direct contact. It is important to note that because the continued effectiveness of the containment remedy depends on the integrity of the containment system, it is likely that institutional controls will be necessary to restrict future activities at a CERCLA municipal landfill after construction of the cap and associated systems. EPA has thus determined that it is not appropriate or necessary to estimate the risk associated with future residential use of the landfill source, as such use would be incompatible with the need to maintain the integrity of the containment system. (Long-term waste management areas, such as municipal landfills, may be appropriate, however, for recreational or other limited uses on a site-specific basis.) The availability and efficacy of institutional controls should be evaluated in the FS. Decision documents should include measures such as institutional controls to ensure the continued integrity of such containment systems whenever possible.

Areas of Contaminant Migration

Almost every municipal landfill site has some characteristic that may require additional study, such as leachate discharge to a wetland or significant surface water run-off caused by drainage problems. These migration pathways, as well as ground-water contamination that has migrated away from the source, generally will require characterization and a more comprehensive risk assessment to determine whether action is warranted beyond the source area and, if so, the type of action that is appropriate.

While future residential use of the landfill source area itself is not considered appropriate, the land adjacent to landfills is frequently used for residential purposes. Therefore, based on site-specific circumstances, it may be appropriate to consider future residential use for ground water and other exposure pathways when assessing risk from areas of contaminant migration.

4. Developing the Response Action

As a first step in developing containment alternatives, response action objectives should be developed on the basis of the pathways identified for action in the conceptual site model. Typically, the primary response action objectives for municipal landfill sites include:

Presumptive Remedy

- Preventing direct contact with landfill contents;
- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

Non-Presumptive Remedy

- Remediating ground water;
- Remediating contaminated surface water and sediments; and
- Remediating contaminated wetland areas.

As discussed in Section 3, "Defining Risks," the containment presumptive remedy accomplishes all but the last three of these objectives by addressing all pathways associated with the source. Therefore, the focus of the RI/FS can be shifted to characterizing the media addressed in the last three objectives (contaminated ground water, surface water and sediments, and wetland areas) and on collecting data to support design of the containment remedy.

Treatment of Hot Spots

The decision to characterize and/or treat hot spots is a site-specific judgement that should be based on the consideration of a standard set of factors. Highlight 4 lists questions that should be answered before making the decision to characterize and/or treat hot spots. The overriding question is whether the combination of the waste's physical and chemical characteristics and volume is such that the integrity of the new containment system will be threatened if the waste is left in place. This question should be answered on the basis of what is known about a site (e.g., from operating records or other reliable information). An answer in the affirmative to all of the questions listed in Highlight 4 would indicate that it is likely that the integrity of the containment system would be threatened, or that excavation and treatment of hot spots would be practicable, and that a significant reduction in risk at the site would occur as a result of treating hot spots. EPA expects that few CERCLA municipal landfills will fall into this category; rather, based on the Agency's experience, the majority of sites are expected to be suitable for containment only, based on the heterogeneity of the waste, the lack of reliable information concerning disposal history, and the problems associated with excavating through refuse.

The volume of industrial and/or hazardous waste co-disposed with municipal waste at CERCLA municipal landfills varies from site to site, as does the amount of information available concerning disposal history. It is impossible to fully characterize, excavate, and/or treat the source area of municipal landfills, so uncertainty about the landfill contents is expected. Uncertainty by itself does not call into question the containment approach. However, containment remedies must be designed to take into account the possibility that hot spots are present in addition to those that have been identified and characterized. The presumptive remedy must be relied upon to contain landfill contents and prevent migration of contaminants. This is accomplished by a combination of measures, such as a landfill cap combined with a leachate collection system. Monitoring will further ensure the continued effectiveness of the remedy.

The following examples illustrate site-specific decision making and show how these factors affect the decision whether to characterize and/or treat hot spots.

Examples of Site-Specific Decision Making Concerning Hot Spot Characterization/ Treatment

Site A

There is anecdotal information that approximately 200 drums of hazardous waste were disposed of at this 70-acre former municipal landfill, but their location and contents are unknown. The remedy includes a landfill cap and ground-water and landfill gas treatment.

A search for and characterization of hot spots is not supported at Site A based on the questions listed in

Highlight 4: Characterization of Hot Spots

If all of the following questions can be answered in the affirmative, it is likely that characterization and/or treatment of hot spots is warranted:

1. Does evidence exist to indicate the presence and approximate location of waste?
2. Is the hot spot known to be principal threat waste?*
3. Is the waste in a discrete, accessible part of the landfill?
4. Is the hot spot known to be large enough that its remediation will reduce the threat posed by the overall site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

*See *A Guide to Principal Threat and Low Level Threat Wastes*, November 1991, Superfund Publication No. 9380.3-06FS.

Highlight 4: (1) no reliable information exists to indicate the location of the waste; (2) the determination of whether the waste is principal threat waste cannot be made since the physical/chemical characteristics of the wastes are unknown; (3) since the location of the waste is unknown, the determination of whether the waste is in a discrete accessible location cannot be made; (4) in this ease, the presence of 200 drums in a 70-acre landfill is not considered to significantly affect the threat posed by the overall site. Rather, the containment system will include measures to ensure its continued effectiveness (e.g., monitoring and/or leachate collection) given the uncertainty associated with the landfill contents and suspected drums.

Site B

Approximately 35,000 drums, many containing hazardous wastes, were disposed of in two drum disposal units at this privately owned 80-acre inactive landfill, which was licensed to receive general refuse. The site is divided into two operable units. The remedy for Operable Unit 1 (OU 1) is incineration of drummed wastes in the two drum disposal units. The remedy for OU 2 consists of treatment of contaminated ground water and leachate and containment of treatment residuals (from OU 1) and remaining landfill contents, including passive gas collection and flaring.

Treatment of landfill contents is supported at Site B because all of the questions in Highlight 4 can be answered in the affirmative: (1) existing evidence from previous investigations and sampling conducted by the state (prior to the RI) indicated the presence and approximate location of wastes; (2) the wastes were considered principal threat wastes because they were liquids and (based on sampling) were believed to contain contaminants of concern; (3) the waste is located in discrete accessible parts of the landfill; and (4) the waste volume is large enough that its remediaton will significantly reduce the threat posed by the overall site.

CLOSURE REQUIREMENTS

Subtitle D

In the absence of Federal Subtitle D closure regulations, State Subtitle D closure requirements generally have governed CERCLA response actions at municipal landfills as applicable or relevant and appropriate requirements (ARARs). New Federal Subtitle D closure and post-closure care regulations will be in effect on October 9, 1993 (56 FR 50978 and 40 CFR 258)[1] State closure requirements that are ARARs and that are more stringent than the Federal requirements must be attained or waived

The new Federal regulations contain requirements related to construction and maintenance of the final cover, and leachate collection, ground-water monitoring, and gas monitoring systems. The final cover regulations will be applicable requirements for landfills that received household waste after October 9, 1991. EPA expects that the final cover requirements will be applicable to few, if any, CERCLA municipal landfills, since the receipt of household wastes ceased at most CERCLA landfills before October 1991. Rather, the substantive requirements of the new Subtitle D regulations generally will be considered relevant and appropriate requirements for CERCLA response actions that occur after the effective date.

Subtitle C

RCRA Subtitle C closure requirements may be applicable or relevant and appropriate in certain circumstances. RCRA Subtitle C is applicable if the landfill received waste that is a listed or characteristic waste under RCRA, and:

1. The waste was disposed of after November 19, 1980 (effective date of RCRA), or

[1]An extension of the effective date has been proposed but not finalized at this time.

2. The new response action constitutes disposal under RCRA (i.e., disposal back into the original landfill).[3]

The decision about whether a Subtitle C closure requirement is relevant and appropriate is based on a variety of factors, including the nature of the waste and its hazardous properties, the date on which it was disposed, and the nature of the requirement itself. For more information on RCRA Subtitle C closure requirements, see *RCRA ARARs: Focus on Closure Requirements* Directive No. 9234.2-04FS, October 1989.

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[3]Note that disposal of only small quantity hazardous waste and household hazardous waste does not make Subtitle C applicable.

Notice:

The policies set out in this document are intended solely as guidance to the U.S. Environmental Protection Agency (EPA) personnel; they are not final EPA actions and do not constitute rulemaking. These policies are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances. EPA also reserves the right to change the guidance at any time without public notice.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES

This Appendix summaizes the analysis that EPA conducted of feasibilty study (FS) and Record of Decision (ROD) data from CERCLA municipal landfill sites which led to the establishment of containment as the presumptive remedy for these sites. The objectve of the study was to idenify those technologies that are consistently included in the remedies selected, those that are consistently screened out, and to identify the basis for their elimination Resuts of this analysis support the decision to eliminate the initial technology identification and screening steps on a site-specific basis for this site type. The technical review found that certain technologies are appropriately screened out based on effectiveness, implementability, or excessive costs.

The methodology for this analysis entailed reviewing the technology identification and screening components of the remedy selecton process for a representative sample of municipal landfill sites. The number of times each technology was either screened out or selected in each remedy was compiled. A detailed discussion of the methodology used is provided below.

METHODOLOGY

Identification of Sites for Feasibility Study Analysis

Of the 230 municipal landfill sites on the NPL, 149 sites have had a remedy selected for at least one operable unit Of the 149 sites, 30 were selected for this study on a random basis, or slightly greater than 20 percent The sites range in size from 8.5 acres to over 200 acres and are located primarily in Regions 1,2,3, and 5. This geographical distribution approximates the distribution of municipal landfils on the NPL.

Technology Secrming and Remedial Alternative Analysis

The FS analysis involved a review of the technology identification and screening phase, including any pre-screening steps, followed by a review of the detailed analysis and comparative analysis phases. Information derived from each review was documented on site-specific data collection forms, which are available for evaluation as part of the Administrative Record for this presumptive remedy directive. The review focused on the landfill source contamination only; ground-water technologies and alternatives were not included in the analysis.

For the screening phase, the full range of technologies considered was listed on the data collection forms, along with the key reasons given for eliminating technologies from further consideration. These reasons were categorized according to the screening criteria: cost, effectiveness, or implementability. The frequency with which specific reasons were given for eliminating a technology from further consideration was then tallied and compiled into a screening phase summary table.

For the detailed analysis and comparative analysis, information on the relative performance of each technology/alternative with respect to the seven NCP criteria was documented on the site-specific data collection forms. The advantages and disadvantages associated with each clean-up option were highlighted. In some cases, a technology was combined with one or more technologies into one or more alternatives. The disadvantages of a technology/alternative were then compiled into a detailed analysis/comparative analysis summary table, under the assumption that these disadvantages contributed to non-selection. All summary tables are available for review as part of the Administrative Record.

APPENDIX A
TECHNICAL BASIS FOR PRESUMPTIVE REMEDIES (continued)

RESULTS

The information from the technology screening and remedial alternative analyses is provided in Table 1. It demonstrates that containment (the presumptive remedy), was chosen as a component of the selected remedy at all thirty of the sites analyzed. No other technologies or treatments were consistently selected as a remedy or retained for consideration in a remedial alternative. However, at eight of the thirty sites, there were circumstances where technologies were included in the selected remedy to address a site-specific concern, such as principal threat wastes. These technologies are included in the column entitled "Tech. Not Primary Component of Alternative"[1] in Table 1 and include incineration at two sites, waste removal and off-site disposal at two sites, soil vapor extraction at two sites, and bioreclamation at one site.

Leachate collection and gas collection systems were also tracked as part of the detailed analysis and comparison of remedial alternatives. These types of systems generally were not considered as remediation technologies during the screening phases. At fifteen sites, leachate collection was selected as part of the overall containment remedy. At seventeen sites, gas collection systems were selected as part of the overall containment remedy.

This analysis supports the decision to eliminate the initial technology identification and screening step for municipal landfill sites. On a site-specific basis, consideration of remediation technologies may be retained as needed.

[1] This column title is used for record-keeping purposes only and is not meant to imply that these treatment technologies are not considered important components of the selected remedies.

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns [4]	Community Concerns [4]
Multi-layer Cap	28	25	3	0	2	2	0	18	7	1	0	0	1	3	5	3	---	---
Clay Cap	16	8	8	0	1	8	0	4	4	2	2	1	2	1	0	1	---	---
Asphalt Cap	17	0	17	0	2	14	5	0	0	0	0	0	0	0	0	0	---	---
Concrete Cap	17	0	17	0	3	14	5	0	0	0	0	0	0	0	0	0	---	---
Soil Cover	16	7	5	4	0	5	1	5	2	1	0	0	0	0	0	0	---	---
Synthetic Cap	13	3	10	0	0	10	1	2	1	1	1	1	1	1	1	1	---	---
Chemical Seal	5	0	5	0	0	4	0	0	0	0	0	0	0	0	0	0	---	---
Slurry Wall	22	5	14	3	2	8	6	2	3	3	2	2	1	2	0	2	---	---
Grout Curtain	18	0	18	0	3	15	9	0	0	0	0	0	0	0	0	0	---	---
Sheet Piling	17	1	16	0	0	13	5	0	1	0	0	0	0	0	0	0	---	---
Grout Injection	8	0	8	0	0	8	2	0	0	0	0	0	0	0	0	0	---	---
Block Displacement	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Bottom Sealing	5	0	5	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out [3]: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns [4]	Community Concerns [4]
Vibrating Beam	5	0	5	0	0	3	3	0	0	0	0	0	0	0	0	0	---	---
Liners	2	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	---	---
Offsite Nonhazardous Landfill	3	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	---	---
Offsite RCRA Landfill	17	0	13	4	8	3	12	0	0	0	0	0	0	0	0	0	---	---
Offsite Landfill (unspecified)	9	1	8	0	5	3	5	1	0	0	0	0	0	0	0	0	---	---
Onsite Nonhazardous Landfill	2	0	2	0	1	1	1	0	0	0	0	0	0	0	0	0	---	---
Onsite RCRA Landfill	14	1	11	2	3	2	10	0	1	0	0	0	0	0	0	1	---	---
Onsite Landfill (unspecified)	7	0	6	1	3	3	6	0	0	0	0	0	0	0	0	0	---	---
Bioremediation (unspecified)	13	0	13	0	0	13	1	0	0	0	0	0	0	0	0	0	---	---
Bioremediation Ex-situ	10	0	10	0	0	7	7	0	0	0	0	0	0	0	0	0	---	---
Bioremediation In-situ	15	1	14	0	1	13	7	1	0	0	0	0	0	0	0	0	---	---
Dechlorinization/ APEG	6	0	5	1	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Oxidation/ Reduction	12	0	12	0	1	8	5	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-Selection: Protect	ARARs	TMV Through Treatment	Long-term Effect	Short-term Effect	Cost	Implem.	State Concerns[4]	Community Concerns[4]
Neutralization	4	0	3	1	0	2	1	0	0	0	0	0	0	0	0	0	---	---
Thermal Destruction (unspecified)	6	0	6	0	0	3	4	0	0	0	0	0	0	0	0	0	---	---
Offsite Incineration (unspecified)	19	2	14	3	9	5	10	1	1	0	0	0	0	1	1	0	---	---
Onsite Incineration (unspecified)	12	0	8	3	5	5	6	0	1	0	0	0	0	1	1	1	---	---
Fluidized Bed	9	0	9	0	5	6	4	0	0	0	0	0	0	0	0	0	---	---
Infrared	8	0	7	1	6	3	3	0	0	0	0	0	0	0	0	0	---	---
Pyrolysis	5	2	3	1	2	2	1	0	1	0	1	0	0	1	1	1	---	---
Multiple Hearth	4	0	4	0	2	2	1	0	0	0	0	0	0	0	0	0	---	---
Rotary Kiln	10	0	9	1	6	5	4	0	0	0	0	0	0	0	0	0	---	---
Vitrification	21	0	21	0	8	15	11	0	0	0	0	0	0	0	0	0	---	---
Low Temperature Thermal Desorp/ Stripping	13	1	11	1	2	9	3	0	1	0	0	0	0	0	1	0	---	---
In-situ Steam Stripping	5	0	5	0	1	4	2	0	0	0	0	0	0	0	0	0	---	---
Soil Flushing	16	2	14	0	2	9	10	0	0	0	0	0	0	0	0	0	---	---

TABLE 1• SUMMARY OF SCREENING AND DETAILED ANALYSIS FOR LANDFILLS[1]

TECHNOLOGY[2]	# FSs Where Technology Considered	# FSs Tech. Passed Screening	# FSs Tech. Screened Out	Tech. Not Primary Component of Alternative	# FSs Where Criterion Contributed To Screening Out 3: Cost	Effectiveness	Implement	# RODs Tech. Selected	# RODs Tech. Not Selected	#RODs Where Criterion Contributed to Non-selection: Protect	ARARs	TMV Through Treatment	Long-term Effect.	Short-term Effect.	Cost	Implem.	State Concerns [4]	Community Concerns [4]
Soil Washing	12	2	9	1	1	8	6	0	0	0	0	0	0	0	0	0	---	---
Soil Vapor Extraction (SVE)	14	1	11	2	2	9	5	1	0	0	0	0	0	0	0	0	---	---
Fixation	7	1	5	1	0	4	2	2	0	0	0	0	0	0	0	0	---	---
Stabilization/ Solidification	20	0	19	2	1	13	6	0	0	0	0	0	0	0	0	0	---	---
Aeration	7	0	7	0	0	5	3	0	0	0	0	0	0	0	0	0	---	---

[1] The study was conducted on 30 RODs and their corresponding FSs.

[2] This does not include the no-action or institutional control only alternatives. No RODs selected either of these as remedies.

[3] FSs and RODs may contain more than one criterion for screening or non-selection of technology. Also, some FSs did not fully explain the criteria for screening out a technology. Thus, the totals for screening and non-selection criteria are not equal to the number of FSs and RODs considered.

[4] Information on State and community concerns was not included in this analysis because FSs do not contain this information and RODs generally only reference supporting documentation (i.e., State concurrence letter and responsiveness summary).

Attachment B:
A Guide to Principal Threat and Low Level Threat Wastes

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Superfund Publication: 9380.3-06FS November 1991

EPA

A Guide to Principal Threat and Low Level Threat Wastes

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Quick Reference Fact Sheet

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) promulgated on March 8, 1990 states that EPA expects to use "treatment to address the principal threats posed by a site, wherever practicable" and "engineering controls, such as containment, for waste that poses a relatively low long-term threat." (40 CFR Section 300.430(a)(1)(iii).) These expectations, derived from the mandates of CERCLA §121 and based on previous Superfund experience, were developed as guidelines to communicate the types of remedies that the EPA generally anticipates to find appropriate for specific types of wastes. Although remedy selection decisions are ultimately site-specific determinations based on an analysis of remedial alternatives using the nine evaluation criteria, these expectations help to streamline and focus the remedial investigation/feasibility study (RI/FS) on appropriate waste management options. **This guide explains considerations that should be taken into account in categorizing waste for which treatment or containment generally will be suitable and provides definitions, examples, and ROD documentation requirements related to waste that constitute a principal or low level threat.** EPA makes this categorization of waste as principal or low level threat waste after deciding whether to take remedial action at a site. The "Interim Final Guidance on Preparing Superfund Decision Documents." (EPA/624/1-87/90, October 1990) and "A Guide to Developing Superfund Records of Decision" (Publication 9335.3-02FS-1, May 1990) provide additional information on ROD documentation.

NCP Expectations

EPA established general expectations in the NCP (40 CFR 300.430(a)(1)(iii)) to inform the public of the types of remedies that EPA has found to be appropriate for certain types of waste in the past and anticipates selecting in the future. These expectations (see Highlight 1) provide a means of sharing collected experience to guide the development of cleanup options. They reflect EPA's belief that certain source materials are addressed best through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur. Conversely, these expectations also reflect the fact that other source materials can be safely contained and that treatment for all waste will not be appropriate or necessary to ensure protection of human health and the environment, nor cost effective.

Identifying Principal and Low Level Threat Wastes

The concept of principal threat waste and low level threat waste as developed by EPA in the NCP is to be applied on a site-specific basis when characterizing <u>source material</u>. "Source material" is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, to surface water, to air, or acts as a source for direct exposure.

HIGHLIGHT 1: NCP Expectations Involving Principal and Low Level Threat Wastes

EPA expects to:

1. Use treatment to address the principal threats posed by a site, wherever practicable.

2. Use engineering controls, such as containment, for wastes that pose a relatively low long-term threat or where treatment is impracticable.

3. Use a combination of methods, as appropriate, to achieve protection of human health and the environment. In appropriate site situations, treatment of principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic or highly mobile, will be combined with engineering controls (such as containment) and institutional controls, as appropriate, for treatment residuals and untreated waste.

4. Use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances.

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Contaminated ground water generally is not considered to be a source material although non-aqueous phase liquids (NAPLs) may be viewed as source materials. The NCP establishes a different expectation for remediating contaminated ground water (i.e., to return usable ground waters to their beneficial uses in a time frame that is reasonable given the particular circumstances of the site). Examples of source and non-source materials are provided in Highlight 2.

> **HIGHLIGHT 2: Examples of Source and Non-Source Materials**
>
> **Source Materials**
>
> - Drummed wastes
> - Contaminated soil and debris
> - "Pools" of dense non-aqueous phase liquids (NAPLs) submerged beneath ground water or in fractured bedrock
> - NAPLs floating on ground water
> - Contaminated sediments and sludges
>
> **Non-Source Materials**
>
> - Ground water
> - Surface water
> - Residuals resulting from treatment of site materials

<u>Principal threat wastes</u> are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be evaluated.

<u>Low level threat wastes</u> are those source materials that generally can be reliably contained and that would present only a low risk in the event of release. They include source materials that exhibit low toxicity, low mobility in the environment, or are near health-based levels.

Determinations as to whether a source material is a principal or low level threat waste should be based on the inherent toxicity as well as a consideration of the physical state of the material (e.g., liquid), the potential mobility of the wastes in the particular environmental setting, and the lability and degradation products of the material. However, this concept of principal and low level threat waste should not necessarily be equated with the risks posed by site contaminants via various exposure pathways. Although the characterization of some material as principal or low level threats takes into account toxicity (and is thus related to degree of risk posed assuming exposure occurs), characterizing a waste as a principal threat does not mean that the waste poses the primary risk at the site. For example, buried drums leaking solvents into ground water would be considered a principal threat waste, yet the primary risk at the site (assuming little or no direct contact threat) could be ingestion of contaminated ground water, which as discussed above is not considered to be a source material, and thus would not be categorized as a principal threat.

The identification of principal and low level threats is made on a site-specific basis. In some situations site wastes will not be readily classifiable as either a principal or low level threat waste, and thus no general expectations on how best to manage these source materials of moderate toxicity and mobility will necessarily apply. [NOTE: In these situations wastes do not have to be characterized as either one or the other. The principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification requirement.]

> **HIGHLIGHT 3: Examples of Principal and Low Level Threat Wastes**
>
> Wastes that generally will be considered to constitute principal threats include, but are not limited to:
>
> - <u>Liquids</u> - waste contained in drums, lagoons or tanks, free product (NAPLs) floating on or under ground water (generally excluding ground water) containing contaminants of concern.
> - <u>Mobile source material</u> - surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilization (e.g., VOCs), surface runoff, or sub-surface transport.
> - <u>Highly-toxic source material</u> - buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soils containing significant concentrations of highly toxic materials.
>
> Waste that generally will be considered to constitute low level threat wastes include, but are not limited to:
>
> - <u>Non-mobile contaminated source material of low to moderate toxicity</u> - Surface soil containing contaminants of concern that generally are relatively immobile in air or ground water (i.e., non-liquid, low volatility, low leachability contaminants such as high molecular weight compounds) in the specific environmental setting.
> - <u>Low toxicity source material</u> - soil and subsurface soil concentrations not greatly above reference dose levels or that present an excess cancer risk near the acceptable risk range.

Examples of principal and low level threat wastes are provided in Highlight 3.

Risk Management Decisions fo. Principal and Low Level Threat Wastes

The categorization of source material as a principal threat or low level threat waste, and the expectations regarding the use of treatment and containment technologies follows the fundamental decision as to whether any remedial action is required at a site. These determinations, and the application of the expectations, serve as general guidelines and do not dictate the selection of a particular remedial alternative. For example, EPA's experience has demonstrated that highly mobile wastes (e.g., liquids) are difficult to reliably contain and thus generally need to be treated. As such, EPA expects alternatives developed to address highly mobile material to focus on treatment options rather that containment approaches.

However, as stated in the preamble to the NCP (55 FR at 8703, March 8, 1990), there may be situations where wastes identified as constituting a principal threat may be contained rather than treated due to difficulties in treating the wastes. Specific situations that may limit the use of treatment include:

- Treatment technologies are not technically feasible or are not available within a reasonable time frame;
- The extraordinary volume of materials or complexity of the site make implementation of treatment technologies impracticable;
- Implementation of a treatment-based remedy would result in greater overall risk to human health and the environment due to risks posed to workers or the surrounding community during implementation; or
- Severe effects across environmental media resulting from implementation would occur.

Conversely, there may be situations where treatment will be selected for both principal threat wastes and low level threat wastes. For example, once a decision has been made to treat some wastes (e.g., in an onsite incinerator) economies of scale may make it cost effective to treat all materials including low level threat wastes to alleviate or minimize the need for engineering/institutional controls.

While these expectations may guide the development of appropriate alternatives, the fact that a remedy is consistent with the expectations does not constitute sufficient grounds for the selection of that remedial alternative. The selection of an appropriate waste management strategy is determined solely through the remedy selection process outlined in the NCP (i.e., all remedy selection decisions are site-specific and must be based on a comparative analysis of the alternatives using the nine criteria in accordance with the NCP). Independent of the expectations, selected remedies must be protective, ARAR-compliant, cost-effective, and use permanent solutions or treatment to the maximum extent practicable. Once the final remedy is selected, consistency with the NCP expectations should be discussed as part of the documented rationale for the decision.

ROD Documentation

Declaration

The "Description of the Selected Remedy" section should note whether the remedy is addressing any source materials that constitute "principal" or "low level" threat wastes, or both.

The "Statutory Determinations" section should discuss how the selected remedy satisfies the statutory preference stated in CERCLA §121 to select remedial actions "in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element." In evaluating this statutory preference, the site manager needs to decide whether treatment selected in the ROD constitutes treatment as a major component of the remedy for that site. Remedies which involve treatment of principal threat wastes likely will satisfy the statutory preference for treatment as a principal element, although this will not necessarily be true in all cases (e.g., when principal threat wastes that are treated represent only a small fraction of the wastes managed through containment). Ground water treatment remedies also may satisfy the statutory preference, even though contaminated ground water is not considered a principal threat waste and even though principal threat source material may not be treated.

Decision Summary

The "Decision Summary" of the ROD should identify those source materials that have been identified as principal threat and/or low level threat wastes, and the basis for these designations. These designations should be provided in the "Summary of Site Characteristics" section as part of the discussion focusing on these source materials that pose or potentially pose a risk to human health and the environment. In addition, the "Description of Alternatives" and the "Selection of Remedy" sections should briefly note how principal and/or low level threat wastes that may have been identified are being managed.

The "Statutory Determinations" section of the ROD should include a discussion of how the statutory preference for treatment as a principal element is satisfied or explain why it is not satisfied, stating reasons in terms of the nine evaluation criteria.

NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

EPA

United States
Environmental Protection
Agency (OS-220W)
Washington, DC 20460

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Appendix C – Existing Deed Restrictions West Lake Landfill and Areas 1 and 2

SPENCER FANE BRITT & BROWNE LLP
ATTORNEYS AND COUNSELORS AT LAW

MICHAEL D. HOCKLEY
DIRECT DIAL (816) 292-8233
mdh@spencerfane.com

File No. 2741000/1

July 30, 1997

David A. Hoefer, Esq.
Assistant Regional Counsel
Office of Regional Counsel
U.S. Environmental Protection Agency
Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101

Re: West Lake Landfill Site, Declaration of Covenants and Restrictions

Dear David:

With this letter I enclose copies of the following documents:

1. Declaration of Covenants and Restrictions executed by West Lake Quarry and Material Company, recorded with the St. Louis County Recorder of Deeds on June 30, 1997 at Book 11208, Page 2499;

2. Declaration of Covenants and Restrictions executed by Rock Road Industries, Inc., recorded with the St. Louis County Recorder of Deeds on June 30, 19997 at Book 11208, Page 2508;

3. Declaration of Covenants and Restrictions executed by Laidlaw Waste Systems (Bridgeton) Inc., recorded with the St. Louis County Recorder of Deeds on June 30, 1997 at Book 11208, Page 2515.

By recording these Declarations of Covenants and Restrictions, future use of the area encompassed by the West Lake Superfund Site has been limited and cannot include residential use. To change such use, the Environmental Protection Agency, the Missouri Department of Natural Resources, and the owner of the affected premises would have to agree to such changes. Therefore, the West

212540.1

1000 WALNUT STREET, SUITE 1400
KANSAS CITY, MISSOURI 64106-2140
(816) 474-8100 FAX (816) 474-3216
OVERLAND PARK, KANSAS WASHINGTON, D.C.

Lake Landfill Site Respondents believe that the only reasonable future use that should be considered for risk assessment purposes is a non-residential use.

Sincerely,

Michael D. Hockley

MDH:nrl

cc: Mr. Doug Borro
William R. Werner, Esq.
Charlotte L. Neitzel, Esq.
Mr. James W. Wagoner II
Mr. Paul V. Rosasco, P.E.
(All via mail, w/enclosure)

BP11208/2499

[redacted]

1997063000829

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	WEST LAKE QUARRY AND MATERIAL CO ETAL		

PROPERTY DESCRIPTION: YOSTI PARTITION LOT PT 1 2 3 & 4

Lien Number	Notation	Document Number	Locator
		829	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of 8 pages, (this page inclusive), was filed for record in my office on the 30 day of June 1997 at 02:30 PM and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

SEAL OF THE RECORDER OF DEEDS FOR ST. LOUIS COUNTY, MO

Daniel R O'Leary
Recorder of Deeds
St. Louis County, Missouri

J. Allen
Deputy Recorder

RECORDING FEE $36.32

7

DECLARATION OF COVENANTS AND RESTRICTIONS

WEST LAKE QUARRY AND MATERIAL COMPANY

West Lake Quarry and Material Company, a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all other persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit A, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The Premises and nearly all real property in the immediate vicinity of the Premises have been used exclusively for more than 40 years for non-residential uses, primarily for commercial and industrial uses and in some cases, for agricultural uses.

C. Such uses have included, but have not been limited to, quarrying operations, demolition and sanitary landfill operations, asphalt and concrete batch plant operations, and vehicle maintenance, repair and body shop operations.

D. Such uses, and the character and nature of the land uses in the vicinity of the Premises, make the Premises unsuitable for any future residential use.

E. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Laidlaw Waste Systems (Bridgeton) Inc., Rock Road Industries, Inc., and the United States Department of Energy.

F. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises and which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials, and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

G. Declarant desires to prohibit the present and future use of the Premises for any residential purpose in accordance with the terms and provisions of this Declaration.

DECLARATION

Declarant hereby states and declares as follows:

1. Neither the Premises, nor any portion thereof, shall be used now or hereafter for any residential purpose, or for any day care, preschool or other educational use.

2. This Declaration shall not unlawfully restrict and shall not be used to violate any federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. No water well for drinking water use shall be installed on the Premises.

4. This Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

5. Any deed or other instrument of conveyance for the Premises or any portion thereof shall be subject to this Declaration.

6. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor) and the owner of any portion of the Premises shall have the right to sue for and obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

7. The provisions of this Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Declaration may be filed at any time after the effective date of this Declaration, and the Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

IN WITNESS WHEREOF, West Lake Quarry and Material Company has caused this instrument to be executed this 27th day of May, 199~~6~~ 7.

WEST LAKE QUARRY AND MATERIAL COMPANY
a Missouri corporation

By: ______________________
William E. Whitaker
President

ACKNOWLEDGEMENT

STATE OF MISSOURI)
) ss
County OF ST. LOUIS)

On this 27th day of May, 199~~6~~ 7, before me, a notary public, personally appeared William E. Whitaker, to me known, who, being by me duly sworn, did say that he is the President of West Lake Quarry and Material Company, a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Margaret G. Cusumano
Notary Public

My Commission Expires:

November 5, 1998

MARGARET G CUSUMANO
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. NOV. 5,1998

MARGARET G. CUSUMANO
NOTARY PUBLIC
NOTARY SEAL
STATE OF

GRANTOR'S PROPERTY

A tract of land in part of Lots 1,2,3, and 4 of the Yosti Partition in U.S. Survey 131, part of Lot 21, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934, part of U.S. Survey 131, and part of U.S. Survey 47 in Townships 46 and 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County Missouri, described as follows:

Beginning at the most easterly corner of Lot 1 of the Yosti Partition in U.S. Survey 131, being a point in the centerline of Taussig Avenue; thence South 43 degrees 34 minutes 53 seconds East, along the northeasterly line of Lot 4 of the Yosti Partition, a distance of 99.92; thence South 6 degrees 41 minutes 15 seconds West, a distance of 68.96 feet; thence South 23 degrees 21 minutes 55 seconds West, a distance of 154.73 feet; thence South 26 degrees 49 minutes 07 East, a distance of 55.27 feet; thence South 14 degrees 32 minutes 36 seconds West, a distance of 143.63 feet; thence South 34 degrees 03 minutes 12 seconds West, a distance of 220.86 feet; thence North 55 degrees 41 minutes 34 seconds West, a distance of 127.00 feet; thence South 88 degrees 59 minutes 19 seconds West, a distance of 62.24 feet; thence South 54 degrees 43 minutes 18 seconds West, a distance of 240.50 feet; thence South 26 degrees 44 minutes 32 seconds West, a distance of 450.91 feet; thence South 8 degrees 25 minutes 49 seconds West, a distance of 224.01 feet; thence South 17 degrees 14 minutes 43 seconds East, a distance of 28.63 feet; thence South 47 degrees 09 minutes 44 seconds East, a distance of 61.27 feet; thence South 24 degrees 34 minutes 10 seconds East, a distance of 73.64 feet; thence South 0 degrees 07 minutes 21 seconds West, a distance of 107.37 feet to the northeasterly right of way line of the St. Charles Rock Road, 60 foot wide; thence North 61 degrees 07 minutes 11 seconds West, along said right of way line, a distance of 99.72 feet to the centerline of Taussig Avenue; thence North 28 degrees 07 minutes 01 seconds East, along said centerline, a distance of 100.00 feet to the intersection of said centerline and the southeasterly prolongation of the northeasterly line of a tract of land conveyed to American Telephone and Telegraph Company of Missouri by deed recorded in Book 1719 on Page 170; thence North 61 degrees 07 minutes 11 seconds West, along said line, a distance of 120.00 feet to the most northerly corner of said tract; thence South 28 degrees 07 minutes 01 seconds West, along the northwesterly line of said tract and its southwesterly extension, a distance of 130.00 feet to the centerline of the St. Charles Rock Road; thence North 61 degrees 07 minutes 11 seconds West, along said centerline a distance of 252.27 feet; thence North 51 degrees 56 minutes 32 seconds East, a distance of 311.60 feet; thence North 26 degrees 44 minutes 32 seconds East, a distance of 644.89 feet; thence North 56 degrees 34 minutes 13 seconds West, a distance of 296.04 feet; thence North 49 degrees 02 minutes 55 seconds West, a distance of 174.81 feet; thence North 7 degrees 43 minutes 38 seconds West, a distance of 65.61 feet; thence South 82 degrees 16 minutes 22 seconds West, a distance of 106.78 feet; thence around a curve to the right, having a radius of 150.00 feet and a chord bearing North 47 degrees 50 minutes 16 seconds West, a chord distance of 229.44 feet to a point of compound curve; thence around a curve to the right, having a radius of 450.00 feet and a chord bearing North 30 degrees 29 minutes 30 seconds East, a chord distance of 428.61 feet to its point of tangency; thence North 58 degrees 55 minutes 53 seconds East, a distance of 277.03 feet; thence North 2 degrees 03 minutes 23 seconds West, a distance of 332.12 feet; thence North 43 degrees 55 minutes 12 seconds West, a distance of 444.12 feet; thence North 39 degrees 22 minutes 26 seconds East, a distance of 463.83 feet; thence North 53 degrees 20 minutes 34 second East, a distance of 126.98 feet; thence South 50 degrees 18 minutes 12 seconds East, a distance of 205.86 feet; thence North 75 degrees 52 minutes 00 seconds East, a distance of 426.11 feet; thence North 51 degrees 12 minutes 40 seconds East, a distance of 277.46 feet to the southwesterly right of way line of Highway 40; also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 137.18 feet; thence leaving said right of way, South 51 degrees 12 minutes 40 seconds West, a distance of 1023.23 feet; thence South 25 degrees 58 minutes 41 seconds West, a distance of 181.33 feet to the northeasterly line of Lot 1 of the Yosti Partition of U.S. Survey 131; thence South 43 degrees 34 minutes 53 seconds East, along said northeasterly line, a distance of 971.20 feet to the Point of Beginning.

Excepting from the above the following:

A tract of land being part of Lots 1, 3, and 4 of the "Yosti Partition in U.S. Survey 131, townships 46 and 47 north, range 5 east of the Fifth Principal Meridian, St. Louis County, Missouri, more particularly described as follows:

Commencing at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as "St. Charles Rock Road;" thence South 37 degrees 11 minutes 39 seconds East, along said south right of way line, 209.98 feet; thence exiting said right of way line, South 57 degrees 54 minutes 32 seconds West, 1023.23 feet; thence South degrees 40 minutes 33 seconds West, 181.33 feet to the northeasterly line of said lot 1; thence South 36 degrees 53 minutes 01 seconds East, along said northeasterly line of lot 1, a distance of 591.05 feet to the point of beginning of the tract described herein; thence continuing along the northeasterly line of said lot 1 and along the northeasterly line of said lot 4, South 36 degrees 53 minutes 01 seconds East, 480.07 feet; thence exiting said northeasterly line, South 13 degrees 23 minutes 07 seconds West, 68.96 feet; thence South 30 degrees 03 minutes 47 seconds West, 154.73 feet; thence South 20 degrees 07 minutes 14 seconds East, 55.27 feet; thence South 21 degrees 14 minutes 28 seconds West, 143.63 feet; thence South 40 degrees 45 minutes 05 seconds West, 220.86 feet; thence North 48 degrees 59 minutes 42 seconds West, 127.00 feet; thence North 84 degrees 18 minutes 49 seconds West, 62.24 feet; thence South 61 degrees 25 minutes 10 seconds West, 240.50 feet; thence South 33 degrees 26 minutes 24 seconds West, 450.91 feet; thence South 15 degrees 07 minutes 41 seconds West, 224.01 feet; thence South 10 degrees 32 minutes 51 seconds East, 28.63 feet; thence South 40 degrees 27 minutes 52 seconds East, 61.27 feet; thence South 17 degrees 52 minutes 18 seconds East, 73.64 feet; thence South 06 degrees 49 minutes 13 seconds West, 107.37 feet to the north right of way line of "Old St. Charles Rock Road;" thence North 54 degrees 25 minutes 19 seconds West, along said right of way line, 99.72 feet; thence North 34 degrees 48 minutes 53 seconds East, 100.00 feet; thence exiting said west line, North 54 degrees 25 minutes 19 seconds West, 120.00 feet; thence North 21 degrees 27 minutes 09 seconds East, 153.52 feet; thence North 00 degrees 02 minutes 46 seconds West, 37.43 feet; thence North 56 degrees 33 minutes 36 seconds West, 70.00 feet; thence North 33 degrees 26 minutes 24 seconds East, 624.89 feet; thence South 49 degrees 52 minutes 21 seconds East, 56.85 feet; thence North 67 degrees 30 minutes 55 seconds East, 06.05 feet; thence North 08 degrees 48 minutes 44 seconds East, 158.15 feet; thence South 59 degrees 03 minutes 26 seconds East, 82.21 feet; thence North 33 degrees 28 minutes 55 seconds East, 321.44 feet; thence North 55 degrees 02 minutes 11 seconds West, 158.34 feet; thence North 01 degrees 10 minutes 17 seconds East, 342.38 feet to the point of beginning.

BP11208/2507

[redacted]

1997063000830

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	ROCK ROAD INDUSTRIES INC ETAL		

PROPERTY DESCRIPTION: SUR 131 T 47 R 5 W/O/P

Lien Number	Notation	Document Number	Locator
		830	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of 7 pages, (this page inclusive), was filed for record in my office on the 30 day of June 1997 at 02:30 PM and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

SEAL OF THE RECORDER OF DEEDS FOR ST. LOUIS COUNTY, MO

Recorder of Deeds
St. Louis County, Missouri

Deputy Recorder

RECORDING FEE $33.32

(Paid at the time of Recording)

DECLARATION OF COVENANTS AND RESTRICTIONS

ROCK ROAD INDUSTRIES, INC.

Rock Road Industries, Inc., a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all other persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit A, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The Premises and nearly all real property in the immediate vicinity of the Premises have been used exclusively for more than 40 years for non-residential uses, primarily for commercial and industrial uses and in some cases, for agricultural uses.

C. Such uses have included, but have not been limited to, quarrying operations, demolition and sanitary landfill operations, asphalt and concrete batch plant operations, and vehicle maintenance, repair and body shop operations.

D. Such uses, and the character and nature of the land uses in the vicinity of the Premises, make the Premises unsuitable for any future residential use.

E. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Declarant, Laidlaw Waste Systems (Bridgeton) Inc., and the United States Department of Energy.

F. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises and which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials, and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

G. Declarant desires to prohibit the present and future use of the Premises for any residential purpose in accordance with the terms and provisions of this Declaration.

DECLARATION

Declarant hereby states and declares as follows:

1. Neither the Premises, nor any portion thereof, shall be used now or hereafter for any residential purpose, or for any day care, preschool or other educational use.

2. This Declaration shall not unlawfully restrict and shall not be used to violate any federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. No water well for drinking water use shall be installed on the Premises.

4. This Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

5. Any deed or other instrument of conveyance for the Premises or any portion thereof shall be subject to this Declaration.

6. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor) and the owner of any portion of the Premises shall have the right to sue for and obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

7. The provisions of this Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Declaration may be filed at any time after the effective date of this Declaration, and the Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

IN WITNESS WHEREOF, Rock Road Industries, Inc. has caused this instrument to be executed this 27th day of May, 1997.

ROCK ROAD INDUSTRIES, INC.
a Missouri corporation

By: _______________
William E. Whitaker
President

ACKNOWLEDGEMENT

STATE OF MISSOURI)
) ss
County OF ST. LOUIS)

On this 27th day of May, 1997, before me, a notary public, personally appeared William E. Whitaker, to me known, who, being by me duly sworn, did say that he is the President of Rock Road Industries, Inc., a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Margaret G. Cusumano
Notary Public

My Commission Expires:

November 5, 1998

MARGARET G CUSUMANO
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. NOV. 5,1998

EXHIBIT "A"

AREA 1

A tract of land in part of U.S. Survey 131, Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 729.68 feet; thence South 40 degrees 49 minutes 32 seconds West, a distance of 92.54 feet to the Point of Beginning of the following described tract; thence continuing South 40 degrees 49 minutes 32 seconds West, a distance of 288.61 feet; thence South 89 degrees 29 minutes 50 seconds West, a distance of 241.41 feet; thence North 79 degrees 05 minutes 44 seconds West, a distance of 390.43 feet; thence North 29 degrees 48 minutes 55 seconds East, a distance of 499.73 feet; thence North 84 degrees 45 minutes 59 seconds East, a distance of 248.68 feet; thence South 32 degrees 24 minutes 17 seconds East, a distance of 201.28 feet; thence South 56 degrees 18 minutes 22 seconds East, a distance of 251.78 feet to the Point of Beginning.

AREA 2

A tract of land in part of Lot 20, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934 and in part of U.S. Survey 47 Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the centerline of St. Charles Rock Road and the northwesterly line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said northwesterly line, a distance of 148.48 feet of the Point of Beginning of the following described tract; thence continuing North 28 degrees 53 minutes 11 seconds East, along said line, a distance of 676.08 feet to the northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the northerly line of Lot 19 of the St. Charles Ferry Company tract, a distance of 674.79 feet; thence North 47 degrees 43 minutes 02 seconds East, a distance of 906.64 feet; thence South 64 degrees 46 minutes 52 seconds East, a distance of 389.58 feet; thence South 76 degrees 30 minutes 26 seconds East, a distance of 245.51 feet; thence South 60 degrees 07 minutes 01 seconds East, a distance of 283.36 feet; thence South 31 degrees 26 minutes 39 seconds West, a distance of 1136.42 feet; thence South 33 degrees 08 minutes 25 seconds West, a distance of 109.40 feet; thence South 34 degrees 54 minutes 38 seconds East, a distance of 149.81 feet; thence South 44 degrees 29 minutes 33 seconds West, a distance of 267.70 feet; thence North 78 degrees 25 minutes 41 seconds West, a distance of 241.02 feet; thence North 34 degrees 31 minutes 30 seconds West, a distance of 351.19 feet to the Point of Beginning.

[redacted]

DI 11L00/L317

1997063000831

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	LAIDLAW WASTE SYSTEMS BRIDGETON INC ETAL		

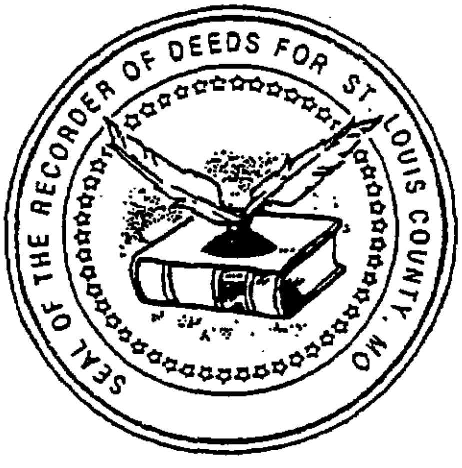
PROPERTY DESCRIPTION: YOSTI PARTITION LOT PT 1 2 & 3

Lien Number	Notation	Document Number	Locator
		831	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of 10 pages, (this page inclusive), was filed for record in my office on the 30 day of June 1997 at 02:30 PM and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.



Recorder of Deeds
St. Louis County, Missouri

J. Allen

Deputy Recorder

RECORDING FEE $42.32

(Paid at the time of Recording)

9

DECLARATION OF COVENANTS AND RESTRICTIONS

LAIDLAW WASTE SYSTEMS (BRIDGETON) INC.

Laidlaw Waste Systems (Bridgeton) Inc. f/k/a/ West Lake Landfill, Inc., a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit 1, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The Premises and nearly all real property in the immediate vicinity of the Premises have been used exclusively for more than 40 years for non-residential uses, primarily for commercial and industrial uses and in some cases, for agricultural uses.

C. Such uses have included, but have not been limited to, quarrying operations, demolition and sanitary landfill operations, asphalt and concrete batch plant operations, and vehicle maintenance, repair and body shop operations.

D. Such uses, and the character and nature of the land uses in the vicinity of the Premises, make the Premises unsuitable for any future residential use.

E. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Declarant, Rock Road Industries, Inc., and the United States Department of Energy.

F. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises, which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials, and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

G. The EPA and Declarant have entered into an additional Administrative Order on Consent, which has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-94-F-0025, to investigate the nature and extent of any potential contamination at the Premises (other than Radiological Areas 1 and 2) relating to the historical use of the Premises.

H. Declarant desires to prohibit the present and future use of the Premises for any residential purpose in accordance with the terms and provisions of this Declaration.

DECLARATION

Declarant hereby states and declares as follows:

1. Neither the Premises, nor any portion thereof, shall be used now or hereafter for any residential purpose, or for any day care, preschool, or other educational use.

2. This Declaration shall not unlawfully restrict and shall not be used to violate any federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. No water well for drinking water use shall be installed on the Premises.

4. This Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

5. Any deed or other instrument of conveyance for the Premises or any portion therefor shall be subject to this Declaration.

6. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor), and the owner of any portion of the Premises shall have the right to sue for and

obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

7. The provisions of this Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Declaration may be filed at any time after the effective date of this Declaration, and the Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

IN WITNESS WHEREOF, Laidlaw Waste Systems (Bridgeton) Inc. has caused this instrument to be executed this 9th day of June, 1997.

LAIDLAW WASTE SYSTEMS
(BRIDGETON) INC.

By ______________________

ACKNOWLEDGMENT

STATE OF Arizona)
) ss.
COUNTY OF Maricopa)

On this 9th day of June, 1997, before me, a notary public, personally appeared Steven Eklm, to me known, who, being by me duly sworn, did say that he is the Vice President of Laidlaw Waste Systems (Bridgeton) Inc., a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Mary Deborah Stoup
Notary Public

My commission expires:
5/16/99

DEBORAH STOUP NOTARY PUBLIC MARICOPA COUNTY, AZ

EXHIBIT "1"

Landfill Area

Tract 1

tract of land in part of Lots 1,2, and 3 of the Yosti Partition in U.S. Survey 131, part of Lots 20,21, and 22 of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934, part of U.S. Survey 131, and part of U.S. Survey 47 in Townships 46 and 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County Missouri, described as follows:

Beginning at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 72.80 feet; thence South 51 degrees 12 minutes 40 seconds West, a distance of 277.46 feet; thence South 75 degrees 52 minutes 00 seconds West, a distance of 426.11 feet; thence North 50 degrees 18 minutes 12 seconds West, a distance of 205.86 feet; thence South 53 degrees 20 minutes 34 seconds West, a distance of 126.98 feet; thence South 39 degrees 22 minutes 26 seconds West, a distance of 463.83 feet; thence South 43 degrees 55 minutes 12 seconds East, a distance of 444.12 feet; thence South 2 degrees 03 minutes 23 seconds East, a distance of 332.12 feet; thence South 58 degrees 55 minutes 53 seconds West, a distance of 277.03 feet; thence around a curve to the left, having a radius of 450.00 feet and a chord bearing South 30 degrees 29 minutes 30 seconds West, a chord distance of 428.61 feet to a point of compound curve; thence around a curve to the left, having a radius of 150.00 feet and a chord bearing South 47 degrees 9 minutes 16 seconds East, a chord distance of 229.44 feet to its point of tangency; thence North 82 degrees 16 minutes 22 seconds East, a distance of 106.78 feet; thence South 7 degrees 43 minutes 38 seconds East, a distance of 65.61 feet; thence South 49 degrees 02 minutes 55 seconds East, a distance of 174.81 feet; thence South 56 degrees 34 minutes 13 seconds East, a distance of 296.04 feet; thence South 26 degrees 44 minutes 32 seconds West, a distance of 644.89 feet; thence South 51 degrees 56 minutes 32 seconds West, a distance of 311.60 feet to the centerline of St. Charles Rock Road; thence along said centerline the following courses and distances: North 61 degrees 07 minutes 11 seconds West, a distance of 739.36 feet; North 5 degrees 58 minutes 11 seconds West, a distance of 997.50 feet; North 11 degrees 22 minutes 11 seconds West, a distance of 477.70 feet; North 17 degrees 07 minutes 11 seconds West, a distance of 348.30 feet; North 31 degrees 34 minutes 11 seconds West, a distance of 349.50 feet; North 38 degrees 50 minutes 11 seconds West, a distance of 22.38 feet to the northwest line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said Northwest line, a distance of 824.56 feet to the Northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the North line of Lot 19 of the St. Charles Ferry Company Tract, a distance of 674.79 feet; thence North 47 degrees 43 minutes 02 seconds East, a distance of 1137.84 feet to the Southwesterly right of way line of Highway 40 also known as St. Charles Rock Road; thence along said right of way line the following courses and distances; thence South 75 degrees 56 minutes 31 seconds East, a distance of 260.00 feet; thence around a curve to the right, having a radius of 1825.08 feet and a chord bearing South 65 degrees 11 minutes 52 seconds East, a chord distance of 680.49 feet; thence

North 35 degrees 32 minutes 48 seconds East, a distance of 30.00 feet; thence around a curve to the right, having a radius of 1855.08 feet and a chord bearing South 49 degrees 10 minutes 22 seconds East, chord distance of 341.47 feet; thence South 43 degrees 53 minutes 31 seconds East, a distance of 47.91 feet; thence South 46 degress 06 minutes 29 seconds West, a distance of 15.00 feet; thence South 43 degrees 53 minutes 31 seconds East, a distance of 34.28 feet; thence South 55 degrees 55 minutes 28 seconds East, a distance of 95.94 feet; thence South 43 degrees 53 minutes 31 seconds East, a distance of 602.78 feet to the Point of Beginning and containing 111.80 Acres.

Tract 2

A tract of land in part of Lots 1,3, and 4 of the Yosti Partition in U.S. Survey 131, and part of U.S. Survey 131, in Townships 46 and 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Beginning at the most easterly corner of Lot 1 of the Yosti Partition in U.S. Survey 131, being a point in the centerline of Taussig Avenue; thence South 43 degrees 34 minutes 53 seconds East, along the northeasterly line of Lot 4 of the Yosti Partition, a distance of 99.92 feet; thence South 6 degrees 41 minutes 15 seconds West, a distance of 68.96 feet; thence South 23 degrees 21 minutes 55 seconds West, a distance of 154.73 feet; thence South 26 degrees 49 minutes 07 seconds East, a distance of 55.27 feet; thence South 14 degrees 32 minutes 36 seconds West, a distance of 143.63 feet; thence South 34 degrees 03 minutes 12 seconds West, a distance of 220.86 feet; thence North 55 degrees 41 minutes 34 seconds West, a distance of 127.00 feet; thence South 88 degrees 59 minutes 19 seconds West, a distance of 62.24 feet; thence South 54 degrees 43 minutes 18 seconds West, a distance of 240.50 feet; thence South 26 degrees 44 minutes 32 seconds West, a distance of 450.91 feet; thence South 8 degrees 25 minutes 49 seconds West, a distance of 224.01 feet; thence South 17 degrees 14 minutes 43 seconds East, a distance of 28.63 feet; thence South 47 degrees 09 minutes 44 seconds East, a distance of 61.27 feet; thence South 24 degrees 34 minutes 10 seconds East, a distance of 73.64 feet; thence South 0 degrees 07 minutes 21 seconds West, a distance of 107.37 feet to the northeasterly right of way line of the St. Charles Rock Road, 60 foot wide; thence South 61 degrees 07 minutes 11 seconds East, along said right of way line, a distance of 758.45 feet to the most southerly corner of Lot 4 of said Yosti Partition; thence North 39 degrees 17 minutes 12 seconds East, along the southeasterly line of said Lot 4, a distance of 1349.58 feet to the most easterly corner thereof; thence North 43 degrees 34 minutes 53 seconds West, along the northeasterly line of said lot 4, a distance of 779.68 feet to a point 50.00 feet southeasterly of the most southerly corner of a tract of land conveyed to John Guerra and wife by deed recorded in Book 1642 on Page 263; thence North 46 degrees 24 minutes 31 seconds East, parallel with the southeasterly line of said Guerra tract, a distance of 437.11 feet; thence North 43 degrees 34 minutes 53 seconds West, parallel with the northeasterly line of said Guerra tract, a distance of 486.26 feet to the centerline of Taussig Avenue; thence North 41 degrees 52 minutes 29 seconds East, along said centerline, a distance of 68.21 feet; thence North 47 degrees 48 minutes 29 seconds East, along said centerline, a distance of 340.00 feet; thence North 42 degrees 11 minutes 31 seconds West, a distance of 30.00 feet to the northwesterly right of way line of said Taussig Avenue; thence North 47 degrees 48 minutes

29 seconds East, along said right of way a distance of 312.95 feet; thence North 5 degrees 09 minutes 06 seconds West, continuing along said right of way, a distance of 57.50 feet to the southwesterly right of way of Highway 40, also known as St. Charles Rock Road; thence North 43 degrees 53 minutes 31 seconds West, along said southwesterly right of way line, a distance of 877.45 feet; thence South 51 degrees 12 minutes 40 seconds West, a distance of 1023.23 feet; thence South 25 degrees 58 minutes 41 seconds West, a distance of 181.33 feet, to the northeasterly line of Lot 1 of the Yosti Partition of U.S. Survey 131; thence South 43 degrees 34 minutes 53 seconds East, along said northeasterly line, a distance of 971.20 feet to the Point of Beginning.

Tract 3

A tract of land being part of Lots 1, 3, and 4 of the "Yosti Partition in U.S. Survey 131, townships 46 and 47 north, range 5 east of the Fifth Principal Meridian, St. Louis County, Missouri, more particularly described as follows:

Commencing at the intersection of the northwesterly line of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as "St. Charles Rock Road;" thence South 37 degrees 11 minutes 39 seconds East, along said south right of way line, 209.98 feet; thence exiting said right of way line, South 57 degrees 54 minutes 32 seconds West, 1023.23 feet; thence South 32 degrees 40 minutes 33 seconds West, 181.33 feet to the northeasterly line of said lot 1; thence South 36 degrees 53 minutes 01 seconds East, along said northeasterly line of lot 1, a distance of 591.05 feet to the point of beginning of the tract described herein; thence continuing along the northeasterly line of said lot 1 and along the northeasterly line of said lot 4, South 36 degrees 53 minutes 01 seconds East, 480.07 feet; thence exiting said northeasterly line, South 13 degrees 23 minutes 07 seconds West, 68.96 feet; thence South 30 degrees 03 minutes 47 seconds West, 154.73 feet; thence South 20 degrees 07 minutes 14 seconds East, 55.27 feet; thence South 21 degrees 14 minutes 28 seconds West, 143.63 feet; thence South 40 degrees 45 minutes 05 seconds West, 220.86 feet; thence North 48 degrees 59 minutes 42 seconds West, 127.00 feet; thence North 84 degrees 18 minutes 49 seconds West, 62.24 feet; thence South 61 degrees 25 minutes 10 seconds West, 240.50 feet; thence South 33 degrees 26 minutes 24 seconds West, 450.91 feet; thence South 15 degrees 07 minutes 41 seconds West, 224.01 feet; thence South 10 degrees 32 minutes 51 seconds East, 28.63 feet; thence South 40 degrees 27 minutes 52 seconds East, 61.27 feet; thence South 17 degrees 52 minutes 18 seconds East, 73.64 feet; thence South 06 degrees 49 minutes 13 seconds West, 107.37 feet to the north right of way line of "Old St. Charles Rock Road;" thence North 54 degrees 25 minutes 19 seconds West, along said right of way line, 99.72 feet; thence North 34 degrees 48 minutes 53 seconds East, 100.00 feet; thence exiting said west line, North 54 degrees 25 minutes 19 seconds West, 120.00 feet; thence North 21 degrees 27 minutes 09 seconds East, 153.52 feet; thence North 00 degrees 02 minutes 46 seconds West, 37.43 feet; thence North 56 degrees 33 minutes 36 seconds West, 70.00 feet; thence North 33 degrees 26 minutes 24 seconds East, 624.89 feet; thence South 49 degrees 52 minutes 21 seconds East, 56.85 feet; thence North 67 degrees 30 minutes 55 seconds East, 36.05 feet; thence North 08 degrees 48 minutes 44 seconds East, 158.15 feet; thence South 59 degrees 03 minutes 26 seconds East, 82.21 feet; thence North 3[illegible] degrees 28 minutes 55 seconds East, 321.44 feet; thence North 55 degrees 02 minutes 11 seconds West, 158.34 feet; thence North 01 degrees 10 minutes 17 seconds East, 342.38 feet to the point of beginning.

Excluding from the above tracts the real property sometimes referred to as Area 1 and Area 2, and more particularly described as follows:

AREA 1

A tract of land in part of U.S. Survey 131, Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the northwesterly line, of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 729.68 feet; thence South 40 degrees 49 minutes 32 seconds West, a distance of 92.54 feet to the Point of Beginning of the following described tract; thence continuing South 40 degrees 49 minutes 32 seconds West, a distance of 288.61 feet; thence South 89 degrees 29 minutes 50 seconds West, a distance of 241.41 feet; thence North 79 degrees 05 minutes 44 seconds West, a distance of 390.43 feet; thence North 29 degrees 48 minutes 55 seconds East, a distance of 499.73 feet; thence North 84 degrees 45 minutes 59 seconds East, a distance of 248.68 feet; thence South 32 degrees 24 minutes 17 seconds East, a distance of 201.28 feet; thence South 56 degrees 18 minutes 22 seconds East, a distance of 251.78 feet to the Point of Beginning.

AREA 2

A tract of land in part of Lot 20, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934 and in part of U.S. Survey 47 Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the centerline of St. Charles Rock Road and the northwesterly line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said northwesterly line, a distance of 148.48 feet of the Point of Beginning of the following described tract; thence continuing North 28 degrees 53 minutes 11 seconds East, along said line, a distance of 676.08 feet to the northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the northerly line of Lot 19 of the St. Charles Ferry Company tract, a distance of 674.79 feet; thence North 47 degrees 43 minutes 02 seconds East, a distance of 906.64 feet; thence South 64 degrees 46 minutes 52 seconds East, a distance of 389.58 feet; thence South 76 degrees 30 minutes 26 seconds East, a distance of 245.51 feet; thence South 60 degrees 07 minutes 01 seconds East, a distance of 283.36 feet; thence South 31 degrees 26 minutes 39 seconds West, a distance of 1136.42 feet; thence South 33 degrees 08 minutes 25 seconds West, a distance of 109.40 feet; thence South 34 degrees 54 minutes 38 seconds East, a distance of 149.81 feet; thence South 44 degrees 29 minutes 33 seconds West, a distance of 267.70 feet; thence North 78 degrees 25 minutes 41 seconds West, a distance of 241.02 feet; thence North 34 degrees 31 minutes 30 seconds West, a distance of 351.19 feet to the Point of Beginning.

THE STOLAR PARTNERSHIP
ATTORNEYS AT LAW
THE LAMMERT BUILDING
911 WASHINGTON AVENUE
ST. LOUIS, MISSOURI 63101-1290
(314) 231-2800
TELEFAX: (314) 436-8400

WILLIAM R. WERNER
Email: WRW@TSPSTL.COM

H.M. STOLAR
(RETIRED 1964)

February 5, 1998

David A. Hoefer, Esq.
Office of Regional Counsel
U.S. Environmental Protection
Agency - Region VII
726 Minnesota Ave.
Kansas City, KS 66101

RE: West Lake Landfill Site - Supplemental Declaration of Covenants and Restrictions

Dear David;

Attached for your file is a copy of the Supplemental Declaration of Covenants and Restrictions which was executed on behalf of Rock Road Industries, Inc. subsequent to your review. The Declaration has been recorded with the St. Louis County Recorder of Deeds at the Book and Page number shown on the enclosed copy.

Very truly yours,

William R. Werner

WRW:jvb
Enclosure
cc(w/enc): John Frazier
Angela Foster
Michael Hockley
Charlotte Neitzel
Paul Rosasco
James Wagoner II

DF 11762/1033

[redacted]

1998012001106

DANIEL T. O'LEARY
RECORDER OF DEEDS
ST. LOUIS COUNTY MISSOURI
41 SOUTH CENTRAL
CLAYTON, MO 63105

RECORDER OF DEEDS DOCUMENT IDENTIFICATION & CERTIFICATION SHEET

TYPE OF INSTRUMENT	GRANTOR	TO	GRANTEE
RESTR	**ROCK ROAD INDUSTRIES INC**		

PROPERTY DESCRIPTION: **SUR 131 T 47 R 5 W/O/P**

Lien Number	Notation	Document Number	Locator
		1,106	

STATE OF MISSOURI)
SS.
COUNTY OF ST. LOUIS)

I, the undersigned Recorder of Deeds for said County and State, do hereby certify that the following and annexed instrument of writing, which consists of **6** pages, (this page inclusive), was filed for record in my office on the **20** day of **January** **1998** at **04:27 PM** and is truly recorded in the book and at the page shown at the top and/or bottom of this page.

In witness whereof I have hereunto set my hand and official seal the day, month and year aforesaid.

5

SUPPLEMENTAL DECLARATION OF COVENANTS AND RESTRICTIONS

ROCK ROAD INDUSTRIES, INC.

Rock Road Industries, Inc., a Missouri corporation ("Declarant"), hereby (a) imposes the provisions of this Supplemental Declaration upon the Premises (as defined below), (b) publishes and declares that the following terms, conditions, restrictions and obligations shall (i) affect and encumber the Premises, (ii) run with and be a burden upon and a benefit to the Premises, and (iii) be fully binding upon Declarant and all other persons or entities acquiring the Premises or any part thereof or interest therein whether by descent, devise, purchase or otherwise, and (c) declares that any person or entity, by the acceptance of title to the Premises or any part thereof or interest therein, shall thereby agree and covenant to abide by and be bound by the following terms, conditions, restrictions and obligations.

RECITALS

A. Declarant is the owner of certain real property (located in the City of Bridgeton, County of St. Louis, State of Missouri), legally described on Exhibit A, attached hereto and incorporated herein by this reference, which real property is herein referred to as the "Premises".

B. The United States Environmental Protection Agency ("EPA") has entered into an Administrative Order on Consent (the "Consent Order") with Cotter Corporation (N.S.L.), Declarant, Laidlaw Waste Systems (Bridgeton) Inc., and the United States Department of Energy for a Remedial Investigation and Feasibility Study.

C. The Consent Order, among other things, (i) provides for the investigation of the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from two isolated areas either on or in the vicinity of the Premises and which have been designated as Radiological Areas 1 and 2 in the Consent Order, and which contain low-level radioactive waste materials (the "Environmental Condition"), and (ii) has been filed with the Regional Hearing Clerk, EPA, Region VII, 726 Minnesota Avenue, Kansas City, Kansas, Docket No. VII-93-F-0005.

D. The Premises is subject to a Declaration of Covenants and Restrictions dated May 27, 1997, which is recorded in Book 11208 Page 2507 in the St. Louis County Recorder of Deeds Office (the "May 1997 Declaration").

E. In addition to the restrictions contained in the May 1997 Declaration, Declarant desires to prohibit in perpetuity (i) the construction or placement upon the Premises of any building for any purpose, and (ii) the installation of underground utilities, pipes and/or excavation upon the Premises, except as set forth herein.

<u>DECLARATION</u>

Declarant hereby states and declares as follows:

1. No building of any kind or nature for any purpose shall be constructed or placed on the Premises, now or at any time in the future, in perpetuity. In addition, no underground utilities or pipes shall be installed at the Premises and no excavation work shall be performed on the Premises, now or at any time in the future, in perpetuity, except such utilities, pipes and/or excavation work, if any, which (a) are approved by EPA in connection with a plan selected by EPA to remediate the Environmental Condition and are performed in accordance with safety regulations applicable to such remedial plan or otherwise required by EPA as a condition of such approval, or (b) are any part of a landfill gas control, leachate collection, or surface water management system installed and operated pursuant to a plan approved by all

applicable Federal, State and/or local authorities exercising jurisdiction over inactive landfill conditions on the Premises or active or inactive landfill operations conducted adjacent to the Premises.

2. This Supplemental Declaration shall not unlawfully restrict and shall not be used to violate any Federal law, rule, or regulation regarding the use of real estate, including, but not limited to, the Fair Housing Act.

3. This Supplemental Declaration shall be recorded in the office of the Recorder of Deeds for the County of St. Louis, State of Missouri.

4. Any deed or other instrument of conveyance for the Premises or any portion thereof shall be subject to this Supplemental Declaration.

5. Each of EPA (or its successor), the Missouri Department of Natural Resources ("MDNR") (or its successor) and the owner of any portion of the Premises shall have the right to sue for and obtain an injunction, prohibitive or mandatory, to prevent the breach, or to enforce the observance, of this Supplemental Declaration. This right shall be in addition to any other action available at law or in equity. The failure to enforce any covenant or restriction herein at the time of its violation shall not constitute a waiver of the right to do so later.

6. The provisions of this Supplemental Declaration shall continue in full force and effect until the fiftieth anniversary of the date of this Supplemental Declaration and thereafter for successive twenty-year periods unless, prior to the expiration of the then current term, a written notice of termination of this Supplemental Declaration, executed by each of the then owners of the Premises and by authorized representatives of EPA (or its successor) and MDNR (or its successor), has been filed with the office of the Recorder of Deeds for St. Louis County, State of Missouri. A notice of termination of this Supplemental Declaration may be filed at any

time after the effective date of this Supplemental Declaration, and this Supplemental Declaration shall terminate on the date the notice of termination is filed with the Recorder of Deeds.

7. The May 1997 Declaration remains in full force and effect, and shall be deemed supplemented, but not amended, by this Supplemental Declaration.

IN WITNESS WHEREOF, Rock Road Industries, Inc. has caused this instrument to be executed this 16th day of January, 1998.

ROCK ROAD INDUSTRIES, INC., a Missouri corporation

By: ______________________
William E. Whitaker
President

ACKNOWLEDGEMENT

STATE OF MISSOURI)
) ss
County OF ST. LOUIS)

On this 16th day of January, 1998, before me, a notary public, personally appeared William E. Whitaker, to me known, who, being by me duly sworn, did say that he is the President of Rock Road Industries, Inc., a Missouri corporation, and that said instrument was signed on behalf of said corporation by authority of its Board of Directors, and said person acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal in the County and State aforesaid, the day and year first above written.

Margaret G. Cusumano
Notary Public

My Commission Expires:

MARGARET G CUSUMANO
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. NOV. 5,1998

EXHIBIT A

AREA 1

A tract of land in part of U.S. Survey 131, Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the northwesterly line, of U.S. Survey 131 and the southwesterly right of way line of Highway 40, also known as St. Charles Rock Road; thence South 43 degrees 53 minutes 31 seconds East, along said right of way line, a distance of 729.68 feet; thence South 40 degrees 49 minutes 32 seconds West, a distance of 92.54 feet to the Point of Beginning of the following described tract; thence continuing South 40 degrees 49 minutes 32 seconds West, a distance of 288.61 feet; thence South 89 degrees 29 minutes 50 seconds West, a distance of 241.41 feet; thence North 79 degrees 05 minutes 44 seconds West, a distance of 390.43 feet; thence North 29 degrees 48 minutes 55 seconds East, a distance of 499.73 feet; thence North 84 degrees 45 minutes 59 seconds East, a distance of 248.68 feet; thence South 32 degrees 24 minutes 17 seconds East, a distance of 201.28 feet;thence South 56 degrees 18 minutes 22 seconds East, a distance of 251.78 feet to the Point of Beginning.

AREA 2

A tract of land in part of Lot 20, of the St. Charles Ferry Company Tract in U.S. Survey 47 and 1934 and in part of U.S. Survey 47 Township 47 North, Range 5 East of the 5th Principal Meridian, St. Louis County, Missouri, described as follows:

Commencing at the intersection of the centerline of St. Charles Rock Road and the northwesterly line of Lot 20 of the St. Charles Ferry Company Tract; thence North 28 degrees 53 minutes 11 seconds East, along said northwesterly line, a distance of 148.48 feet of the Point of Beginning of the following described tract; thence continuing North 28 degrees 53 minutes 11 seconds East, along said line, a distance of 676.08 feet to the northwest corner of said Lot 20; thence North 72 degrees 46 minutes 42 seconds West, along the northerly line of Lot 19 of the St. Charles Ferry Company tract, a distance of 674.79 feet;thence North 47 degrees 43 minutes 02 seconds East, a distance of 906.64 feet; thence South 64 degrees 46 minutes 52 seconds East, a distance of 389.58 feet; thence South 76 degrees 30 minutes 26 seconds East, a distance of 245.51 feet; thence South 60 degrees 07 minutes 01 seconds East, a distance of 283.36 feet; thence South 31 degrees 26 minutes 39 seconds West, a distance of 1136.42 feet; thence South 33 degrees 08 minutes 25 seconds West, a distance of 109.40 feet; thence South 34 degrees 54 minutes 38 seconds East, a distance of 149.81 feet; thence South 44 degrees 29 minutes 33 seconds West, a distance of 267.70 feet; thence North 78 degrees 25 minutes 41 seconds West, a distance of 241.02 feet; thence North 34 degrees 31 minutes 30 seconds West, a distance of 351.19 feet to the Point of Beginning.

Appendix D – Cost Estimates Summary Tables

APPENDIX D – COST ESTIMATES SUMMARY TABLES

Capital, operation and maintenance (O&M), and present worth cost estimates for each alternative are presented in this Appendix. A summary table of these costs for each alternative is provided at the beginning and detailed cost estimates for the components of each alternative are presented following the summary table. Detailed costs are broken down by the various components of each alternative. For example, the costs for Alternative L4 are presented in the following categories: groundwater monitoring capital costs, establishing additional access restrictions and institutional controls, regrading and cover construction capital costs, and O&M costs for groundwater monitoring, cover maintenance, and 5-year CERCLA review. O&M costs for maintaining access restrictions and institutional controls are assumed to be negligible.

In accordance with EPA guidance, the cost estimates for each alternative are order-of-magnitude estimates and are generally accurate within the range specified in the RI/FS guidance of +50/-30 percent. The accuracy of the estimates is subject to substantial variation because details of the specific design will not be known until any remedy is implemented. For example, if a remedy were implemented, the actual site conditions, project scope and schedule, design details, competitive market conditions, changes during construction, labor, material, and equipment rates, and other variables are not known. Also, remedial design efforts might reveal possible cost savings as a result of value engineering studies and reduce the cost of implementing the remedy.

All cost estimates are shown in March 2005 dollars and include a 25 percent costing and scoping contingency. For capital cost items, percentage costs for contractor markup, mobilization/demobilization, and insurance (10 percent); engineering, permitting, and construction management (20 percent); and regulatory oversight (2.5 percent) are added to the estimated construction cost subtotal. Present worth cost estimates (assuming a 7 percent discount rate in accordance with the most recent EPA guidance [USEPA, 2000]) are also provided.

Detail regarding the assumptions used in developing the estimated costs for the various components of the alternatives is provided below.

Groundwater Monitoring. For purposes of preparing a cost estimate, it is assumed that preparation of planning documents would be required for groundwater monitoring. It is assumed that these planning documents would consist of modifications to the existing OU-1 RI/FS Work Plan (McLaren/Hart, 1994) or Additional Sampling and Analysis Plan (EMSI, 1997c) and address the wells to be sampled, parameters to be analyzed, analytical methods, frequency and methodology of sampling, quality assurance/quality control procedures to be employed, and reporting requirements. It is also assumed that a minimal effort associated with securing easements for monitoring would be conducted.

With respect to O&M costs for monitoring, sampling frequencies and proposed wells are discussed in Section 4. It is assumed that samples would be analyzed for gross alpha and beta, uranium isotopes and radium isotopes; the analytical results would be validated; and a brief report of the results would be prepared and submitted.

Institutional Controls. For purposes of preparing a cost estimate, it is assumed that approximately $20,000 of labor would be required to prepare and file the additional deed restriction institutional control discussed in Section 4. A unit price estimate of $24.00 per lineal foot (lf) for the additional fencing (6-foot high chain link with 3-strand barbed wire at top) access restriction under Alternative L2 was obtained from the Means Heavy Construction Cost Data 2004 (R.S. Means, 2003).

Soil Cover and Regrading/Landfill Cover Improvements. For the capital cost estimates developed for Alternatives L2, L3, L4, L5, and L6, it is assumed that a remedial action work plan would be required and that some effort would be necessary to secure access and easements for construction. It is also assumed that geotechnical testing of borrow materials to be used for the cover would be conducted; surveying to layout the site, survey control during regrading and placement of the cover, and record drawings of the top of cover topography would be necessary; and a construction completion report would be prepared at the end of construction. In addition, it is assumed that approximately 800 feet of the berm along the western edge of Area 2 adjacent to the buffer/Crossroad properties would be regraded through placement of additional fill materials from a sideslope of approximately 42 percent to a sideslope of 25 percent. Further, it is assumed that monitoring of site conditions (air flow, meteorological, and radiological), health and safety monitoring of personnel by a health and safety officer, and materials testing (sieve analyses and compaction) would be conducted during regrading and placement of the cover materials.

For placement of the 30-inch soil cover under Alternative L3, it is assumed that because of the compaction factor (i.e., loose cubic yards of soil delivered to the site versus in-place cubic yards of soil after placement and compaction), 40-inches of soil would be required to achieve the 30-inch thickness of soil cover. For the two-foot thick clay layer of the cover improvements under Alternatives L4, L5, and L6, a 20 percent allowance was assumed for compaction and an additional 25 percent allowance was added to account for additional soil anticipated to be required because of settlement of the landfilled materials in some areas of Areas 1 and 2. A 33 percent material compaction allowance was added to the one-foot thick topsoil/vegetative layer that would be placed above the initial two-foot thick soil layer under Alternatives L4, L5, and L6. These compaction allowances were obtained from The Building Estimator's Reference Book (Walker, 1999).

For those construction activities anticipated to occur at the surface of Areas 1 and 2, a 10 percent surcharge was added to the construction cost estimate for the following activities to account for the contractor to be health and safety trained/certified to perform construction activities at a CERCLA site: surveying, silt fence installation, drainage ditch installation, Area 2 berm regrading, clearing/grubbing/rough grading, addition of soil or regrading to achieve 2% or 5% slopes, and miscellaneous sitework.

Unit prices for other construction activities and materials associated with Alternatives L2, L3, L4, L5, and L6 were obtained from the most recent Means Heavy Construction Cost Data (R.S. Means, 2003), Dodge Unit Cost Guide (Marshall & Swift, 2000), The Building Estimator's Reference Book (Walker, 1999), the Environmental Cost Handling Options and Solutions Assemblies and Unit Cost books (ECHOS, 1995), and/or recent quotes from the Lafarge Rock Quarry in St. Charles, Missouri and are detailed below. For activities where unit cost information was not available, estimates based on EMSI experience at other sites were developed. Unit cost information from references dated prior to April 2004 was updated using Engineering News Record's (ENR's) Construction Cost Index (ENR, 2004).

Activity or Material	Units	Unit Rate ($)
Surveying	crew day	1,000
Silt fence	lineal foot	2.00
Drainage ditch	lineal foot	4.41
Clearing/grubbing	acre	2,100
Rough grading	acre	3,700
6" Rock fill	cubic yard	9.90
Soil fill		
Earth	cubic yard	5.67
Load/haul (5 to 10 miles)	cubic yard	8.97
Spread/Compact	cubic yard	3.49
Total	cubic yard	16.83
Topsoil fill		
Topsoil, purchase and spread	cubic yard	15.49
Load/haul (5 to 10 miles)	cubic yard	8.97
Total	cubic yard	24.46
Fertilize/seed/mulch	acre	1,500
Health & Safety Officer	hour	52.93
Mowing	acre	40.00

With respect to O&M costs for Alternatives L2, L3, L4, L5, and L6, it is estimated that the cover would require mowing three times per year, an annual inspection of the cover surface would be conducted, and an annual inspection report would be prepared. Also, for costing purposes, it is assumed that at an interval of once every five years, a CERCLA review would be conducted and approximately one acre of the cover would require maintenance and reseeding.

Alternative L1 Cost Estimates

5 - year Review Cost Estimate - First Review
Alternative L1 - No Action

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Costs:				
Labor and expenses	1	LS	20,000	20,000
Subtotal				20,000
Regulatory Oversight	1	LS	5,000	5,000
Estimated Costs Initial 5-year Review - Total				**25,000**

5 - year Review Cost Estimate - Subsequent to Initial Review
Alternative L1 - No Action

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Costs:				
Labor and expenses	1	LS	15,000	15,000
Subtotal				15,000
Regulatory Oversight	1	LS	5,000	5,000
Estimated Costs Subsequent 5-year Reviews - Total				**20,000**

Present Worth Cost Estimate
Alternative L1 - No Action

			5 - year Review Costs			Present	Cumulative
Year	*n*	P/F(*i* =7%)	Initial 5-yr Review	Subsequent 5-yr Reviews	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000			0	0	0
2006	1	0.93458			0	0	0
2007	2	0.87344			0	0	0
2008	3	0.81630			0	0	0
2009	4	0.76290			0	0	0
2010	5	0.71299	25,000		25,000	18,000	18,000
2011	6	0.66634			0	0	18,000
2012	7	0.62275			0	0	18,000
2013	8	0.58201			0	0	18,000
2014	9	0.54393			0	0	18,000
2015	10	0.50835		20,000	20,000	10,000	28,000
2016	11	0.47509			0	0	28,000
2017	12	0.44401			0	0	28,000
2018	13	0.41496			0	0	28,000
2019	14	0.38782			0	0	28,000
2020	15	0.36245		20,000	20,000	7,000	35,000
2021	16	0.33873			0	0	35,000
2022	17	0.31657			0	0	35,000
2023	18	0.29586			0	0	35,000
2024	19	0.27651			0	0	35,000
2025	20	0.25842		20,000	20,000	5,000	40,000
2026	21	0.24151			0	0	40,000
2027	22	0.22571			0	0	40,000
2028	23	0.21095			0	0	40,000
2029	24	0.19715			0	0	40,000
2030	25	0.18425		20,000	20,000	4,000	44,000
2031	26	0.17220			0	0	44,000
2032	27	0.16093			0	0	44,000
2033	28	0.15040			0	0	44,000
2034	29	0.14056			0	0	44,000
2035	30	0.13137		20,000	20,000	3,000	47,000
	Total Estimated Costs:		25,000	100,000			47,000

Alternative L2 Cost Estimates

Capital Cost Estimate

Alternative L2 - Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

(Fence and Cover Repair)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Additional Access Restrictions (fencing)				
Surveying	2	day	1,000	2,000
6' chain link fence and gates - Area 1	2,500	ft	24.00	60,000
6' chain link fence and gates - Area :	2,300	ft	24.00	55,200
Subtotal - Access Restriction				**117,000**
Existing Cover Repair				
Assume 20% of total area (45.2 ac) of Areas 1 and 2 would require placement of 1' thick of soil to repair and patch existing cover, cover bare spots, and revegetation				
Silt fence	1,920	ft	2.00	3,840
Geotechnical testing of borrow materials	1	ea	2,000	2,000
Perimeter drainage				
Drainage channels	320	lin ft	4.41	1,411
Areas 1 and 2 - Place soil				
Clearing/grubbing/regrading/preparation	9.0	acre	5,800	52,000
Deliver, place and compactsoil	14,585	cu yd	16.83	245,000
Survey control	5	day	1,000	5,000
Materials testing equipment during construction	0.25	month	2,000	1,000
Monitoring during construction				
Continuous monitoring/recording of air flow	1	LS	1,000	1,000
Meteorological	0.25	month	2,000	1,000
Radiological (radon, particulates, and radioisotopes)	0.25	month	16,000	4,000
Health and safety monitoring	0.25	month	260,000	65,000
Surveying ("record drawings"	2	day	1,000	2,000
Subtotal - Existing Cover Repair				**383,000**
Estimated Construction Costs - Subtotal				**500,000**
Contractor Markup, Mob/demob, Insurance		%	10	50,000
Engineering, Permitting and Construction Management		%	20	100,000
Regulatory Oversigh		%	2.5	13,000
Estimated Project Capital Costs - Subtotal				**663,000**
Contingency		%	25	166,000
Estimated Fence/Cover Repair Capital Costs - Total				**830,000**

Capital Cost Estimate
Alternative L2 - Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

(Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Monitoring Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Monitoring Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Monitoring Capital Costs - Total				**38,000**

Capital Cost Estimate
Alternative L2 - Cover Repair and Maintenance, Additional Access Restrictions, Addition
Institutional Controls, and Monitoring

(Additional Institutional Controls)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Additional ICs Capital Costs - Subtotal				16,000
Contingency		%	25	4,000
Estimated Additional ICs Capital Costs - Total				**20,000**

Operation and Maintenance Cost Estimate
Alternative L2 - Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

(Monitoring and Cover repair)

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:					
Labor					
Field Technician Labor - groundwater monitoring: 11 wells		12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes		4	days	750	3,000
Materials and equipment					
Groundwater sample kits (11 wells) and filters + 2 duplicates		52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater		4	event	200	800
LEL meter rental - LF gas monitoring		4	event	100	400
Radon carbon cannisters		48	ea	50	2,400
Vehicle		16	days	100	1,600
Shipping of sample coolers		12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)					
Vacuum truck		16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)		220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]					
Gross alpha/beta		56	ea	60	3,360
Isotopic uranium		56	ea	120	6,720
Isotopic thorium		56	ea	120	6,720
Radium-226/Radium-228		56	ea	170	9,520
Volatile organics		56	ea	110	6,160
Semi-volatile organics		56	ea	220	12,320
Metals + Hg		56	ea	90	5,040
TOC		56	ea	45	2,520
Major anions and cations		56	ea	60	3,360
Phosphorus		56	ea	30	1,680
Ammonia		56	ea	35	1,960
Radon gas		48	ea	100	4,800
Full electronic data packages (% of analytical costs)		60,800	%	10%	6,080
Data validation		56	ea	200	11,200
Reporting		4	events	10,000	40,000
Estimated Annual Monitoring Costs - Subtotal					**145,300**
Estimated Annual Cover Repair Costs:					
Bi-annual inspection and report		2	each	6,000	12,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Cover maintenance (1 acre, 1' thick)		1,613	cu yd	16.83	27,000
Reseeding		1	acre	2,000	2,000
Estimated Annual Cover Maintenance Costs - Subtotal					**46,000**
Estimated Annual O&M Costs - Subtotal					**191,000**
Contingency			%	25	48,000
Estimated Annual Monitoring & Cover Repair Costs - Total					**239,000**

5 - year Review Cost Estimate

Alternative L2 - Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Costs:				
Labor and expenses	1	LS	15,000	15,000
Subtotal				15,000
Regulatory Oversight	1	LS	5,000	5,000
Estimated Costs Subsequent 5-year Reviews - Total				**20,000**

Present Worth Cost Estimate

Alternative L2 - Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring

			Capital Costs ($)				Annual O&M Costs ($/yr)				Present	Cumulative
Year	n	P/F(i=7%)	Fence and Cover Repair	Monitoring	Institutional Controls	Subtotal Capital Costs	Monitoring and Cover Repair	5 - Year Review	Subtotal O&M Costs	Total Costs ($)	Worth of Costs ($)	Present Worth ($)
2005	0	1.00000	830,000	38,000	20,000	888,000				888,000	888,000	888,000
2006	1	0.93458				0	239,000		239,000	239,000	223,000	1,111,000
2007	2	0.87344				0	239,000		239,000	239,000	209,000	1,320,000
2008	3	0.81630				0	239,000		239,000	239,000	195,000	1,515,000
2009	4	0.76290				0	239,000		239,000	239,000	182,000	1,697,000
2010	5	0.71299				0	239,000	20,000	259,000	259,000	185,000	1,882,000
2011	6	0.66634				0	239,000		239,000	239,000	159,000	2,041,000
2012	7	0.62275				0	239,000		239,000	239,000	149,000	2,190,000
2013	8	0.58201				0	239,000		239,000	239,000	139,000	2,329,000
2014	9	0.54393				0	239,000		239,000	239,000	130,000	2,459,000
2015	10	0.50835				0	239,000	20,000	259,000	259,000	132,000	2,591,000
2016	11	0.47509				0	239,000		239,000	239,000	114,000	2,705,000
2017	12	0.44401				0	239,000		239,000	239,000	106,000	2,811,000
2018	13	0.41496				0	239,000		239,000	239,000	99,000	2,910,000
2019	14	0.38782				0	239,000		239,000	239,000	93,000	3,003,000
2020	15	0.36245				0	239,000	20,000	259,000	259,000	94,000	3,097,000
2021	16	0.33873				0	239,000		239,000	239,000	81,000	3,178,000
2022	17	0.31657				0	239,000		239,000	239,000	76,000	3,254,000
2023	18	0.29586				0	239,000		239,000	239,000	71,000	3,325,000
2024	19	0.27651				0	239,000		239,000	239,000	66,000	3,391,000
2025	20	0.25842				0	239,000	20,000	259,000	259,000	67,000	3,458,000
2026	21	0.24151				0	239,000		239,000	239,000	58,000	3,516,000
2027	22	0.22571				0	239,000		239,000	239,000	54,000	3,570,000
2028	23	0.21095				0	239,000		239,000	239,000	50,000	3,620,000
2029	24	0.19715				0	239,000		239,000	239,000	47,000	3,667,000
2030	25	0.18425				0	239,000	20,000	259,000	259,000	48,000	3,715,000
2031	26	0.17220				0	239,000		239,000	239,000	41,000	3,756,000
2032	27	0.16093				0	239,000		239,000	239,000	38,000	3,794,000
2033	28	0.15040				0	239,000		239,000	239,000	36,000	3,830,000
2034	29	0.14056				0	239,000		239,000	239,000	34,000	3,864,000
2035	30	0.13137				0	239,000	20,000	259,000	259,000	34,000	3,898,000
	Total Estimated Costs:		830,000	38,000	20,000	888,000						3,900,000

Alternative L3 Cost Estimates

Capital Cost Estimate
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential
(Soil Cover)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Work Plan	1	ea	50,000	50,000
Surveying (site layout)	14	day	1,000	14,000
Secure access/easements	1	LS	10,000	10,000
Silt fence	9,600	ft	2.00	19,200
Geotechnical testing of borrow materials	1	ea	20,000	20,000
Perimeter drainage				
Drainage channels	1,600	lin ft	4.41	7,100
Area 2 berm regrading (800 feet)	20,000	cu yd	16.83	336,600
Construct cover				
Clearing/grubbing/regrading/preparation	45.2	acre	5,800	262,000
Deliver, place 30-inch soil cover	228,000	cu yd	16.83	3,837,000
Fertilize/seeding/mulching	45.2	acre	1,500	68,000
Survey control	46	day	1,000	46,000
Materials testing equipment during construction	3	month	2,000	6,000
Monitoring during construction				
Continuous monitoring/recording of air flow	1	LS	20,000	20,000
Meteorological	6	month	2,000	12,000
Radiological (radon, particulates, and radioisotopes)	3	month	16,000	48,000
Health and safety monitoring	3	month	21,667	65,000
Misc. sitework	1	LS	50,000	50,000
Surveying ("record drawings")	10	day	1,000	10,000
Construction Completion Report	1	LS	50,000	50,000
Health & safety surcharge for CERCLA site contractor	10	%	1,211,000	121,000
Estimated Construction Costs - Subtotal				**5,052,000**
Contractor Markup, Mob/demob, Insurance		%	10	505,000
Engineering, Permitting and Construction Management		%	20	1,010,000
Regulatory Oversight		%	2.5	126,000
Estimated Project Capital Costs - Subtotal				**6,693,000**
Contingency		%	25	1,673,000
Estimated Project Capital Costs - Total				**8,370,000**

Capital Cost Estimate
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential
(Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Project Capital Costs - Total				**38,000**

Capital Cost Estimate
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential
(Additional Institutional Controls)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Project Capital Costs - Subtotal				16,000
Contingency		%	25	4,000
Estimated Project Capital Costs - Total				**20,000**

Operation and Maintenance Cost Estimate - Soil Cover
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Operation & Maintenance Costs:					
Bi-annual inspection and report		2	each	6,000	12,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Estimated Project O&M Costs - Subtotal					17,000
Contingency			%	25	4,000
Estimated Project O&M Costs - Total					**21,000**

Operation and Maintenance Cost Estimate - Monitoring
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:				
Labor				
Field Technician Labor - groundwater monitoring: 11 wells	12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes	4	days	750	3,000
Materials and equipment				
Groundwater sample kits (11 wells) and filters + 2 duplicates	52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater	4	event	200	800
LEL meter rental - LF gas monitoring	4	event	100	400
Radon carbon cannisters	48	ea	50	2,400
Vehicle	16	days	100	1,600
Shipping of sample coolers	12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)				
Vacuum truck	16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)	220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]				
Gross alpha/beta	56	ea	60	3,360
Isotopic uranium	56	ea	120	6,720
Isotopic thorium	56	ea	120	6,720
Radium-226/Radium-228	56	ea	170	9,520
Volatile organics	56	ea	110	6,160
Semi-volatile organics	56	ea	220	12,320
Metals + Hg	56	ea	90	5,040
TOC	56	ea	45	2,520
Major anions and cations	56	ea	60	3,360
Phosphorus	56	ea	30	1,680
Ammonia	56	ea	35	1,960
Radon gas	48	ea	100	4,800
Full electronic data packages (% of analytical costs)	60,800	%	10%	6,080
Data validation	56	ea	200	11,200
Reporting	4	events	10,000	40,000
Estimated Annual Monitoring Costs - Subtotal				145,300
Contingency		%	25	36,000
Estimated Annual Monitoring Costs - Total				**181,000**

5 year Maintenance and Review Operation and Maintenance Cost Estimate
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Cover maintenance (1 acre, 1' thick)	1,613	cu yd	15	24,000
Reseeding	1	acre	2,000	2,000
5-year review	1	each	20,000	20,000
Estimated Project O&M Costs - Subtotal				46,000
Contingency		%	25	12,000
Estimated Project O&M Costs - Total				**58,000**

Present Worth Cost Estimate
Alternative L3 - Soil Cover to Address Gamma Exposure and Erosion Potential

			Capital Costs ($)				Annual Operation and Maintenance Costs ($/yr)						
Year	*n*	P/F(*i* =7%)	Soil Cover	Monitoring	Institutional Controls	Subtotal Capital Costs	Soil Cover	Monitoring	5 year Main + Review	Subtotal O&M Costs	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000	8,370,000	38,000	20,000	8,428,000					8,428,000	8,428,000	8,428,000
2006	1	0.93458				0	21,000	181,000		202,000	202,000	189,000	8,617,000
2007	2	0.87344				0	21,000	181,000		202,000	202,000	176,000	8,793,000
2008	3	0.81630				0	21,000	181,000		202,000	202,000	165,000	8,958,000
2009	4	0.76290				0	21,000	90,500		111,500	111,500	85,000	9,043,000
2010	5	0.71299				0	21,000		58,000	79,000	79,000	56,000	9,099,000
2011	6	0.66634				0	21,000	90,500		111,500	111,500	74,000	9,173,000
2012	7	0.62275				0	21,000			21,000	21,000	13,000	9,186,000
2013	8	0.58201				0	21,000	90,500		111,500	111,500	65,000	9,251,000
2014	9	0.54393				0	21,000			21,000	21,000	11,000	9,262,000
2015	10	0.50835				0	21,000	90,500	58,000	169,500	169,500	86,000	9,348,000
2016	11	0.47509				0	21,000			21,000	21,000	10,000	9,358,000
2017	12	0.44401				0	21,000	90,500		111,500	111,500	50,000	9,408,000
2018	13	0.41496				0	21,000			21,000	21,000	9,000	9,417,000
2019	14	0.38782				0	21,000	90,500		111,500	111,500	43,000	9,460,000
2020	15	0.36245				0	21,000		58,000	79,000	79,000	29,000	9,489,000
2021	16	0.33873				0	21,000	90,500		111,500	111,500	38,000	9,527,000
2022	17	0.31657				0	21,000			21,000	21,000	7,000	9,534,000
2023	18	0.29586				0	21,000	90,500		111,500	111,500	33,000	9,567,000
2024	19	0.27651				0	21,000			21,000	21,000	6,000	9,573,000
2025	20	0.25842				0	21,000	90,500	58,000	169,500	169,500	44,000	9,617,000
2026	21	0.24151				0	21,000			21,000	21,000	5,000	9,622,000
2027	22	0.22571				0	21,000	90,500		111,500	111,500	25,000	9,647,000
2028	23	0.21095				0	21,000			21,000	21,000	4,000	9,651,000
2029	24	0.19715				0	21,000	90,500		111,500	111,500	22,000	9,673,000
2030	25	0.18425				0	21,000		58,000	79,000	79,000	15,000	9,688,000
2031	26	0.17220				0	21,000	90,500		111,500	111,500	19,000	9,707,000
2032	27	0.16093				0	21,000			21,000	21,000	3,000	9,710,000
2033	28	0.15040				0	21,000	90,500		111,500	111,500	17,000	9,727,000
2034	29	0.14056				0	21,000			21,000	21,000	3,000	9,730,000
2035	30	0.13137				0	21,000	90,500	58,000	169,500	169,500	22,000	9,752,000
	Total Estimated Costs:		8,370,000	38,000	20,000	8,430,000							9,800,000

Alternative L4 Cost Estimates

Capital Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Regrading and Cover Installation)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Work Plan	1	ea	50,000	50,000
Surveying (site layout)	14	day	1,000	14,000
Secure access/easements	1	LS	10,000	10,000
Silt fence	9,600	ft	2.00	19,200
Geotechnical testing of borrow materials	1	ea	20,000	20,000
Perimeter drainage				
Drainage channels	1,600	lin ft	4.41	7,056
Area 2 berm regrading (800 feet) adjacent to buffer zone	20,000	cu yd	16.83	336,600
Area 1 - Soil fill to achieve minimum 2% grades				
Clearing/grubbing/regrading/preparation	10.4	acre	5,800	60,000
Deliver, place and compactsoil	23,467	cu yd	16.83	395,000
Survey control	5	day	1,000	5,000
Materials testing equipment during construction	0.25	month	2,000	1,000
Area 2 Soil fill to achieve minimum 2% grades				
Clearing/grubbing/regrading/preparation	34.8	acre	5,800	202,000
Deliver, place and compactsoil	88,289	cu yd	16.83	1,486,000
Survey control	18	day	1,000	18,000
Materials testing equipment during construction	1	month	2,000	2,000
Place cover over Areas 1 and 2				
Deliver and place 2' of 6" diameter rock	172,735	cu yd	9.90	1,710,000
Deliver and place soil to fill voids between rock (35% of rock volume)	60,457	cu yd	16.83	1,017,000
Deliver, place and compact 2' of 10^{5} compactedsoil	243,008	cu yd	16.83	4,090,000
Deliver, place 1' vegetative growth layer	124,648	cu yd	24.46	3,049,000
Fertilize/seeding/mulching	45.2	acre	1,500	68,000
Survey control	122	day	1,000	122,000
Materials testing equipment during construction	7	month	2,000	14,000
Monitoring during construction				
Continuous monitoring/recording of air flow	1	LS	20,000	20,000
Meteorological	12	month	2,000	24,000
Radiological (radon, particulates, and radioisotopes)	9	month	16,000	144,000
Health and safety monitoring	9	month	7,222	65,000
Misc. sitework	1	LS	50,000	50,000
Surveying ("record drawings")	10	day	1,000	10,000
Construction Completion Report	1	LS	50,000	50,000
Health & safety surcharge for CERCLA site contractor	10	%	930,000	93,000
Estimated Construction Costs - Subtotal				**13,152,000**
Contractor Markup, Mob/demob, Insurance		%	10	1,315,000
Engineering, Permitting and Construction Management		%	20	2,630,000
Regulatory Oversight		%	2.5	329,000
Estimated Project Capital Costs - Subtotal				**17,426,000**
Contingency		%	25	4,357,000
Estimated Project Capital Costs - Total				**21,780,000**

Capital Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Project Capital Costs - Total				**38,000**

Capital Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Additional Institutional Controls)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Project Capital Costs - Subtotal				16,000
Contingency		%	25	4,000
Estimated Capital Costs - Additional Institutional Controls - Total				**20,000**

Operation and Maintenance Cost Estimate - Cover System
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Operation & Maintenance Costs:					
Annual inspection and report		1	each	6,000	6,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Estimated Project O&M Costs - Subtotal					11,000
Contingency			%	25	3,000
Estimated Annual Cover Maintenance O&M Costs - Total					**14,000**

Operation and Maintenance Cost Estimate - 5 year Maintenance and Review
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Cover maintenance (1 acre, 1' thick)	1,613	cu yd	15	24,000
Reseeding	1	acre	2,000	2,000
5-year review	1	each	20,000	20,000
Estimated Project O&M Costs - Subtotal				46,000
Contingency		%	25	12,000
Estimated 5-year Maintenance O&M Costs - Total				**58,000**

Operation and Maintenance Cost Estimate - Monitoring
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Groundwater, Radon Gas, and Landfill Gas Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:				
Labor				
Field Technician Labor - groundwater monitoring: 11 wells	12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes	4	days	750	3,000
Materials and equipment				
Groundwater sample kits (11 wells) and filters + 2 duplicates	52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater	4	event	200	800
LEL meter rental - LF gas monitoring	4	event	100	400
Radon carbon cannisters	48	ea	50	2,400
Vehicle	16	days	100	1,600
Shipping of sample coolers	12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)				
Vacuum truck	16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)	220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]				
Gross alpha/beta	56	ea	60	3,360
Isotopic uranium	56	ea	120	6,720
Isotopic thorium	56	ea	120	6,720
Radium-226/Radium-228	56	ea	170	9,520
Volatile organics	56	ea	110	6,160
Semi-volatile organics	56	ea	220	12,320
Metals + Hg	56	ea	90	5,040
TOC	56	ea	45	2,520
Major anions and cations	56	ea	60	3,360
Phosphorus	56	ea	30	1,680
Ammonia	56	ea	35	1,960
Radon gas	48	ea	100	4,800
Full electronic data packages (% of analytical costs)	60,800	%	10%	6,080
Data validation	56	ea	200	11,200
Reporting	4	events	10,000	40,000
Estimated Annual Monitoring Costs - Subtotal				145,300
Contingency		%	25	36,000
Estimated Annual Monitoring Costs - Total				**181,000**

Present Worth Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (fill to minimum slope of 2%) and Installation of a Subtitle D Cover System

			Capital Costs ($)				Annual Operation and Maintenance Costs ($/yr)						
Year	*n*	P/F(*i* =7%)	2% Fill and Cover	Monitoring	Institutional Controls	Subtotal Capital Costs	Cover Improvements	Monitoring	5 year Main + Review	Subtotal O&M Costs	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000	21,780,000	38,000	20,000	21,838,000					21,838,000	21,838,000	21,838,000
2006	1	0.93458				0	14,000	181,000		195,000	195,000	182,000	22,020,000
2007	2	0.87344				0	14,000	181,000		195,000	195,000	170,000	22,190,000
2008	3	0.81630				0	14,000	181,000		195,000	195,000	159,000	22,349,000
2009	4	0.76290				0	14,000	90,500		104,500	104,500	80,000	22,429,000
2010	5	0.71299				0	14,000		58,000	72,000	72,000	51,000	22,480,000
2011	6	0.66634				0	14,000	90,500		104,500	104,500	70,000	22,550,000
2012	7	0.62275				0	14,000			14,000	14,000	9,000	22,559,000
2013	8	0.58201				0	14,000	90,500		104,500	104,500	61,000	22,620,000
2014	9	0.54393				0	14,000			14,000	14,000	8,000	22,628,000
2015	10	0.50835				0	14,000	90,500	58,000	162,500	162,500	83,000	22,711,000
2016	11	0.47509				0	14,000			14,000	14,000	7,000	22,718,000
2017	12	0.44401				0	14,000	90,500		104,500	104,500	46,000	22,764,000
2018	13	0.41496				0	14,000			14,000	14,000	6,000	22,770,000
2019	14	0.38782				0	14,000	90,500		104,500	104,500	41,000	22,811,000
2020	15	0.36245				0	14,000		58,000	72,000	72,000	26,000	22,837,000
2021	16	0.33873				0	14,000	90,500		104,500	104,500	35,000	22,872,000
2022	17	0.31657				0	14,000			14,000	14,000	4,000	22,876,000
2023	18	0.29586				0	14,000	90,500		104,500	104,500	31,000	22,907,000
2024	19	0.27651				0	14,000			14,000	14,000	4,000	22,911,000
2025	20	0.25842				0	14,000	90,500	58,000	162,500	162,500	42,000	22,953,000
2026	21	0.24151				0	14,000			14,000	14,000	3,000	22,956,000
2027	22	0.22571				0	14,000	90,500		104,500	104,500	24,000	22,980,000
2028	23	0.21095				0	14,000			14,000	14,000	3,000	22,983,000
2029	24	0.19715				0	14,000	90,500		104,500	104,500	21,000	23,004,000
2030	25	0.18425				0	14,000		58,000	72,000	72,000	13,000	23,017,000
2031	26	0.17220				0	14,000	90,500		104,500	104,500	18,000	23,035,000
2032	27	0.16093				0	14,000			14,000	14,000	2,000	23,037,000
2033	28	0.15040				0	14,000	90,500		104,500	104,500	16,000	23,053,000
2034	29	0.14056				0	14,000			14,000	14,000	2,000	23,055,000
2035	30	0.13137				0	14,000	90,500	58,000	162,500	162,500	21,000	23,076,000
	Total Estimated Costs:		21,780,000	38,000	20,000	21,840,000							23,100,000

Capital Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Regrading and Cover Installation)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Work Plan	1	ea	50,000	50,000
Surveying (site layout)	14	day	1,000	14,000
Secure access/easements	1	LS	10,000	10,000
Silt fence	9,600	ft	2.00	19,200
Geotechnical testing of borrow materials	1	ea	20,000	20,000
Perimeter drainage				
Drainage channels	1,600	lin ft	4.41	7,056
Area 2 berm regrading (800 feet)	20,000	cu yd	16.83	336,600
Area 1 Fill to achieve minimum 2% grades				
Clearing/grubbing/regrading/preparation	10.4	acre	5,800	60,000
Excavate (cut) subsurface material, load trucks and haul to fill area	15,173	in-place yd^3	10.15	154,000
place, spread and compact cut landfill material in fill area	30,346	loose yd^3		
Deliver, place and compact soil needed from offsite	144	cu yd	16.83	2,000
Survey control	7	day	1,000	7,000
Materials testing equipment during construction	1	month	2,000	2,000
Area 2 Cut/fill to achieve minimum 2% grades				
Clearing/grubbing/regrading/preparation	34.8	acre	5,800	202,000
Excavate (cut) subsurface material, load trucks and haul to fill area	125,668	in-place yd^3	10.15	1,276,000
place, spread and compact cut landfill material in fill area	251,336	loose yd^3		
Deliver, place and compact soil needed from offsite	8,527	cu yd	16.83	144,000
Survey control	53	day	1,000	53,000
Materials testing equipment during construction	3	month	2,000	6,000
Place cover over Areas 1 and 2				
Deliver and place 2' of 6" diameter rock	162,915	cu yd	9.90	1,613,000
Deliver and place soil to fill voids between rock (35% of rock volume)	57,020	cu yd	16.83	960,000
Deliver, place and compact 2' of 10^5 compacted soil	225,609	cu yd	16.83	3,797,000
Deliver, place 1' vegetative growth layer	116,861	cu yd	24.46	2,858,000
Fertilize/seeding/mulching	45.2	acre	1,500	68,000
Survey control	115	day	1,000	115,000
Materials testing equipment during construction	6	month	2,000	12,000
Monitoring during construction				
Continuous monitoring/recording of air flow	1	LS	20,000	20,000
Meteorological	13	month	2,000	26,000
Radiological (radon, particulates, and radioisotopes)	10	month	16,000	160,000
Health and safety monitoring	10	month	6,500	65,000
Misc. sitework	1	LS	50,000	50,000
Surveying ("record drawings")	10	day	1,000	10,000
Construction Completion Report	1	LS	50,000	50,000
Health & safety surcharge for CERCLA site contractor	10	%	1,481,000	148,000
Estimated Construction Costs - Subtotal				**12,315,000**
Contractor Markup, Mob/demob, Insurance		%	10	1,232,000
Engineering, Permitting and Construction Management		%	20	2,463,000
Regulatory Oversight		%	2.5	308,000
Estimated Project Capital Costs - Subtotal				**16,318,000**
Contingency		%	25	4,080,000
Estimated Project Capital Costs - Total				**20,400,000**

Capital Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Project Capital Costs - Total				**38,000**

Capital Cost Estimate

Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installa of a Subtitle D Cover System

(Additional Institutional Controls)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Project Capital Costs - Subtotal				16,000
Contingency		%	25	4,000
Estimated Capital Costs - Additional Institutional Controls - Total				**20,000**

Operation and Maintenance Cost Estimate - Cover System
Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installation of a Subtitle D Cover System

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Operation & Maintenance Costs:					
Annual inspection and report		1	each	6,000	6,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Estimated Project O&M Costs - Subtotal					11,000
Contingency			%	25	3,000
Estimated Annual Cover Maintenance O&M Costs - Total					**14,000**

Operation and Maintenance Cost Estimate - 5 year Maintenance and Review
Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installation of a Subtitle D Cover System

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Cover maintenance (1 acre, 1' thick)	1,613	cu yd	15	24,000
Reseeding	1	acre	2,000	2,000
5-year review	1	each	20,000	20,000
Estimated Project O&M Costs - Subtotal				46,000
Contingency		%	25	12,000
Estimated 5-year Maintenance O&M Costs - Total				**58,000**

Operation and Maintenance Cost Estimate - Monitoring
Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installation of a Subtitle D Cover System
(Groundwater, Radon Gas, and Landfill Gas Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:				
Labor				
Field Technician Labor - groundwater monitoring: 11 wells	12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes	4	days	750	3,000
Materials and equipment				
Groundwater sample kits (11 wells) and filters + 2 duplicates	52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater	4	event	200	800
LEL meter rental - LF gas monitoring	4	event	100	400
Radon carbon cannisters	48	ea	50	2,400
Vehicle	16	days	100	1,600
Shipping of sample coolers	12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)				
Vacuum truck	16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)	220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]				
Gross alpha/beta	56	ea	60	3,360
Isotopic uranium	56	ea	120	6,720
Isotopic thorium	56	ea	120	6,720
Radium-226/Radium-228	56	ea	170	9,520
Volatile organics	56	ea	110	6,160
Semi-volatile organics	56	ea	220	12,320
Metals + Hg	56	ea	90	5,040
TOC	56	ea	45	2,520
Major anions and cations	56	ea	60	3,360
Phosphorus	56	ea	30	1,680
Ammonia	56	ea	35	1,960
Radon gas	48	ea	100	4,800
Full electronic data packages (% of analytical costs)	60,800	%	10%	6,080
Data validation	56	ea	200	11,200
Reporting	4	events	10,000	40,000
Estimated Annual Monitoring Costs - Subtotal				145,300
Contingency		%	25	36,000
Estimated Annual Monitoring Costs - Total				**181,000**

Present Worth Cost Estimate
Alternative L4 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 2%) and Installation of a Subtitle D Cover System

			Capital Costs ($)				Annual Operation and Maintenance Costs ($/yr)					Present	Cumulative
			2% Cut/Fill		Institutional	Subtotal	Cover		5 year	Subtotal	Total	Worth of	Present
Year	*n*	P/F(*i*=7%)	and Cover	Monitoring	Controls	Capital Costs	Improvements	Monitoring	Main + Review	O&M Costs	Costs ($)	Costs ($)	Worth ($)
2005	0	1.00000	20,400,000	38,000	20,000	20,458,000					20,458,000	20,458,000	20,458,000
2006	1	0.93458				0	14,000	181,000		195,000	195,000	182,000	20,640,000
2007	2	0.87344				0	14,000	181,000		195,000	195,000	170,000	20,810,000
2008	3	0.81630				0	14,000	181,000		195,000	195,000	159,000	20,969,000
2009	4	0.76290				0	14,000	90,500		104,500	104,500	80,000	21,049,000
2010	5	0.71299				0	14,000		58,000	72,000	72,000	51,000	21,100,000
2011	6	0.66634				0	14,000	90,500		104,500	104,500	70,000	21,170,000
2012	7	0.62275				0	14,000			14,000	14,000	9,000	21,179,000
2013	8	0.58201				0	14,000	90,500		104,500	104,500	61,000	21,240,000
2014	9	0.54393				0	14,000			14,000	14,000	8,000	21,248,000
2015	10	0.50835				0	14,000	90,500	58,000	162,500	162,500	83,000	21,331,000
2016	11	0.47509				0	14,000			14,000	14,000	7,000	21,338,000
2017	12	0.44401				0	14,000	90,500		104,500	104,500	46,000	21,384,000
2018	13	0.41496				0	14,000			14,000	14,000	6,000	21,390,000
2019	14	0.38782				0	14,000	90,500		104,500	104,500	41,000	21,431,000
2020	15	0.36245				0	14,000		58,000	72,000	72,000	26,000	21,457,000
2021	16	0.33873				0	14,000	90,500		104,500	104,500	35,000	21,492,000
2022	17	0.31657				0	14,000			14,000	14,000	4,000	21,496,000
2023	18	0.29586				0	14,000	90,500		104,500	104,500	31,000	21,527,000
2024	19	0.27651				0	14,000			14,000	14,000	4,000	21,531,000
2025	20	0.25842				0	14,000	90,500	58,000	162,500	162,500	42,000	21,573,000
2026	21	0.24151				0	14,000			14,000	14,000	3,000	21,576,000
2027	22	0.22571				0	14,000	90,500		104,500	104,500	24,000	21,600,000
2028	23	0.21095				0	14,000			14,000	14,000	3,000	21,603,000
2029	24	0.19715				0	14,000	90,500		104,500	104,500	21,000	21,624,000
2030	25	0.18425				0	14,000		58,000	72,000	72,000	13,000	21,637,000
2031	26	0.17220				0	14,000	90,500		104,500	104,500	18,000	21,655,000
2032	27	0.16093				0	14,000			14,000	14,000	2,000	21,657,000
2033	28	0.15040				0	14,000	90,500		104,500	104,500	16,000	21,673,000
2034	29	0.14056				0	14,000			14,000	14,000	2,000	21,675,000
2035	30	0.13137				0	14,000	90,500	58,000	162,500	162,500	21,000	21,696,000
	Total Estimated Costs:		20,400,000	38,000	20,000	20,460,000							21,700,000

Alternative L5 Cost Estimates

Capital Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installation of a Subtitle D Cover System
(Regrading and Cover Installation)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Work Plan	1	ea	50,000	50,000
Surveying (site layout)	14	day	1,000	14,000
Secure access/easements	1	LS	10,000	10,000
Silt fence	9,600	ft	2.00	19,200
Geotechnical testing of borrow materials	1	ea	20,000	20,000
Perimeter drainage				
Drainage channels	1,600	lin ft	4.41	7,056
Area 2 berm regrading (800 feet) adjacent to buffer zone	20,000	cu yd	16.83	336,600
Area 1 - Soil fill to achieve minimum 5% grades				
Clearing/grubbing/regrading/preparation	10.4	acre	5,800	60,000
Deliver, place and compactsoil	51,200	cu yd	16.83	862,000
Survey control	11	day	1,000	11,000
Materials testing equipment during construction	0.55	month	2,000	1,000
Area 2 Soil fill to achieve minimum 5% grades				
Clearing/grubbing/regrading/preparation	34.8	acre	5,800	202,000
Deliver, place and compactsoil	239,597	cu yd	16.83	4,032,000
Survey control	48	day	1,000	48,000
Materials testing equipment during construction	3	month	2,000	6,000
Place cover over Areas 1 and 2				
Deliver and place 2' of 6" diameter rock	148,287	cu yd	9.90	1,468,000
Deliver and place soil to fill voids between rock (35% of rock volume)	51,900	cu yd	16.83	873,000
Deliver, place and compact 2' of 10^{-5} compacted soil	206,397	cu yd	16.83	3,474,000
Deliver, place 1' vegetative growth layer	107,534	cu yd	24.46	2,630,000
Fertilize/seeding/mulching	45.2	acre	1,500	68,000
Survey control	103	day	1,000	103,000
Materials testing equipment during construction	6	month	2,000	12,000
Monitoring during construction				
Continuous monitoring/recording of air flow	1	LS	20,000	20,000
Meteorological	13	month	2,000	26,000
Radiological (radon, particulates, and radioisotopes)	10	month	16,000	160,000
Health and safety monitoring	10	month	6,500	65,000
Misc. sitework	1	LS	50,000	50,000
Surveying ("record drawings")	10	day	1,000	10,000
Construction Completion Report	1	LS	50,000	50,000
Health & safety surcharge for CERCLA site contractor	10	%	1,261,000	126,000
Estimated Construction Costs - Subtotal				**14,814,000**
Contractor Markup, Mob/demob, Insurance		%	10	1,481,000
Engineering, Permitting and Construction Management		%	20	2,963,000
Regulatory Oversight		%	2.5	370,000
Estimated Project Capital Costs - Subtotal				**19,628,000**
Contingency		%	25	4,907,000
Estimated Project Capital Costs - Total				**24,540,000**

Capital Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installation of a Subtitle D Cover System
(Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Project Capital Costs - Total				**38,000**

Capital Cost Estimate

Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installatio of a Subtitle D Cover System

(Additional Institutional Controls)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Project Capital Costs - Subtotal				16,000
Contingency		%	25	4,000
Estimated Capital Costs - Additional Institutional Controls - Total				**20,000**

Operation and Maintenance Cost Estimate - Cover System
Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installation of a Subtitle D Cover System

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Operation & Maintenance Costs:					
Annual inspection and report		1	each	6,000	6,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Estimated Project O&M Costs - Subtotal					11,000
Contingency			%	25	3,000
Estimated Annual Cover Maintenance O&M Costs - Total					**14,000**

Operation and Maintenance Cost Estimate - 5 year Maintenance and Review
Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installation of a Subtitle D Cover System

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Cover maintenance (1 acre, 1' thick)	1,613	cu yd	15	24,000
Reseeding	1	acre	2,000	2,000
5-year review	1	each	20,000	20,000
Estimated Project O&M Costs - Subtotal				46,000
Contingency		%	25	12,000
Estimated 5-year Maintenance O&M Costs - Total				**58,000**

Operation and Maintenance Cost Estimate - Monitoring
Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installation of a Subtitle D Cover System
(Groundwater, Radon Gas, and Landfill Gas Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:				
Labor				
Field Technician Labor - groundwater monitoring: 11 wells	12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes	4	days	750	3,000
Materials and equipment				
Groundwater sample kits (11 wells) and filters + 2 duplicates	52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater	4	event	200	800
LEL meter rental - LF gas monitoring	4	event	100	400
Radon carbon cannisters	48	ea	50	2,400
Vehicle	16	days	100	1,600
Shipping of sample coolers	12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)				
Vacuum truck	16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)	220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]				
Gross alpha/beta	56	ea	60	3,360
Isotopic uranium	56	ea	120	6,720
Isotopic thorium	56	ea	120	6,720
Radium-226/Radium-228	56	ea	170	9,520
Volatile organics	56	ea	110	6,160
Semi-volatile organics	56	ea	220	12,320
Metals + Hg	56	ea	90	5,040
TOC	56	ea	45	2,520
Major anions and cations	56	ea	60	3,360
Phosphorus	56	ea	30	1,680
Ammonia	56	ea	35	1,960
Radon gas	48	ea	100	4,800
Full electronic data packages (% of analytical costs)	60,800	%	10%	6,080
Data validation	56	ea	200	11,200
Reporting	4	events	10,000	40,000
Estimated Annual Monitoring Costs - Subtotal				145,300
Contingency		%	25	36,000
Estimated Annual Monitoring Costs - Total				**181,000**

Present Worth Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut to minimum slope of 5%) and Installation of a Subtitle D Cover System

			Capital Costs ($)				Annual Operation and Maintenance Costs ($/yr)					Present	Cumulative
Year	*n*	P/F(*i* =7%)	5% Fill and Cover	Monitoring	Institutional Controls	Subtotal Capital Costs	Cover Improvements	Monitoring	5 year Main + Review	Subtotal O&M Costs	Total Costs ($)	Worth of Costs ($)	Present Worth ($)
2005	0	1.00000	24,540,000	38,000	20,000	24,598,000					24,598,000	24,598,000	24,598,000
2006	1	0.93458				0	14,000	181,000		195,000	195,000	182,000	24,780,000
2007	2	0.87344				0	14,000	181,000		195,000	195,000	170,000	24,950,000
2008	3	0.81630				0	14,000	181,000		195,000	195,000	159,000	25,109,000
2009	4	0.76290				0	14,000	90,500		104,500	104,500	80,000	25,189,000
2010	5	0.71299				0	14,000		58,000	72,000	72,000	51,000	25,240,000
2011	6	0.66634				0	14,000	90,500		104,500	104,500	70,000	25,310,000
2012	7	0.62275				0	14,000			14,000	14,000	9,000	25,319,000
2013	8	0.58201				0	14,000	90,500		104,500	104,500	61,000	25,380,000
2014	9	0.54393				0	14,000			14,000	14,000	8,000	25,388,000
2015	10	0.50835				0	14,000	90,500	58,000	162,500	162,500	83,000	25,471,000
2016	11	0.47509				0	14,000			14,000	14,000	7,000	25,478,000
2017	12	0.44401				0	14,000	90,500		104,500	104,500	46,000	25,524,000
2018	13	0.41496				0	14,000			14,000	14,000	6,000	25,530,000
2019	14	0.38782				0	14,000	90,500		104,500	104,500	41,000	25,571,000
2020	15	0.36245				0	14,000		58,000	72,000	72,000	26,000	25,597,000
2021	16	0.33873				0	14,000	90,500		104,500	104,500	35,000	25,632,000
2022	17	0.31657				0	14,000			14,000	14,000	4,000	25,636,000
2023	18	0.29586				0	14,000	90,500		104,500	104,500	31,000	25,667,000
2024	19	0.27651				0	14,000			14,000	14,000	4,000	25,671,000
2025	20	0.25842				0	14,000	90,500	58,000	162,500	162,500	42,000	25,713,000
2026	21	0.24151				0	14,000			14,000	14,000	3,000	25,716,000
2027	22	0.22571				0	14,000	90,500		104,500	104,500	24,000	25,740,000
2028	23	0.21095				0	14,000			14,000	14,000	3,000	25,743,000
2029	24	0.19715				0	14,000	90,500		104,500	104,500	21,000	25,764,000
2030	25	0.18425				0	14,000		58,000	72,000	72,000	13,000	25,777,000
2031	26	0.17220				0	14,000	90,500		104,500	104,500	18,000	25,795,000
2032	27	0.16093				0	14,000			14,000	14,000	2,000	25,797,000
2033	28	0.15040				0	14,000	90,500		104,500	104,500	16,000	25,813,000
2034	29	0.14056				0	14,000			14,000	14,000	2,000	25,815,000
2035	30	0.13137				0	14,000	90,500	58,000	162,500	162,500	21,000	25,836,000
	Total Estimated Costs:		24,540,000	38,000	20,000	24,600,000							25,800,000

Capital Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installation of a Subtitle D Cover System
(Regrading and Cover Installation)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Work Plan	1	ea	50,000	50,000
Surveying (site layout)	14	day	1,000	14,000
Secure access/easements	1	LS	10,000	10,000
Silt fence	9,600	ft	2.00	19,200
Geotechnical testing of borrow materials	1	ea	20,000	20,000
Perimeter drainage				
Drainage channels	1,600	lin ft	4.41	7,056
Area 2 berm regrading (800 feet)	20,000	cu yd	16.83	336,600
Area 1 Cut/fill to achieve minimum 5% grades				
Clearing/grubbing/regrading/preparation	10.4	acre	5,800	60,000
Excavate (cut) subsurface material, load trucks and haul to fill area	16,696	in-place yd^3	10.15	169,000
place, spread and compact cut landfill material in fill area	33,392	loose yd^3		
Deliver, place and compact soil needed from offsite	0	cu yd	16.83	0
Survey control	7	day	1,000	7,000
Materials testing equipment during construction	1	month	2,000	2,000
Area 2 Cut/fill to achieve minimum 5% grades				
Clearing/grubbing/regrading/preparation	34.8	acre	5,800	202,000
Excavate (cut) subsurface material, load trucks and haul to fill area	115,169	in-place yd^3	10.15	1,169,000
place, spread and compact cut landfill material in fill area	230,338	loose yd^3		
Deliver, place and compact soil needed from offsite	0	cu yd	16.83	0
Survey control	47	day	1,000	47,000
Materials testing equipment during construction	3	month	2,000	6,000
Place cover over Areas 1 and 2				
Deliver and place 2' of 6" diameter rock	162,400	cu yd	9.90	1,608,000
Deliver and place soil to fill voids between rock (35% of rock volume)	56,840	cu yd	16.83	957,000
Deliver, place and compact 2' of 10^{-5} compacted soil	224,444	cu yd	16.83	3,777,000
Deliver, place 1' vegetative growth layer	113,555	cu yd	24.46	2,778,000
Fertilize/seeding/mulching	45.2	acre	1,500	68,000
Survey control	113	day	1,000	113,000
Materials testing equipment during construction	6	month	2,000	12,000
Monitoring during construction				
Continuous monitoring/recording of air flow	1	LS	20,000	20,000
Meteorological	13	month	2,000	26,000
Radiological (radon, particulates, and radioisotopes)	10	month	16,000	160,000
Health and safety monitoring	10	month	6,500	65,000
Misc. sitework	1	LS	50,000	50,000
Surveying ("record drawings")	10	day	1,000	10,000
Construction Completion Report	1	LS	50,000	50,000
Health & safety surcharge for CERCLA site contractor	10	%	1,687,000	169,000
Estimated Construction Costs - Subtotal				**11,982,000**
Contractor Markup, Mob/demob, Insurance		%	10	1,198,000
Engineering, Permitting and Construction Management		%	20	2,396,000
Regulatory Oversight		%	2.5	300,000
Estimated Project Capital Costs - Subtotal				**15,876,000**
Contingency		%	25	3,969,000
Estimated Project Capital Costs - Total				**19,850,000**

Capital Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installation of a Subtitle D Cover System
(Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Project Capital Costs - Total				**38,000**

Capital Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installa of a Subtitle D Cover System
(Additional Institutional Controls)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Project Capital Costs - Subtotal				16,000
Contingency		%	25	4,000
Estimated Capital Costs - Additional Institutional Controls - Total				**20,000**

Operation and Maintenance Cost Estimate - Cover System
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installation of a Subtitle D Cover System

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Operation & Maintenance Costs:					
Annual inspection and report		1	each	6,000	6,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Estimated Project O&M Costs - Subtotal					11,000
Contingency			%	25	3,000
Estimated Annual Cover Maintenance O&M Costs - Total					**14,000**

Operation and Maintenance Cost Estimate - 5 year Maintenance and Review
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installation of a Subtitle D Cover System

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Cover maintenance (1 acre, 1' thick)	1,613	cu yd	15	24,000
Reseeding	1	acre	2,000	2,000
5-year review	1	each	20,000	20,000
Estimated Project O&M Costs - Subtotal				46,000
Contingency		%	25	12,000
Estimated 5-year Maintenance O&M Costs - Total				**58,000**

Operation and Maintenance Cost Estimate - Monitoring
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installation of a Subtitle D Cover System
(Groundwater, Radon Gas, and Landfill Gas Monitoring)

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:				
Labor				
Field Technician Labor - groundwater monitoring: 11 wells	12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes	4	days	750	3,000
Materials and equipment				
Groundwater sample kits (11 wells) and filters + 2 duplicates	52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater	4	event	200	800
LEL meter rental - LF gas monitoring	4	event	100	400
Radon carbon cannisters	48	ea	50	2,400
Vehicle	16	days	100	1,600
Shipping of sample coolers	12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)				
Vacuum truck	16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)	220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]				
Gross alpha/beta	56	ea	60	3,360
Isotopic uranium	56	ea	120	6,720
Isotopic thorium	56	ea	120	6,720
Radium-226/Radium-228	56	ea	170	9,520
Volatile organics	56	ea	110	6,160
Semi-volatile organics	56	ea	220	12,320
Metals + Hg	56	ea	90	5,040
TOC	56	ea	45	2,520
Major anions and cations	56	ea	60	3,360
Phosphorus	56	ea	30	1,680
Ammonia	56	ea	35	1,960
Radon gas	48	ea	100	4,800
Full electronic data packages (% of analytical costs)	60,800	%	10%	6,080
Data validation	56	ea	200	11,200
Reporting	4	events	10,000	40,000
Estimated Annual Monitoring Costs - Subtotal				145,300
Contingency		%	25	36,000
Estimated Annual Monitoring Costs - Total				**181,000**

Present Worth Cost Estimate
Alternative L5 - Regrading of Areas 1 and 2 (cut/fill to minimum slope of 5%) and Installation of a Subtitle D Cover System

			Capital Costs ($)				Annual Operation and Maintenance Costs ($/yr)					Present	Cumulative
Year	*n*	P/F(*i* =7%)	5% Cut/Fill and Cover	Monitoring	Institutional Controls	Subtotal Capital Costs	Cover Improvements	Monitoring	5 year Main + Review	Subtotal O&M Costs	Total Costs ($)	Worth of Costs ($)	Present Worth ($)
2005	0	1.00000	19,850,000	38,000	20,000	19,908,000					19,908,000	19,908,000	19,908,000
2006	1	0.93458				0	14,000	181,000		195,000	195,000	182,000	20,090,000
2007	2	0.87344				0	14,000	181,000		195,000	195,000	170,000	20,260,000
2008	3	0.81630				0	14,000	181,000		195,000	195,000	159,000	20,419,000
2009	4	0.76290				0	14,000	90,500		104,500	104,500	80,000	20,499,000
2010	5	0.71299				0	14,000		58,000	72,000	72,000	51,000	20,550,000
2011	6	0.66634				0	14,000	90,500		104,500	104,500	70,000	20,620,000
2012	7	0.62275				0	14,000			14,000	14,000	9,000	20,629,000
2013	8	0.58201				0	14,000	90,500		104,500	104,500	61,000	20,690,000
2014	9	0.54393				0	14,000			14,000	14,000	8,000	20,698,000
2015	10	0.50835				0	14,000	90,500	58,000	162,500	162,500	83,000	20,781,000
2016	11	0.47509				0	14,000			14,000	14,000	7,000	20,788,000
2017	12	0.44401				0	14,000	90,500		104,500	104,500	46,000	20,834,000
2018	13	0.41496				0	14,000			14,000	14,000	6,000	20,840,000
2019	14	0.38782				0	14,000	90,500		104,500	104,500	41,000	20,881,000
2020	15	0.36245				0	14,000		58,000	72,000	72,000	26,000	20,907,000
2021	16	0.33873				0	14,000	90,500		104,500	104,500	35,000	20,942,000
2022	17	0.31657				0	14,000			14,000	14,000	4,000	20,946,000
2023	18	0.29586				0	14,000	90,500		104,500	104,500	31,000	20,977,000
2024	19	0.27651				0	14,000			14,000	14,000	4,000	20,981,000
2025	20	0.25842				0	14,000	90,500	58,000	162,500	162,500	42,000	21,023,000
2026	21	0.24151				0	14,000			14,000	14,000	3,000	21,026,000
2027	22	0.22571				0	14,000	90,500		104,500	104,500	24,000	21,050,000
2028	23	0.21095				0	14,000			14,000	14,000	3,000	21,053,000
2029	24	0.19715				0	14,000	90,500		104,500	104,500	21,000	21,074,000
2030	25	0.18425				0	14,000		58,000	72,000	72,000	13,000	21,087,000
2031	26	0.17220				0	14,000	90,500		104,500	104,500	18,000	21,105,000
2032	27	0.16093				0	14,000			14,000	14,000	2,000	21,107,000
2033	28	0.15040				0	14,000	90,500		104,500	104,500	16,000	21,123,000
2034	29	0.14056				0	14,000			14,000	14,000	2,000	21,125,000
2035	30	0.13137				0	14,000	90,500	58,000	162,500	162,500	21,000	21,146,000
	Total Estimated Costs:		19,850,000	38,000	20,000	19,910,000							21,100,000

Alternative L6 Cost Estimates

Capital Cost Estimate

Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' vegetation layer Cover System

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Work Plans (FSP, QAPP, CQCP, HSP)	1	ea	150,000	150,000
Surveying (site layout)	14	day	1,000	14,000
Secure access/easements	1	LS	10,000	10,000
Silt fence	9,600	ft	2.00	19,000
Establish staging area to load trucks	1	LS	10,000	10,000
Excavate subsurface material	42,430	cu yd	4.00	170,000
Load trucks with excavated material	84,860	cu yd	1.00	85,000
Truck hauling of excavated material to railyard	31,823	ton	7.10	226,000
Construct loading facility at railyard (truck to railcar)	1	LS	250,000	250,000
Transfer from truck to railcar	31,823	ton	2.00	64,000
Rail haul to disposal facility (Barnwell, SC)	50,916,800	ton-mile	0.15	7,638,000
Disposal fee (debris)	84,860	cu yd	353.49	29,997,000
Backfill excavated areas w/ imported fill	56,573	cu yd	16.83	952,000
Geotechnical testing of borrow materials	1	ea	20,000	20,000
Perimeter drainage				
Drainage channels	1,600	lin ft	4.41	7,000
Area 2 berm regrading (800 feet) adjacent to buffer zone	20,000	cu yd	16.83	337,000
Area 1 - Soil fill to achieve minimum 5% grades				
Clearing/grubbing/regrading/preparation	10.4	acre	5,800	60,000
Deliver, place and compact soil	51,200	cu yd	16.83	862,000
Survey control	11	day	1,000	11,000
Materials testing equipment during construction	0.55	month	2,000	1,000
Area 2 Soil fill to achieve minimum 5% grades				
Clearing/grubbing/regrading/preparation	34.8	acre	5,800	202,000
Deliver, place and compact soil	239,597	cu yd	16.83	4,032,000
Survey control	48	day	1,000	48,000
Materials testing equipment during construction	3	month	2,000	6,000
Place cover over Areas 1 and 2				
Deliver and place 2' of 6" diameter rock	148,287	cu yd	9.90	1,468,000
Deliver and place soil to fill voids between rock (35% of rock volume)	51,900	cu yd	16.83	873,000
Deliver, place and compact 2' of 10^5 compacted soil	206,397	cu yd	16.83	3,474,000
Deliver, place 1' vegetative growth layer	107,534	cu yd	24.46	2,630,000
Fertilize/seeding/mulching	45.2	acre	1,500	68,000
Survey control	103	day	1,000	103,000
Materials testing equipment during construction	6	month	2,000	12,000
Misc. sitework	1	LS	50,000	50,000
Monitoring during construction				
Confirmatory sampling of excavation	4.4	acre	7,000	31,000
Meteorological	13	month	2,000	26,000
Radiological (radon, particulates, and radioisotopes)	10	month	16,000	160,000
Health and safety monitoring	10	month	6,500	65,000
Health & safety surcharge for CERCLA site contractor	10	%	1,737,000	174,000
Surveying ("record drawings")	10	day	1,000	10,000
Construction Completion Report	1	LS	50,000	50,000
Estimated Construction Costs - Subtotal				54,365,000
Contractor Markup, Mob/demob, Insurance **		%	10	1,673,000
Engineering, Permitting and Construction Management **		%	20	3,346,000
Regulatory Oversight **		%	2.5	418,000
Estimated Project Capital Costs - Subtotal				59,800,000
Contingency		%	25	14,950,000
Preliminary Estimated Project Capital Costs - Total				**75,000,000**

** Note: Indirect costs not taken on rail haul and disposal fee.

Capital Cost Estimate

Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' vegetati layer Cover System

Monitoring

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Planning documents	1	LS	10,000	10,000
Secure easements	1	LS	1,000	1,000
Install/develop new groundwater monitoring wells S-8, I-62, D-83	180	feet	60	10,800
Install radon and landfill gas monitoring probes, 20' deep each	12	ea	650	7,800
Estimated Capital Costs - Subtotal				30,000
Contingency		%	25	8,000
Estimated Project Capital Costs - Total				**38,000**

Capital Cost Estimate
Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' veget layer Cover System
Additional Institutional Controls

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Capital Costs:				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Estimated Capital Costs - Additional Institutional Controls - Subtotal				16,000
Contingency		%	25	4,000
Estimated Capital Costs - Additional Institutional Controls - Total				**20,000**

Operation and Maintenance Cost Estimate
Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' vegetation layer Cover System
Cover System

Description		Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Operation & Maintenance Costs:					
Annual inspection and report		1	each	6,000	6,000
Mowing (3 times/year)	3	45.2	acre	40	5,000
Estimated Annual Cover Maintenance O&M Costs - Subtotal					11,000
Contingency			%	25	3,000
Estimated Annual Cover Maintenance O&M Costs - Total					**14,000**

Operation and Maintenance Cost Estimate

Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' vegetation layer Cover System

5 year Maintenance and Review

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Cover maintenance (1 acre, 1' thick)	1,613	cu yd	15	24,000
Reseeding	1	acre	2,000	2,000
5-year review	1	each	20,000	20,000
Estimated 5-year Maintenance and Review O&M Costs - Subtotal				46,000
Contingency		%	25	12,000
Estimated 5-year Maintenance and Review O&M Costs - Total				**58,000**

Operation and Maintenance Cost Estimate

Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' vegetation layer Cover System

Groundwater, Radon Gas, and Landfill Gas Monitoring

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Annual Monitoring Costs:				
Labor				
Field Technician Labor - groundwater monitoring: 11 wells	12	days	750	9,000
Field Technician Labor - radon and LF gas: 12 probes	4	days	750	3,000
Materials and equipment				
Groundwater sample kits (11 wells) and filters + 2 duplicates	52	ea	75	3,900
Field instrumentation and flowcell rental - groundwater	4	event	200	800
LEL meter rental - LF gas monitoring	4	event	100	400
Radon carbon cannisters	48	ea	50	2,400
Vehicle	16	days	100	1,600
Shipping of sample coolers	12	ship days	100	1,200
Disposal of purge water (assumes PE tank previously purchased is onsite)				
Vacuum truck	16	hr	90	1,440
Transportation and disposal (assumes approx 5 gal per well per event)	220	gallon	0.45	99
Analytical (28-day turn around time) [includes 2 duplicates and field blank]				
Gross alpha/beta	56	ea	60	3,360
Isotopic uranium	56	ea	120	6,720
Isotopic thorium	56	ea	120	6,720
Radium-226/Radium-228	56	ea	170	9,520

Present Worth Cost Estimate

Alternative L6 - Excavation of Material with Higher Levels of Radioactivity from Area 2; and Regrading of Areas 1 and 2 (fill to 5% slope) and Installation of a 2' rock/2' clay/1' vegetation layer Cover System

			Capital Costs ($)				Annual Operation and Maintenance Costs ($/yr)					Present	Cumulative
			Excavate + 5%		Institutional	Subtotal	Cover		5 year	Subtotal	Total	Worth of	Present
Year	*n*	P/F(*i* =7%)	Fill and Cover	Monitoring	Controls	Capital Costs	Improvements	Monitoring	Main + Review	O&M Costs	Costs ($)	Costs ($)	Worth ($)
2005	0	1.00000	75,000,000	38,000	20,000	75,060,000					75,060,000	75,060,000	75,060,000
2006	1	0.93458				0	14,000	181,000		195,000	195,000	182,000	75,242,000
2007	2	0.87344				0	14,000	181,000		195,000	195,000	170,000	75,412,000
2008	3	0.81630				0	14,000	181,000		195,000	195,000	159,000	75,571,000
2009	4	0.76290				0	14,000	90,500		104,500	104,500	80,000	75,651,000
2010	5	0.71299				0	14,000		58,000	72,000	72,000	51,000	75,702,000
2011	6	0.66634				0	14,000	90,500		104,500	104,500	70,000	75,772,000
2012	7	0.62275				0	14,000			14,000	14,000	9,000	75,781,000
2013	8	0.58201				0	14,000	90,500		104,500	104,500	61,000	75,842,000
2014	9	0.54393				0	14,000			14,000	14,000	8,000	75,850,000
2015	10	0.50835				0	14,000	90,500	58,000	162,500	162,500	83,000	75,933,000
2016	11	0.47509				0	14,000			14,000	14,000	7,000	75,940,000
2017	12	0.44401				0	14,000	90,500		104,500	104,500	46,000	75,986,000
2018	13	0.41496				0	14,000			14,000	14,000	6,000	75,992,000
2019	14	0.38782				0	14,000	90,500		104,500	104,500	41,000	76,033,000
2020	15	0.36245				0	14,000		58,000	72,000	72,000	26,000	76,059,000
2021	16	0.33873				0	14,000	90,500		104,500	104,500	35,000	76,094,000
2022	17	0.31657				0	14,000			14,000	14,000	4,000	76,098,000
2023	18	0.29586				0	14,000	90,500		104,500	104,500	31,000	76,129,000
2024	19	0.27651				0	14,000			14,000	14,000	4,000	76,133,000
2025	20	0.25842				0	14,000	90,500	58,000	162,500	162,500	42,000	76,175,000
2026	21	0.24151				0	14,000			14,000	14,000	3,000	76,178,000
2027	22	0.22571				0	14,000	90,500		104,500	104,500	24,000	76,202,000
2028	23	0.21095				0	14,000			14,000	14,000	3,000	76,205,000
2029	24	0.19715				0	14,000	90,500		104,500	104,500	21,000	76,226,000
2030	25	0.18425				0	14,000		58,000	72,000	72,000	13,000	76,239,000
2031	26	0.17220				0	14,000	90,500		104,500	104,500	18,000	76,257,000
2032	27	0.16093				0	14,000			14,000	14,000	2,000	76,259,000
2033	28	0.15040				0	14,000	90,500		104,500	104,500	16,000	76,275,000
2034	29	0.14056				0	14,000			14,000	14,000	2,000	76,277,000
2035	30	0.13137				0	14,000	90,500	58,000	162,500	162,500	21,000	76,298,000
	Total Estimated Costs:		75,000,000	38,000	20,000	75,100,000							76,000,000

Alternative F1 Cost Estimates

Capital Cost Estimate
Alternative F1 - No Action
(Soil Sampling)

Description	**Quantity**	**Units**	**Unit Rate**	**Estimated Cost**
Soil Sampling: 1 sample per 10 sq meters (196,000 sq ft area)				
Labor				
Field Technician Labor - assume 6 samples per hour	33	hour	75	2,500
Materials and equipment				
Soil sample kits	200	ea	5	1,000
Field instrumentation - gamma meter	4	day	100	400
Vehicle	4	days	100	400
Shipping of sample coolers	4	ship days	100	400
Analytical (28-day turn around time) [includes 1 duplicate per 10 samples]				
Isotopic uranium	220	ea	120	26,400
Isotopic thorium	220	ea	120	26,400
Radium-226/Radium-228	220	ea	170	37,400
Full electronic data packages (% of analytical costs)	90,200	%	10%	9,020
Data validation	220	ea	55	12,100
Reporting	1	event	10,000	10,000
Estimated Capital Costs - Subtotal				**126,000**
Contingency		%	25	32,000
Estimated Capital Costs - Total				**158,000**

Present Worth Cost Estimate
Alternative F1 - No Action

Year	*n*	P/F(*i*=7%)	Capital Costs ($) Soil Sampling	O&M Costs ($/yr)	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000	158,000		158,000	158,000	158,000
2006	1	0.93458		0	0	0	158,000
2007	2	0.87344		0	0	0	158,000
2008	3	0.81630		0	0	0	158,000
2009	4	0.76290		0	0	0	158,000
2010	5	0.71299		0	0	0	158,000
2011	6	0.66634		0	0	0	158,000
2012	7	0.62275		0	0	0	158,000
2013	8	0.58201		0	0	0	158,000
2014	9	0.54393		0	0	0	158,000
2015	10	0.50835		0	0	0	158,000
2016	11	0.47509		0	0	0	158,000
2017	12	0.44401		0	0	0	158,000
2018	13	0.41496		0	0	0	158,000
2019	14	0.38782		0	0	0	158,000
2020	15	0.36245		0	0	0	158,000
2021	16	0.33873		0	0	0	158,000
2022	17	0.31657		0	0	0	158,000
2023	18	0.29586		0	0	0	158,000
2024	19	0.27651		0	0	0	158,000
2025	20	0.25842		0	0	0	158,000
2026	21	0.24151		0	0	0	158,000
2027	22	0.22571		0	0	0	158,000
2028	23	0.21095		0	0	0	158,000
2029	24	0.19715		0	0	0	158,000
2030	25	0.18425		0	0	0	158,000
2031	26	0.17220		0	0	0	158,000
2032	27	0.16093		0	0	0	158,000
2033	28	0.15040		0	0	0	158,000
2034	29	0.14056		0	0	0	158,000
2035	30	0.13137		0	0	0	158,000
	Total Estimated Costs:		158,000				158,000

Alternative F2 Cost Estimates

Capital Cost Estimate
Alternative F2 - Institutional and Access Controls
(Soil Sampling, Establish Institutional Controls, Fence for Access Restriction)

Description	Quantity	Units	Unit Rate	Estimated Cost
Soil Sampling: 1 sample per 10 sq meters (196,000 sq ft area)				
Labor				
Field Technician Labor - assume 6 samples per hour	33	hour	75	2,500
Materials and equipment				
Soil sample kits	200	ea	5	1,000
Field instrumentation - gamma meter	4	day	100	400
Vehicle	4	days	100	400
Shipping of sample coolers	4	ship days	100	400
Analytical (28-day turn around time) [includes 1 duplicate per 10 samples]				
Isotopic uranium	220	ea	120	26,400
Isotopic thorium	220	ea	120	26,400
Radium-226/Radium-228	220	ea	170	37,400
Full electronic data packages (% of analytical costs)	90,200	%	10%	9,020
Data validation	220	ea	55	12,100
Reporting	1	event	10,000	10,000
Subtotal - Soil Sampling				**126,000**
Fence for Access Restriction				
6' chain link fence and gates	900	ft	24.00	21,600
Subtotal - Access Restriction				**21,600**
Institutional Controls				
Labor to establish Institutional Controls	1	LS	16,000	16,000
Subtotal - Institutional Controls				**16,000**
Estimated Capital Costs - Subtotal				**163,600**
Contingency		%	25	41,000
Estimated Capital Costs - Total				**205,000**

Operation and Maintenance and 5-year Review Cost Estimates
Alternative F2 - Institutional and Access Controls

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Land use monitoring (inspection) and letter report	1	each	3,000	3,000
Enforcement of Institutional Controls (attorney fees)	1	year	1,500	1,500
Estimated O&M Costs - Subtotal				4,500
Contingency		%	25	1,100
Estimated O&M Costs - Total				**5,600**

Present Worth Cost Estimate
Alternative F2 - Institutional and Access Controls

Year	*n*	P/F(*i* =7%)	Estimated Capital Costs ($)	Estimated O&M Costs ($/yr)	Estimated 5 - year Review Costs ($)	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000	205,000			205,000	205,000	205,000
2006	1	0.93458		5,600		5,600	5,000	210,000
2007	2	0.87344		5,600		5,600	5,000	215,000
2008	3	0.81630		5,600		5,600	5,000	220,000
2009	4	0.76290		5,600		5,600	4,000	224,000
2010	5	0.71299		5,600	8,100	13,700	10,000	234,000
2011	6	0.66634		5,600		5,600	4,000	238,000
2012	7	0.62275		5,600		5,600	3,000	241,000
2013	8	0.58201		5,600		5,600	3,000	244,000
2014	9	0.54393		5,600		5,600	3,000	247,000
2015	10	0.50835		5,600	8,100	13,700	7,000	254,000
2016	11	0.47509		5,600		5,600	3,000	257,000
2017	12	0.44401		5,600		5,600	2,000	259,000
2018	13	0.41496		5,600		5,600	2,000	261,000
2019	14	0.38782		5,600		5,600	2,000	263,000
2020	15	0.36245		5,600	8,100	13,700	5,000	268,000
2021	16	0.33873		5,600		5,600	2,000	270,000
2022	17	0.31657		5,600		5,600	2,000	272,000
2023	18	0.29586		5,600		5,600	2,000	274,000
2024	19	0.27651		5,600		5,600	2,000	276,000
2025	20	0.25842		5,600	8,100	13,700	4,000	280,000
2026	21	0.24151		5,600		5,600	1,000	281,000
2027	22	0.22571		5,600		5,600	1,000	282,000
2028	23	0.21095		5,600		5,600	1,000	283,000
2029	24	0.19715		5,600		5,600	1,000	284,000
2030	25	0.18425		5,600	8,100	13,700	3,000	287,000
2031	26	0.17220		5,600		5,600	1,000	288,000
2032	27	0.16093		5,600		5,600	1,000	289,000
2033	28	0.15040		5,600		5,600	1,000	290,000
2034	29	0.14056		5,600		5,600	1,000	291,000
2035	30	0.13137		5,600	8,100	13,700	2,000	293,000
	Total Estimated Costs:		205,000					290,000

Alternative F3 Cost Estimates

Capital Cost Estimate
Alternative F3 - Capping and Institutional and Access Controls
(Soil Sampling, Establish Institutional Controls, Fence of Access Restriction, and Capping)

Description	Quantity	Units	Unit Rate	Estimated Cost
Soil Sampling: 1 sample per 10 sq meters (196,000 sq ft area)				
Labor				
Field Technician Labor - assume 6 samples per hour	33	hour	75	2,500
Materials and equipment				
Soil sample kits	200	ea	5	1,000
Field instrumentation - gamma meter	4	day	100	400
Vehicle	4	days	100	400
Shipping of sample coolers	4	ship days	100	400
Analytical (28-day turn around time) [includes 1 duplicate per 10 samples]				
Isotopic uranium	220	ea	120	26,400
Isotopic thorium	220	ea	120	26,400
Radium-226/Radium-228	220	ea	170	37,400
Full electronic data packages (% of analytical costs)	90,200	%	10%	9,020
Data validation	220	ea	55	12,100
Reporting	1	event	10,000	10,000
Subtotal - Soil Sampling				**126,000**
Institutional Controls				
Labor to establish Institutional Control	1	LS	16,000	16,000
Subtotal - Institutional Controls				**16,000**
Fence for Access Restriction				
6' chain link fence and gates	900	ft	24.00	21,600
Subtotal - Access Restriction				**21,600**
Capping				
Surveying	2	day	1,000	2,000
Silt fence	7,000	ft	2.00	14,000
Clearing/grubbing/regrading/preparation	4.50	acre	5,800	26,000
Deliver, place 6-inches grave	3,630	cu yd	10.00	36,000
Subtotal - Capping Construction Costs				78,000
Contractor Markup, Mob/demob, Insurance		%	10	8,000
Engineering, Permitting and Construction Management		%	20	16,000
Regulatory Oversigh		%	2.5	2,000
Subtotal - Capping				**104,000**
Estimated Capital Costs - Subtotal				**267,600**
Contingency		%	25	67,000
Estimated Capital Costs - Total				**335,000**

Operation and Maintenance and 5-year Review Cost Estimates
Alternative F3 - Capping and Institutional and Access Controls

Description	Quantity	Units	Unit Rate	Estimated Cost
Estimated Operation & Maintenance Costs:				
Land use monitoring (inspection) and letter report	1	each	3,000	3,000
Enforcement of Institutional Controls (attorney fees)	1	year	1,500	1,500
Estimated O&M Costs - Subtotal				4,500
Contingency		%	25	1,100
Estimated O&M Costs - Total				**5,600**

Present Worth Cost Estimate
Alternative F3 - Capping and Institutional and Access Controls

Year	*n*	P/F(*i* =7%)	Estimated Capital Costs ($)	Estimated O&M Costs ($/yr)	Estimated 5 - year Review Costs ($)	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000	335,000			335,000	335,000	335,000
2006	1	0.93458		5,600		5,600	5,000	340,000
2007	2	0.87344		5,600		5,600	5,000	345,000
2008	3	0.81630		5,600		5,600	5,000	350,000
2009	4	0.76290		5,600		5,600	4,000	354,000
2010	5	0.71299		5,600	8,100	13,700	10,000	364,000
2011	6	0.66634		5,600		5,600	4,000	368,000
2012	7	0.62275		5,600		5,600	3,000	371,000
2013	8	0.58201		5,600		5,600	3,000	374,000
2014	9	0.54393		5,600		5,600	3,000	377,000
2015	10	0.50835		5,600	8,100	13,700	7,000	384,000
2016	11	0.47509		5,600		5,600	3,000	387,000
2017	12	0.44401		5,600		5,600	2,000	389,000
2018	13	0.41496		5,600		5,600	2,000	391,000
2019	14	0.38782		5,600		5,600	2,000	393,000
2020	15	0.36245		5,600	8,100	13,700	5,000	398,000
2021	16	0.33873		5,600		5,600	2,000	400,000
2022	17	0.31657		5,600		5,600	2,000	402,000
2023	18	0.29586		5,600		5,600	2,000	404,000
2024	19	0.27651		5,600		5,600	2,000	406,000
2025	20	0.25842		5,600	8,100	13,700	4,000	410,000
2026	21	0.24151		5,600		5,600	1,000	411,000
2027	22	0.22571		5,600		5,600	1,000	412,000
2028	23	0.21095		5,600		5,600	1,000	413,000
2029	24	0.19715		5,600		5,600	1,000	414,000
2030	25	0.18425		5,600	8,100	13,700	3,000	417,000
2031	26	0.17220		5,600		5,600	1,000	418,000
2032	27	0.16093		5,600		5,600	1,000	419,000
2033	28	0.15040		5,600		5,600	1,000	420,000
2034	29	0.14056		5,600		5,600	1,000	421,000
2035	30	0.13137		5,600	8,100	13,700	2,000	423,000
	Total Estimated Costs:		335,000					420,000

Alternative F4 Cost Estimates

Capital Cost Estimate
Alternative F4 - Soil Excavation and Consolidation in Area 2
(Soil Sampling, Establish Institutional Controls, Fence as Access Restriction, and Excavation of Soil)

Description	Quantity	Units	Unit Rate	Estimated Cost
Soil Sampling: 1 sample per 10 sq meters (196,000 sq ft area)				
Labor				
Field Technician Labor - assume 6 samples per hour	33	hour	75	2,500
Materials and equipment				
Soil sample kits	200	ea	5	1,000
Field instrumentation - gamma meter	4	day	100	400
Vehicle	4	days	100	400
Shipping of sample coolers	4	ship days	100	400
Analytical (28-day turn around time) [includes 1 duplicate per 10 samples]				
Isotopic uranium	220	ea	120	26,400
Isotopic thorium	220	ea	120	26,400
Radium-226/Radium-228	220	ea	170	37,400
Full electronic data packages (% of analytical costs)	90,200	%	10%	9,020
Data validation	220	ea	55	12,100
Reporting	1	event	10,000	10,000
Subtotal - Soil Sampling				**126,000**
Institutional Controls				
Labor to establish Institutional Control	1	LS	16,000	16,000
Subtotal - Institutional Controls				**16,000**
Fence for Access Restriction				
6' chain link fence and gates	900	ft	24.00	21,600
Subtotal - Access Restriction				**21,600**
Excavation of Soil with Radioactivity Above UMTRCA Standards				
Surveying	2	day	1,000	2,000
Silt fence	7,000	ft	2.00	14,000
Clearing/grubbing/regrading/preparation	4.50	acre	5,800	26,000
Excavate top 1' of soil and haul to Area 2	7,259	cu yd	10.15	74,000
Backfill top 1' of area of Lot 2A2 and Buffer Zon	7,259	cu yd	16.83	122,000
Excavation Construction - Subtotal				238,000
Contractor Markup, Mob/demob, Insurance		%	10	24,000
Engineering, Permitting and Construction Management		%	20	48,000
Regulatory Oversigh		%	2.5	6,000
Subtotal - Excavation of Soil and Haul to Area 2				**316,000**
Estimated Capital Costs - Subtotal				**480,000**
Contingency		%	25	120,000
Estimated Capital Costs - Total				**600,000**

Present Worth Cost Estimate
Alternative F4 - Soil Excavation and Consolidation in Area 2

Year	*n*	P/F(*i*=7%)	Estimated Capital Costs ($)	Total Costs ($)	Present Worth of Costs ($)	Cumulative Present Worth ($)
2005	0	1.00000	600,000	600,000	600,000	600,000
2006	1	0.93458		0	0	600,000
2007	2	0.87344		0	0	600,000
2008	3	0.81630		0	0	600,000
2009	4	0.76290		0	0	600,000
2010	5	0.71299		0	0	600,000
2011	6	0.66634		0	0	600,000
2012	7	0.62275		0	0	600,000
2013	8	0.58201		0	0	600,000
2014	9	0.54393		0	0	600,000
2015	10	0.50835		0	0	600,000
2016	11	0.47509		0	0	600,000
2017	12	0.44401		0	0	600,000
2018	13	0.41496		0	0	600,000
2019	14	0.38782		0	0	600,000
2020	15	0.36245		0	0	600,000
2021	16	0.33873		0	0	600,000
2022	17	0.31657		0	0	600,000
2023	18	0.29586		0	0	600,000
2024	19	0.27651		0	0	600,000
2025	20	0.25842		0	0	600,000
2026	21	0.24151		0	0	600,000
2027	22	0.22571		0	0	600,000
2028	23	0.21095		0	0	600,000
2029	24	0.19715		0	0	600,000
2030	25	0.18425		0	0	600,000
2031	26	0.17220		0	0	600,000
2032	27	0.16093		0	0	600,000
2033	28	0.15040		0	0	600,000
2034	29	0.14056		0	0	600,000
2035	30	0.13137		0	0	600,000
	Total Estimated Costs:		600,000			600,000

Table 2-1: Summary of Estimated Risks, West Lake Landfill Operable Unit 1

Exposure Scenario	**Carcinogenic Risks**			**Non-Carcinogenic**
	Radionuclides	**Chemicals**	**Total Cancer Risks**	**Hazard Index**
Current Exposures				
Onsite				
Groundskeeper adjacent to Area 1	1×10^{-5}	No exposure	1×10^{-5}	No exposure
Groundskeeper adjacent to Area 2	4×10^{-5}	No exposure	4×10^{-5}	No exposure
Offsite				
Ford Property Groundskeeper	6×10^{-7}	No exposure	6×10^{-7}	No exposure
Future Exposures				
Onsite				
Area 1 Groundskeeper	6×10^{-5}	2×10^{-7}	6×10^{-5}	0.0059
Area 2 Groundskeeper	2×10^{-4}	3×10^{-8}	2×10^{-4}	0.0022
Area 1 Adjacent Building User	1×10^{-5}	No exposure	1×10^{-5}	No exposure
Area 2 Adjacent Building User	4×10^{-5}	No exposure	4×10^{-5}	No exposure
Area 1 Storage Yard Worker	1×10^{-4}	No exposure	1×10^{-4}	No exposure
Area 2 Storage Yard Worker	4×10^{-4}	No exposure	4×10^{-4}	No exposure
Offsite				
Ford Property Groundskeeper	2×10^{-6}	No exposure	2×10^{-6}	No exposure

Table 3-1 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart A, Standards for the Control of Residual Radioactive Material from Inactive Uranium Processing Sites	Radon-222	Air	The annual average release rate of radon-222 to the atmosphere applied over the entire surface of a disposal site should not exceed 20 pCi/m2-s, and the annual average concentration of radon-222 in air at or above any location outside the disposal site should not be increased by more than 0.5 pCi/L.	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. The radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Therefore, the waste materials at West Lake Site are not similar to uranium mill tailings. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As these regulations address radon emissions, which is an issue for OU-1, they are considered potentially relevant and appropriate.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart A, Standards for the Control of Residual Radioactive Material from Inactive Uranium Processing Sites	Radium, Uranium, and trace metals	Ground-water	Establsihes maximum concentration of constituents for' groundwater protection. Maximum constituent concentration Combined Ra_{226} and Ra_{228} — 5 pCi/l Combined U_{234} and U_{238} — 30 pCi/l Gross alpha (excluding radon & urnaium) — 15 pCi/l Arsenic — 0.05 mg/L Barium — 1.0 mg/L Cadmium — 0.01 mg/L Chromium — 0.05 mg/L Lead — 0.05 mg/L Mercury — 0.002 mg/L Selenium — 0.01 mg/L Silver — 0.05 mg/L Nitrate (as N) — 10 mg/L Molybdenum — 0.1 mg/L	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. As potential leaching of radionuclides and trace metals from the radiologically impacted materials at West Lake is a possible issue of concern, these standards are potentially relevant and appropriate.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart B, Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites	Radium-226 (Radium-228)	Soil	Residual concentrations of radium-226 in soil at a designated uranium processing site should not exceed background by more than 5 pCi/g in the top 15 cm of soil or 15 pCi/g in each 15 cm layer below the top layer, averaged over an area of 100 m^2. (Similar limits are indirectly indicated for radium-22 in Subpart E, which addresses thorium by-product material.)	Neither applicable nor relevant and appropriate to Areas 1 and 2 Potentially relevant and appropriate for radiologically impacted soil on the buffer zone/ Crossroad prop.	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. The radiologically impacted materials at the West Lake site are a small fraction of an overall matr of municipal solid waste, debris and fill materials. Therefore, the waste materials at West Lake Site are not similar to uranium mill tailings. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. Consequently, these regulations are not relevant and appropriate to Areas 1 and 2. They are potentially relevant and appropriate for the radiologically impacted soil on the buffer zone/ Crossroad property.

Table 3-1 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart D, Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as amended; Subpart E, Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as amended	Radiation	Any	Processing operations during and prior to the end of the closure period at a facility managing uranium and thorium by-product materials should be conducted in a manner that provides reasonable assurance that the annual dose equivalent does not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive material to the general environment (excluding radon-222, radon-220, and their decay products).	Neither applicable nor relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. The radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Therefore, the waste materials at West Lake Site are not similar to uranium mill tailings. As alpha and gamma radiation is a potential exposure route for OU-1, these regaulations are considered to be potentially relevant and appropriate.
OSWER Directive No. 9200.4-25	Radium-226 Radium-228 Thorium-230 Throium-228	Soil	Clarifies EPA's position on the use of the soil cleanup criteria in 40 CFR Part 192 at CERCLA sites with radioactive contamination. In particular it clarifies the intent of 40 CFR Part 192 in setting remediation levels for subsurface soil, Also, Thorium-230 and Thorium-232 should be cleaned-up to the same concentrations as their radium progeny. (5 and 15 pCi/g).	Not an ARAR but potentially a TBC for the buffer zone/ Crossroad prop.	As this is only guidance, it is not an ARAR. As 40 CFR 192 is considered to be potentially relevant and appropriate for the radiologically-impacted soil on the buffer zone/Crossroad property, this guidance would be a TBC for alternatives that include excavation of soil from these properties.
National Emissions Standards for Hazardous Air Pollutants (40 CFR 61), Subpart T, National Emissions Standards for Radon Emissions from the disposal of Uranium Mill Tailings	Radon-222	Air	Radon-222 emissions to ambient air from uranium mill tailings piles that are no longer operational should not exceed 20 pCi/m^2-s.	Potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated uranium mill tailings site, so this requirement would not be applicable; howeve it could be considered relevant and appropriate because a portion of the waste materials at the Site do emit radon.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Radiation	Any	For persons inside a controlled area, the maximum permissible whole-body dose due to all external sources of radiation within a controlled area is limited to 5 rems/year and 3 rems per quarter for the whole body, head and trunk, major portion of the bone marrow, gonads or lens of eye; 30 rems/year and 10 rems/quarter for the shin; and 75 rems/yr and 25 rems/quarter for the hands/forearms and feet/ankles. (Note: a controlled area is an area that requires control of access, occupancy, and working conditions for radiation protection purposes.)	Potentially relevant and appropriate	As these regulations address sources of inoizing radiation, they are not applicable; however, as they provide standards for protection from radiation, they are potentially relevant and appropriate. These regulations may be relevant and appropriate to the protection of workers inside of Areas 1 and 2 during any remedial actions that may be undertaken.

Table 3-1 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Radiation	Any	For persons outside a controlled area, the maximum permissible whole-body dose due to sources in or migrating from the controlled area is limited to 2 mrem in any 1 hour, 0.1 rem in any 7 consecutive days, and 0.5 rem in any 1 year. (Notes: a controlled area is an area that requires control of access, occupancy, and working conditions for radiation protection purposes; 0.5 rem = 500 mrem.)	Potentially relevant and appropriate	As these regulations address sources of inoizing radiation, they are not applicable; however, as they provide standards for protection from radiation, they are potentially relevant and appropriate. These regulations may be relevant and appropriate to the protection of the public outside of Areas 1 and 2 during any remedial actions that may be undertaken.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.040), Maximum Permissible Exposure Limits	Specific radionuclides (see table)	Air	The concentrations above natural background of radionuclides in air ouside a controlled area, averaged over any calendar quarter, should not exceed the following limits: Concentration Limit (uCi/mL) Isotope — Soluble — Insoluble Actinium-227 — 8 x 10-14 — 9 x 10-13 Lead-210 — 4 x 10-12 — 8 x 10-12 Protactinium-231 — 4 x 10-14 — 4 x 10-12 Radium-226 — 1 x 10-12 — 6 x 10-9 Radium-228 — 2 x 10-12 — 1 x 10-12 Radon-222 — 1 x 10-9 — NA Thorium-230 — 8 x 10-14 — 3 x 10-13 Thorium-232 — 7 x 10-14 — 4 x 10-13 Uranium-235 — 2 x 10-11 — 4 x 10-12 Uranium-238 — 3 x 10-12 — 5 x 10-12 NA = not applicable because radon-222 is a gas.	Potentially applicable	These requirements would be applicable to protection of the public during implementation of any remedial action. Specifically, these regulations potentially may require perimeter monitoring to be undertaken during any activities that may expose or disturb the radiologically-impacted materials at the Site.
Missouri Public Drinking Water Program - Contaminant Levels and Monitoring (10 CSR 60-4)	Inorganics, Synthetic Organic Compounds, Radionuclides, Secondary Contaminants, and Volatile Organic Compounds		Maximum contaminant levels for public water systems. Maximum Contaminant Levels Inorganics Antimony — 0.006 mg/L Arsenic — 0.05 mg/L Asbestos — 7×10^6 fibers/L Barium — 2 mg/L Beryllium — 0.004 mg/L Cadmium — 0.005 mg/L Chromium — 0.1 mg/L Cyanide — 0.2 mg/L Fluoride — 4.0 mg/L Mercury — 0.002 mg/L Nitrate (as N) — 10 mg/L Nitrite (as N) — 1 mg/L Total Nitrate + Nitrite (as N) — 10 mg/L Selenium — 0.01 mg/L Thallium — 0.002 mg/L	Not applicable Potentially relevant and appropriate	These standards apply to public water systems and therefore are not applicable to the West Lake Landfill. As these standards provide for maximum concentrations in drinking water and the alluvial aquifer could be used for drinking water outside of the West Lake landfill boundaries; these standarc are potentially relevant and appropriate for groundwater at the Site.

Table 3-1 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Public Drinking Water Program - Contaminant Levels and Monitoring (10 CSR 60-4) (cont.)			Maximum Contaminant Levels			
			Synthetic Organic Compounds			
			Alachlor	0.002 mg/L		
			Atrazine	0.003 mg/L		
			Benzo(a)pyrene	0.0002 mg/L		
			Carbonfugran	0.04 mg/L		
			Chlordane	0.002 mg/L		
			Dalapon	0.2 mg/L		
			Di(2-ethylhexyl) adipate	0.4 mg/L		
			Dibromochloropropane (DBCP)	0.0002 mg/L		
			Di(2-ethylhexyl) phthalate	0.006 mg/L		
			Dinoseb	0.007 mg/L		
			Diquat	0.02 mg/L		
			Endothall	0.1 mg/L		
			Endrin	0.002 mg/L		
			2,4-D	0.07 mg/L		
			Ethylene dibromide (EDB)	0.00005 mg/L		
			Glyphosoate	0.7 mg/L		
			Heptachlor	0.0004 mg/L		
			Heptachlor Epoxide	0.0002 mg/L		
			Hexachlorobenzene	0.001 mg/L		
			Hexachlorocyclopentadiene	0.05 mg/L		
			Lindane	0.0002 mg/L		
			Methoxychlor	0.04 mg/L		
			Oxamyl (Vydate)	0.2 mg/L		
			Picloram	0.5 mg/L		
			Polychlorinated biphenyls (PCBs)	0.0005 mg/L		
			Pentachlorophenol	0.001 mg/L		
			Simazine	0.004 mg/L		
			Toxaphene	0.003 mg/L		
			2,3,7,8-TCDD (Dioxin)	0.00000003 mg/L		
			2,4,5-TP (Silvex)	0.05 mg/L		
			Radionuclides			
			Combined Ra_{226} and Ra_{228}	5 pCi/l		
			Gross alpha (excluding radon & urnaium)	15 pCi/l		
			Uranium	30 ug/L		
			Secondary Contaminants			
			Aluminum	0.05 - 0.2 mg/L		
			Chloride	250 mg/L		
			Copper	1.0 mg/L		
			Fluoride	2.0 mg/L		
			Iron	0.3 mg/L		
			Manganese	0.05 mg/L		
			Silver	0.1 mg/L		
			Sulfate	250 mg/L		
			Total Dissolved Solid (TDS)	500 mg/L		
			Zinc	5 mg/L		

Table 3-1 : Preliminary Identification of Potential Chemical-Specific ARARs and TBC Criteria

Citation	Chemical	Medium	Requirement		Preliminary Determination	Remarks
Missouri Public Drinking Water Program - Contaminant Levels and Monitoring (10 CSR 60-4) (cont.)			Maximum Contaminant Levels			
			Volatile Organic Compounds			
			Benzene	0.005 mg/L		
			Carbon tetrachloride	0.005 mg/L		
			1,2-dichloroethane	0.005 mg/L		
			1,1-dichloroethylene	0.007 mg/L		
			para-dichlorobenzene	0.075 mg/L		
			1,1,1-thrichloroethane	0.2 mg/L		
			Trichloroethylene	0.005 mg/L		
			Vinyl chloride	0.002 mg/L		
			cis-1,2-dichloroethylene	0.07 mg/L		
			Dichloromethane	0.005 mg/L		
			1,2-dichloropropane	0.005 mg/L		
			Ethylbenzene	0.7 mg/L		
			Monodichlorobenzene	0.1 mg/L		
			o-dichlorobenzene	0.6 mg/L		
			Styrene	0.1 mg/L		
			Tetrachloroethylene	0.005 mg/L		
			Toluene	1 mg/L		
			1,2,4-Trichlorobenzene	0.07 mg/L		
			1,1,2-Trichloroethane	0.005 mg/L		
			trans-1,2-dischloroethylene	0.1 mg/L		
			Xylenes (total)	10 mg/L		

Table 3-2 : Preliminary Identification of Potential Location-Specific ARARs and TBC Criteria

Citation	Location	Requirement	Preliminary Determination	Remarks
Archeological and Historic Preservation Act (16 USC 469; PL 93-291; 88 Stat. 174)	Land	Data recovery and preservation activities should be conducted if prehistoric, historical, and archaelogical data might be destroyed as a result of a federal, federally assisted, or federally licensed activity or program.	Potentially applicable	No destruction of such data is expected to result from remedial action. The site has been considerably disturbed by past human activities and is therefore not expected to contain any such data. However, if these data were affected, e.g., at any potential off-site borrow area, the requirement would be applicable.
Endangered Species Act, as amended [16 USC 1531-1543; 50 CFR 17.402; 40 CFR 6.302(h)]	Any	Federal agencies should ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify any critical habitat.	Potentially applicable	No critical habitat has been identified in the affected area, and no adverse impacts to threatened or endangered species are expected to result from any remedial action. However, if such species were affected, the requirement would be applicable. A biological assessment was conducted during preparation of the Baseline Risk Assessment. No federal listed or proposed threatened and endangered species and their habitats were identified.
Missouri Wildlife Code (1989) (RSMo. 252.240;3 CSR 10-4.111), Endangered Species	Any	Endangered species, i.e., those designated by the U.S. Department of the Interior and the Missouri Department of Conservation as threatened or endangered (see1978 Code, RSMo. 252.240), should not be pursued, taken, possessed, or killed.	Potentially applicable	No critical habitat has been identified in the affected area, and no adverse impacts to threatened or endangered species are expected to result from any remedial action. However, if such species were affected, the requirement would be applicable.
Floodplain Management [Executive Order 11988; 40 CFR 6.302(b)]	Floodplain	Federal agencies should avoid, to the maximum extent possible, any adverse impacts associated with direct and indirect development of a floodplain.	Potentially applicable	This requirement may be applicable to any remedial action for the Ford Property and the North Surface Water Body. Mitigative measures would be taken to minimize any adverse impacts.
Governor's Executive Order 82-19	Floodplain	Potential effects of actions taken in a floodplain should be evaluated to avoid adverse impacts.	Potentially applicable	This requirement may be applicable to any remedial action for the Ford Property and the North Surface Water Body. Mitigative measures would be taken to minimize any adverse impacts.

Table 3-2 : Preliminary Identification of Potential Location-Specific ARARs and TBC Criteria

Citation	Location	Requirement	Preliminary Determination	Remarks
Clean Water Act (33 USC 1251-1376); Disposal Sites, Specifications(40 CFR 230), Dredged or Fill Material Discharges (Section 404 Program); Definitions, Exempt Activities Not Requiring Permits (40 CFR 232); State Program Regulations (40 CFR 233); General Regulatory Policies (33 CFR 320); Nationwide Permits (33 CFR 330)	Wetland	Dredge or fill material is not to be dischared into a wetland (as defined by the U.S. Army Corps of Engineers) without a permit.	Potentially applicable	This requirement would be applicable to any off-site borrow area if the location selected contained any wetlands or if the borrow activities could indirectly impact wetlands. No wetlands have been identified on-site.
Farmland Protection Policy Act (7 USC 4201 et seq.) Farmland Protection [7 CRF 658; 40 CFR 6.302(c)]	Farmland (prime, unique, or of state and local impor-tance)	Federal agencies should take steps to ensure that federal actions do not cause U.S. farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland or otherwise outweigh the benefits of maintaining farmland resources. Criteria developed by the U.S. Soil Conservation Service are to be used to identify and take into account the adverse effects of federal programs on farmland preservation. Federal agencies should consider alternative actions that could lessen adverse effects and should ensure that programs are compatible with state and local government and private programs and policies to protect farmland.	Potentailly applicable	This requirement would be applicable for any potential soil borrow area off-site. Mitigative measures and restoration activities would also be conducted at any off-site borrow area, as appropriate, to minimize any adverse impacts to farmland.
RCRA Subtitle D (40 CFR Part 258 Subpart B) and MDNR Solid Waste Regulations (10 CSR 80-3.010 (4)(B)(1	Proximity of solid waste landfills to the end of runways used for turbojet aircraft	Requires new or existing municipal solid waste landfills or lateral expansions that are located within 10,000 ft of any airport runway end used by turbojet aircraft to demonstrate that the units are designed and operated so that the MSWLF unit does not pose a bird hazard to aircraft.	Not applicable Potentially relevant and appropriate	As the OU-1 portion of the West Lake landfill closed in the 1970's and as none of the remedial alternatives under consideration include placement of additional solid waste, this requirement is not applicable. As some of the remedial alternatives include the potential to regrade existing solid waste, this requirement may potentially be relevant and appropriate.

Table 3-3 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart A, Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites	Radioactive waste disposal		Control of residual radioactive materials at designated uranium processing or depository sites should be designed to be effective for at least 200 years and up to 1,000 years, to the extent reasonably achievable. In addition, the control should be designed such that releases of radon-222 from the residual radioactive material would not exceed an average rate of 20 pCi/m2-s or increase the annual average concentration in air outside the disposal site by more than 0.5 pCi/L. Because this standard applies to design, monitoring after disposal is not required to demonstrate compliance.	Not applicable but potentially relevant and appropriate in part	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As OU-1 does contain radiologically impacted materials, these requirements may potentially be relevant; however, the radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Although the waste materials are not similar to uranium tailings, the wastes do contain radium and thorium; therefore the longevity standard is potentially relevant and appropriate. As the radiologically-0impacted materials do emit radon, the radon standard is potentially relevant and appropriate. As radiologically-impacted materials will remain on-site beyond the post-closure period for a solid waste landfill, longevity considerations should be factored into the cover design.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 CFR 192), Subpart D, Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the U.S. Atomic Energy Act of 1954, as amended; Subpart E, Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the U.S. Atomic Energy Act of 1954, as amended.	Radioactive waste disposal		Disposal areas for uranium and thorium by-product materials should be designed to be effective for at least 200 years and up to 1,000 years, to the extent reasonably achievable. In addition the control should be designed so that releases of radon-222 and radon-220 from these materials (i.e., excluding the cover) would not exceed an average of 20 pCi/m2-s. The standard applies to design, so monitoring for radon after inatallation of an appropriately designed cover is not required. (This requirement does not apply to any portion of the site that contains residual surface and subsurface concentrations of radium-226 and radium-228 at or below those identified in Subparts B and E, respectively, which were described under chemical-specific ARARs and TBCs.)	Not applicable but potentially relevant and appropriate in part	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As OU-1 does contain radiologically impacted materials, these requirements may potentially be relevant; however, the radiologically impacted materials at the West Lake site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Although the waste materials at West Lake Site are not similar to uranium mill tailings, the wastes do contain radium . and thorium; therefore the longevity standard is potentially relevant and appropriate. As the radiologically impacted materials will remain on-site beyond the 30-year post-closure period for a solid waste landfill, the 200/1000 year period, this standard is considered to be potentially relevant and appropriate.
Resource Conservation and Recovery Act (RCRA) Subtitle C	Hazardous waste management		Establishes standards for identification of and treatment, storage and disposal of hazardous wastes including hazardous wastes disposed in landfills.	Neither applicable nor relevant and appropriate	The radiologically impacted materials in Areas 1 and 2 do not meet the criteria for classification as hazardous wastes and therefore these requirements are not applicable. The radiologically impacted materials in Areas 1 and 2 are not similar to hazardous waste and therefore these requirements are not relevant and appropriate. The standards and design guidance for final covers may potentially be relevant;however, the Subtitle D standards are considered to be the appropriate criteria for final cover design.

Table 3-3 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.090), Disposal of Radioactive Wastes	Radioactive waste disposal		Radioactive waste material should not be disposed of by dumping or burial in soil, except at sites approved by and registered with the Missouri Department of Health; a permit should be obtained for holding and preparation of such material prior to disposal; and no releases to air or water should cause exposure of any person above the limits specified in 10-CSR 20-10.041.	Potentially applicable to offsite disposal	Certain of these requirements would be applicable to offsite disposal if this were part of the selected remedial action.
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 CSR 20-10.070), Storage of Radioactive Materials	Radioactive waste storage		Radioactive materials should be stored in a manner that will not result in the exposure of any person, during routine access to a controlled area, in excess of the limits identified in 19 CSR 20-10.040 (see related discussion for contaminant-specific requirements); a facility used to store materials that may emit radioactive gases or airborne particulate matter should be vented to ensure that the concentration of such substances in air does not constitute a radiation hazard; and provisions should be made to minimize hazards to emergency workers in the event of a fire, earthquake, flood, or windstorm.	Potentially applicable	These requirements would be applicable to the temporary storage of radiologically-impacted soils that might be generated during any remedial action.
Solid Waste Disposal Act, as amended (42 USC 6901, et seq.); Criteria for Municipal Solid Waste Landfills (40 CFR 258), Subpart F, Closure and Post-Closure Care	Solid waste disposal		Criteria for closure of a landfill unit and post-closure care requirements are specified. Cover system design requirements at closure include (1) an infiltration layer constructed of a minimum of 18 in. of earthen material with a permeability less than or equal to the permeability of the bottom liner system or no greater than 1 x 10-5 cm/s, whichever is less, and (2) an erosion protection layer of earthen material capable of supporting native plant growth; or equivalents approved by the director of an approved state program. Post-closure care requires maintenance of the integrity of the final cover system, the leachate collection system, groundwater monitoring, and gas monitoring for a period of 10 years or as necessary to protect human health and the envrionment. Management of the leachate may be terminated if the owner/operator demonstrates that leachate no longer poses a threat to human health and the environment.	Neither applicable nor relevant and appropriate	Neither applicable nor relevant and appropriate as solid waste landfills in Missouri are regulated by the Missouri solid waste regulations.
Missouri Solid Waste Rules (10 CSR 80), Chapter 3, Sanitary Landfills, 3.010(17), Cover	Solid waste disposal		The landfill should be covered to minimize fire hazard, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance. Final slope of the top shall be a minimum of 5%. No slopes shall ever exceed 33 1/3 % and slopes shall not exceed 25% without a detailed slope stability analysis. The final cover should be at least 2 ft of compacted clay with a permeability of 1 x 10^{-5} cm/sec or less overlain by 1 ft of soil capable of supporting vegetative growth.	Only applicable if Areas 1 or 2 are re-opened to accept additional solid wastes. Potentially relevant and appropriate for design of a new landfill cover.	These requirements are not applicable as they only apply to landfills in operation after 10-9-91. These rquriements would be applicable to addition of new waste material to Areas 1 and 2 if such an activity is included as part of a remedial alternative. The requirements for final slopes and cover design are potentially relevant and appropriate to the design of an upgraded landfill cover for Areas 1 and 2.

Table 3-3 : Preliminary Identification of Potential Action-Specific ARARs and TBC Criteria

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Missouri Solid Waste Rules (10 CSR 80), Chapter 4, Demolition Landfills, 4.010(17), Cover	Solid waste disposal		The landfill should be covered to minimize fire hazard, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance. Final slope of the top shall be a minimum of 5%. No slopes shall ever exceed 33 1/3 % and slopes shall not exceed 25% without a detailed slope stability analysis. The final cover should be at least 2 ft of compacted clay with a permeability of 1 x 10^{-5} cm/sec or less overlain by 1 ft of soil capable of supporting vegetative growth.	Only applicable if Areas 1 or 2 are re-opened to accept additional solid wastes. Potentially relevant and appropriate for design of a new landfill cover.	These requirements are not applicable as they only apply to landfills in operation after 10-9-91. These requirements would be applicable to addition of new waste material to Areas 1 and 2 if such an activity is included as part of a remedial alternative. The requirements for final slopes are potentially relevant and appropriate to the design of an upgraded landfill cover for Areas 1 and 2.
Closure and Post-Closure Plan Laidlaw Waste Systems (Bridgeton), Inc. Sanitary Landfill, December 1996, Revised September 1997	Landfill cover		Sets out closure and post-closure procedures for the West Lake Landfill, in particluar, the final cover, grading and vegetation plan.	Potential TBC	Sets out the procedures to be used at the landfill to comply with the MDNR Solid Waste Regulations. This document should be considered in the design and construction of any cover system or drainage improvements that may be constructed for Areas 1 and 2 or if aditional waste materials are placed in these areas as part of a remedial action. This docment will also need to be considered if any regarding and/or landfill cover improvements are implemented for Areas 1 or 2.
Noise Control Act, as Amended; Noise Pollution and Abatement Act	Construction activities		The public should be protected from noises that jeopardize human health or welfare.	Potentially applicable	These requirements would be applicable to any remedial action.

Table 4-1: Groundwater Monitoring Parameters

Constituent	UMTRA 40 CFR 192.02	MDNR 10 CSR 80-3	OU-1 Anticipated Groundwater Monitoring Program	Notes
Radionuclides				
Combined radium-226 and radium-228	x		x	
Combined uranium-226 and uranium-228	x		x	
Gross alpha (excluding radon and uranium)	x			
Isotopic thorium			x	
Inorganics				
Ammonia		x	x	
Antimony		x	x	
Arsenic	x	x	x	
Barium	x	x	x	
Beryllium		x	x	
Boron		x	x	
Cadmium	x	x	x	
Calcium		x	x	
Chromium	x	x	x	
Cobalt		x	x	
Copper		x	x	
Fluoride		x	x	
Hardness		x	x	
Lead	x	x	x	
Magnesium		x	x	
Manganese		x	x	
Mercury	x	x	x	
Molybdenum	x		x	
Nickel		x	x	
Nitrate/Nitrite	x	x	x	
Phosphorus		x	x	
Selenium	x	x	x	
Silver	x	x	x	
Sodium		x	x	
Sulfate		x	x	
Thallium		x	x	
Total Organic Carbon (TOC)		x	x	
Vanadium		x	x	
Zinc		x	x	

Table 4-1: Groundwater Monitoring Parameters (continued)

Constituent	UMTRA 40 CFR 192.02	MDNR 10 CSR 80-3	OU-1 Anticipated Groundwater Monitoring Program	Notes
Organics				
Acetone		x	x	
Acrylonitrile		x	x	
Benzene		x	x	
Bromochloromethane		x	x	
Bromodichloromethane		x	x	
Bromoform		x	x	
Carbon disulfide		x	x	
Carbon tetrachloride		x	x	
Chlorobenzene		x	x	
Chloroethane		x	x	
Chloroform		x	x	
Dibromochloromethane		x	x	
DBCP		x	x	
EDB		x	x	
o-Dichlorobenzene		x	x	
p-Dichlorobenzene		x	x	
trans-1,4-Dichloro-2-butene		x	x	
1,1-Dichloroethane		x	x	
1,2-Dichloroethane		x	x	
1,1-Dichloroethylene		x	x	
cis-1,2-Dichloroethylene		x	x	
trans-1,2-Dichloroethylene		x	x	
1,2-Dichloropropane		x	x	
cis-1,3-Dichloropropene		x	x	
trans-1,3-Dichloropropene		x	x	
Ethylbenzene		x	x	
2-Hexanone		x	x	
Methyl bromide		x	x	
Methyl chloride		x	x	
Methylene bromide		x	x	
Methylene chloride		x	x	
Methyl ethyl ketone		x	x	
Methyl iodide		x	x	
4-Methyl-2-pentanone		x	x	
Styrene		x	x	
1,1,1,2-Tetrachloroethane		x	x	
1,1,2,2-Tetrachloroethane		x	x	
Tetrachloroethylene		x	x	
Toluene		x	x	
1,1,1-Trichloroethane		x	x	
1,1,2-Trichloroethane		x	x	
Trichloroethylene		x	x	
Trichlorofluoromethane		x	x	
1,2,3-Trichloropropane		x	x	
Vinyl acetate		x	x	
Vinyl Chloride		x	x	
Xylenes		x	x	
Pesticides				
Endrin	x			Never detected at Site, not proposed for inclusion.
Lindane	x			Never detected at Site, not proposed for inclusion.
Methoxychlor	x			Never detected at Site, not proposed for inclusion.
Toxaphene	x			Never detected at Site, not proposed for inclusion.
2,4-D	x			Never detected at Site, not proposed for inclusion.
2,4,5-TP Silvex	x			Never detected at Site, not proposed for inclusion.

Table 6-1: Comparative Analysis of Alternatives

Alternative	Threshold Criteria: Overall Protection of Human Health and the Environment	Threshold Criteria: Compliance with ARARs	Primary Balancing Criteria: Long-Term Effectiveness and Permanence	Primary Balancing Criteria: Reduction of Toxicity, Mobility, and Volume	Primary Balancing Criteria: Short-Term Effectiveness	Primary Balancing Criteria: Implementability	Primary Balancing Criteria: Estimated Costs
L1: No Action	Protective of human health under current conditions assuming the existing institutional controls are monitored and enforced and the disposal areas are monitored and maintained, but not for potential future uses of the Site. Under No Action, existing land use restrictions would remain in effect. BRA evaluations indicate current conditions do not pose unacceptable risk. Future use of the Areas 1 and 2 could pose an unacceptable risk and therefore the No Action alternative is not protective of public health and the environment.	No Action may not meet all chemical-specific ARARs (e.g., Radon NESHAP and radium MCL). No action would meet the location- specific ARARs. The No Action alternative does not meet the containment goals or action-specific ARARs (Subtitle D landfill closure standards) of the presumptive remedy approach.	Institutional controls would not be monitored or maintained and the disposal areas would not be monitored and maintained. Future uses of Areas 1 and 2 could result in potential risk levels to onsite workers at the upper end or slightly above the generally accepted risk range used by EPA. Therefore, no action is not expected to be effective over the long-term.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	No short-term impacts. The RAOs of (1) exposure to radiation above health-/risk-based levels; (2) minimizing infiltration; (3) controlling surface water runoff and erosion; and (4) controlling radon and landfill gas from Areas 1 and 2 would not be met.	No implementability issues.	No capital costs. O&M: $20,000 to 25,000 every 5 years for 5-Year Review. Present Worth: $47,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L2: Cover Repair and Maintenance, Additional Access Restrictions, Additional Institutional Controls, and Monitoring	BRA evaluations indicate current conditions do not pose unacceptable risk. Future use of the Areas 1 and 2 would pose an unacceptable risk. This alternative includes monitoring, access controls (fencing), institutional controls, and maintenance of the landfill cover to restrict future uses to only those uses that would be protective of public health and the environment. Use of institutional controls as an alternative to engineered measures is inconsistent with NCP expectations and presumptive remedy approach to municipal landfill sites and therefore is not considered to be protective.	Would meet some but may not meet all chemical-specific ARARs (Radon NESHAP and radium MCL). L2 would meet the location-specific ARARs. Implementation of additional access restrictions and institutional controls would meet the location-specific ARARs. The additional access restrictions, additional institutional controls and monitoring and existing cover maintenance alternative does not meet the containment goals or action-specific ARARs (Subtitle D landfill closure standards) of the presumptive remedy approach.	Long-term effectiveness and permanence is increased by ongoing monitoring and maintenance of the existing cover, as the cover reduces the potential for erosion by wind or water, eliminates ponding and reduces resultant infiltration. Relies on monitoring and maintenance of existing and implementation of additional deed restrictions and institutional controls for long-term effectiveness, which would not meet EPA's preference for engineering controls and permanence. No actions would be taken to stabilize the physical integrity of the disposal areas.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	No short-term impacts. RAO of preventing exposure above health-/risk-based levels would be met immediately upon implementation of the amendment to the access and deed restrictions and installation of additional fencing. RAOs of minimizing infiltration; controlling surface water runoff and erosion; and controlling radon and landfill gas emissions from Areas 1 and 2 would not be completely met	No implementability issues.	Capital: $890,000 Annual O&M: $240,000 to 260,000 Present Worth: $3,900,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L3: Soil Cover to address gamma exposure and erosion potential	Protective of human health and environment. BRA evaluations indicate current conditions do not pose unacceptable risk. Potential future use of Areas 1 and 2 could pose an unacceptable risk that would be addressed by placement of the soil cover over the landfill and implementation, monitoring and enforcement of existing and additional access and institutional controls. A soil cover would prevent direct contact with surface soil, eliminate potential for wind-blown dust and storm-water/ snowmelt erosion of surface materials and subsequent transport, and reduce potential infiltration.	Should meet all chemical-specific ARARs. As no activities would occur that would affect potential location-specific ARARs for archeological resources, endangered species, floodplain, or wetlands, these ARARs would be met by the soil cover alternative. Impact to wetlands or farmland is not expected at any borrow source. Missouri Radiation Regulations and Noise Control Act action-specific ARARs require monitoring prior to placement of soil cover and limit amount of noise that could occur. Missouri Solid Waste Regulations include standards for final cover over landfills (slope angles, thickness, and engineering properties). These standards would not be met by this alternative.	All current or future risks should be within the EPA-accepted risk range of 10^{-4} to 10^{-6}. Soil cover would eliminate or reduce potential for exposure from gamma exposure, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, and incidental ingestion of soil containing radionuclides or other chemicals pathways. Since L3 would not necessarily be designed to restrict infiltration and prevent leaching to groundwater or subsurface migration of radon and landfill gas, it may not be effective in preventing migration or exposure via all of the identified pathways.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Short-term impact to the community and workers would be minimal during construction of soil cover. Cover installation would require workers and equipment that would initially disturb the soil. Dust control measures would probably be required. Installation of cover will probably destroy habitats, forcing wildlife to migrate to other areas. All RAOs except minimizing infiltration would be met immediately upon construction of soil cover.	Technically feasible. Because Areas 1 and 2 are within a larger area in an existing landfill, it may be difficult to design and construct soil cover over the steeper slopes along the margin of Area 2. Implementability will be influenced by availability and location of offsite soil borrow sources. Will probably require coordination with final cover requirements for existing sanitary landfill.	Capital: $8,400,000 Annual O&M: $20,000 to 200,000 Present Worth: $9,800,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L3: Soil Cover to address gamma exposure and erosion potential (continued)			Permanence would be improved with long-term cover maintenance and monitoring and enforcement of existing and additional access and institutional controls restricting uses and activities in Areas 1 and 2.				

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L4: Regrading of Areas 1 and 2 (2% minimum slope) and installation of Subtitle D Cover System	Placement of additional soil fill or cutting/filling of existing materials, construction of an upgraded landfill cover and additional deed and access restrictions preventing ancillary uses of Areas 1 and 2 would be protective of human health and the environment. Construction of a new landfill cover would prevent direct contact with surface soil, eliminate potential for windblown dust and erosion of surface materials and subsequent transport, and reduce potential for infiltration and leaching to groundwater.	Would meet all chemical-specific ARARs. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, or wetlands, these ARARs would be met. Minimization of impacts to the floodplain would be addressed during design of the landfill regrading. Impact to wetlands or farmland is not expected at any borrow source. Missouri Radiation Regulations and Noise Control Act action-specific ARARs would be addressed by monitoring at the property boundaries. L4 would meet Missouri Solid Waste Regulations for final cover thickness and engineering properties of cover materials; 2% slope would meet intent of providing sufficient slope for drainage, but would not meet prescriptive 5% slope requirement.	All current or future risks would be within the EPA-accepted risk range of 10^{-4} to 10^{-6}. Placement of additional fill material or cutting/filling of existing waste material and new landfill cover would eliminate exposure pathways. Permanence would be improved with long-term cover maintenance and additional access and institutional controls restricting uses and activities in Areas 1 and 2. The lower 2% slope under Alternative L4 would provide a greater degree of reliability against long-term erosion of the soil cover compared to the 5% slopes included in Alternative L5	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Short-term impact to the community and workers would be minimal during regrading and construction of cover. Regrading would require workers and equipment that would initially disturb the soil. Dust control measures would probably be required. Regrading and installation of cover will probably destroy habitat, forcing wildlife to migrate to other areas. All RAOs would be met upon construction of cover systems. Alternative could take several years to implement.	Technically feasible. May be difficult to re-compact existing material if the cut/fill option were used for regrading. Because Areas 1 and 2 are within a larger area in an existing landfill, it may be difficult to design and construct separate independent cover systems for Areas 1 and 2. Implementability will be influenced by availability and location of offsite clean fill/soil borrow sources. Will require coordination with final cover requirements for existing sanitary landfill.	Soil fill option to achieve minimum slope of 2%: Capital: $21,800,000 Annual O&M: $15,000 to 200,000 Present Worth: $23,100,000 Cut/fill existing materials option to achieve minimum slope of 2%: Capital: $20,500,000 Annual O&M: $15,000 to 200,000 Present Worth: $21,700,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L5: Regrading of Areas 1 and 2 (5% minimum slope) and installation of Subtitle D Cover System	Placement of additional soil fill or cutting/filling of existing materials, construction of an upgraded landfill cover and additional deed and access restrictions preventing ancillary uses of Areas 1 and 2 would be protective of public health and the environment, Construction of a new landfill cover would prevent direct contact with surface soil, eliminate potential for windblown dust and erosion of surface materials and subsequent transport, and reduce potential for infiltration and leaching to groundwater.	Would meet all chemical-specific ARARs. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, or wetlands, these ARARs would be met. Minimization of impacts to the floodplain would be addressed during design of the landfill regrading. Impact to wetlands or farmland is not expected at any borrow source. Missouri Radiation Regulations and Noise Control Act action-specific ARARs require monitoring prior to regrading and limit noise that could occur at property boundaries. L5 would meet Missouri Solid Waste Regulation standards for final cover thickness, properties of cover materials, and 5% slope requirement.	All current or future risks would be within the EPA-accepted risk range of 10^{-4} to 10^{-6}. Placement of additional fill material or cutting/filling of existing waste material and new landfill cover would eliminate exposure pathways. Permanence would be improved with long-term cover maintenance and additional access and institutional controls restricting uses and activities in Areas 1 and 2. As compared to 2% slopes under L4, 5% slopes should provide a greater degree of reliability against possible subsidence and associated increased infiltration that could result from subsidence.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Short-term impact to the community and workers would be minimal during regrading and construction of cover. Regrading would require workers and equipment that would initially disturb the soil. Dust control measures would probably be required. Regrading and installation of cover will probably destroy habitat, forcing wildlife to migrate to other areas. All RAOs would be met upon construction of cover systems. Alternative could take several years to implement.	Technically feasible. May be difficult to re-compact existing filled material if the cut/fill option were used for regrading. Because Areas 1 and 2 are within a larger area in an existing landfill, it may be difficult to design and construct separate independent cover systems for Areas 1 and 2. Will require coordination with final cover req'mts for existing sanitary landfill. Implementability will be influenced by availability and location of offsite clean fill/soil borrow sources.	Soil fill option to achieve slope of 5%: Capital: $24,600,000 Annual O&M: $15,000 to 200,000 Present Worth: $25,800,000 Cut/fill existing materials option to achieve minimum slope of 5%: Capital: $19,900,000 Annual O&M: $15,000 to 200,000 Present Worth: $21,100,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L6: Excavation of Material with Higher Levels of Radioactivity from Area 2 and regrading and installation of a Subtitle D cover system	Placement of additional soil fill or cutting/filling of existing materials, construction of an upgraded landfill cover and additional deed and access restrictions preventing ancillary uses of Areas 1 and 2 would be protective of public health and the environment. Construction of a new landfill cover would prevent direct contact with surface soil, eliminate potential for windblown dust and erosion of surface materials and subsequent transport, and reduce potential for infiltration and leaching to groundwater. Removal of materials with higher levels of radionuclides would lower the overall	Would meet all chemical-specific ARARs. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, or wetlands, these ARARs would be met. Minimization of impacts to the floodplain would be addressed during design of the landfill regrading. Impact to wetlands or farmland is not expected at any borrow source. Missouri Radiation Regulations and Noise Control Act action-specific ARARs would require monitoring during removal of material, landfill regrading and landfill cover construction and limit the amount of noise that could occur at the property boundaries. Depending upon the slope angle chosen, this alternative would meet Missouri Solid Waste	All current or future risks would be within the EPA-accepted risk range of 10^{-4} to 10^{-6}. Placement of additional fill material or cutting/filling of existing waste material and new landfill cover would eliminate exposure pathways. Permanence would be improved with long-term cover maintenance and additional access and institutional controls restricting uses and activities in Areas 1 and 2. Excavation of materials in Area 2 with higher levels of radioactivity would potentially reduce the overall magnitude of residual risk posed by the radiologically-impacted materials. However, as radiologically-	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Removal, transport, and disposal of material with higher levels of radioactivity would result in short-term impacts and potential risks to onsite workers and the community including offsite truck and rail transport accidents, odor issues, and potential short-term impacts associated with worker exposure during excavation of soil and segregation of soil that is dispersed in other wastes. Excavation of soil and subsequent backfill would require workers and equipment that would disturb	Technically feasible in general. Technical implementability issues: o Excavation of large volume of landfilled materials. o Addressing odor associated with excavating refuse. o Segregation/ screening of soil that is dispersed in other wastes.. o Transfer of debris/soil from trucks to railcars. Administrative implementability issues: o Transfer of radiologically impacted soil out of state.	Capital: $75,100,000 (for soil fill option to achieve slope of 5%) Annual O&M: $15,000 to 200,000 Present Worth: $76,000,000 Note: Both Capital and Present Worth costs for Alternative L6 are dependent upon the slope angle and regrading method chosen. Costs presented herein represent those for the soil fill option to achieve a slope of 5%.

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
L6 – Excavation of Material with Higher Levels of Radioactivity from Area 2 and regrading and installation of a Subtitle D cover system (continued).	amount of radiologically impacted materials at the site and the magnitude of residual risk. However, construction of an upgraded landfill cover and additional deed and access restrictions would required for L6 to be protective of public health and the environment.	Regulation standards for final cover thickness, properties of cover materials, and either the intent of, or the 5% prescriptive limit for the final slope requirement.	impacted materials would still remain, removal of materials in Area 2 with higher levels of radioactivity in and of itself would not significantly improve the reliability or degree of control that would be achieved by installation and maintenance of a new landfill cover.		the soil. Dust control measures would be required. All RAOs would be met upon construction of cover systems. Alternative could take several years to implement and would require extensive planning and permitting.	o Only a very limited number of offsite disposal options exist. o Securing a fair and reasonable unit price for disposal of impacted soil at a licensed offsite facility.	

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
F1: No Action	May be protective of human health under current conditions; however, uncertainty regarding the disposition of the soil piles created by prior grading by AAA Trailer necessitates an assumption that impacted soil above standards for unrestricted use may still be present. Therefore, this alternative would not be protective of human health and the environment.	Presuming impacted soil still remains on Lot 2A2 and/or the buffer zone, No Action would not meet the UMTRA chemical-specific ARARs for cleanup of soil on adjacent properties. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, floodplain or wetlands, these ARARs would be met. Would not meet the UMTRA standards for cleanup of land to unrestricted use standards.	The calculated human health risks to a potential current or future receptor working in buffer zone/Lot 2A2 were determined to be within the generally accepted risk range of 10^{-4} to 10^{-6} used by EPA; however, the uncertainty regarding the levels and extent of radionuclides that may remain in the soil created by the most recent grading by AAA Trailer necessitates an assumption that impacted soil above standards for unrestricted use may still be present. If soil containing radionuclides at levels above those for unrestricted use are still present on these properties, this alternative would neither be effective nor permanent.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Presuming that soil containing radionuclides at levels above standards for unrestricted use are still present on these properties, the RAO of preventing exposure to radiation above health-/risk-based levels would not be met.	This alternative would require a soil sampling program to assess the current conditions of radionuclide occurrences on Lot 2A2 and the buffer zone. Performance of soil sampling would require the cooperation of and a granting of access by the current owner and possibly lessee of Lot 2A2.	Capital: $160,000 No annual O&M costs Present Worth: $160,000

Table 6-1: Comparative Analysis of Alternatives (continued)

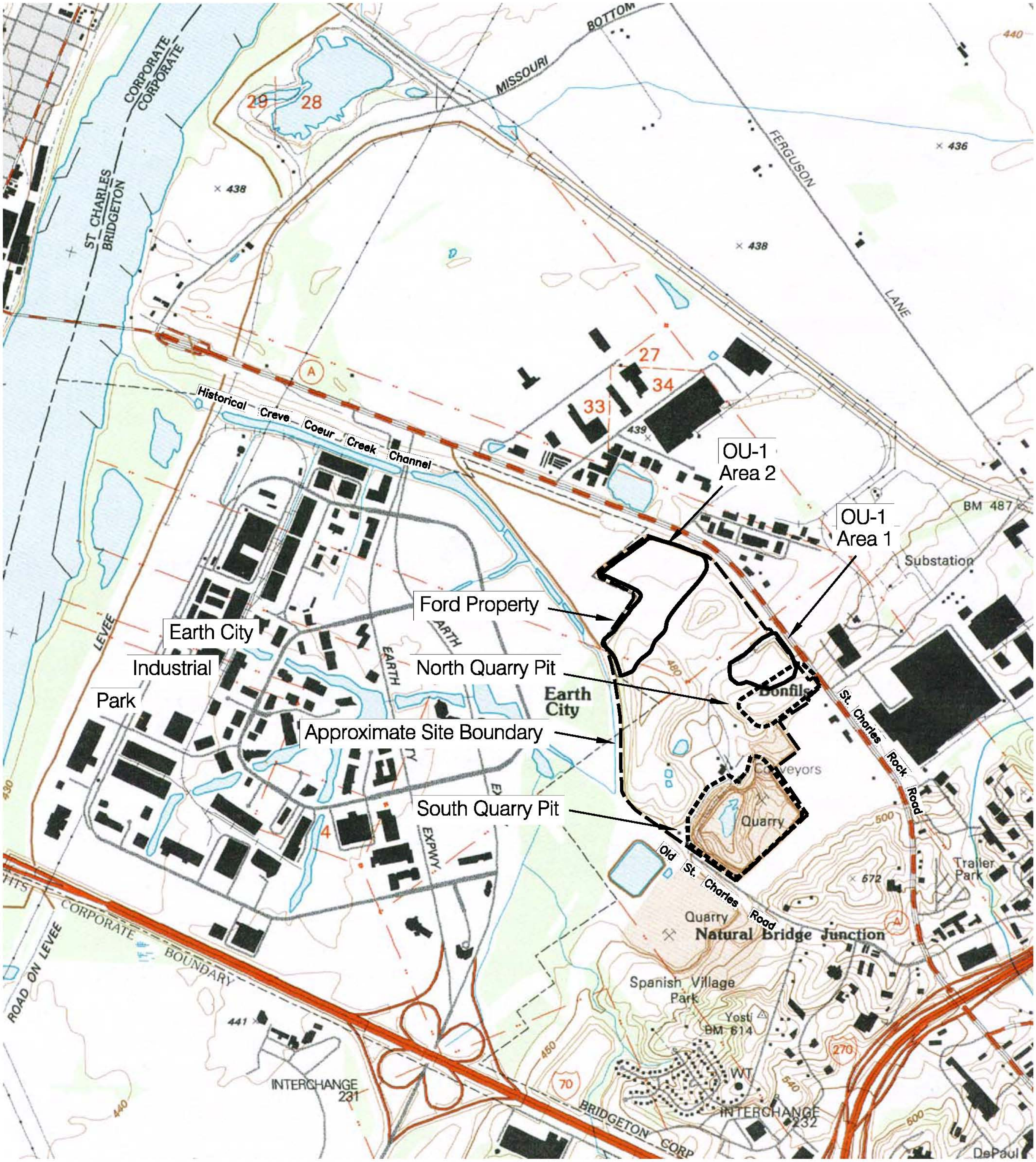
Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
F2: Institutional and Access Controls	May be protective of human health under current conditions; however, uncertainty regarding the disposition of the soil piles created by prior grading by AAA Trailer necessitates an assumption that impacted soil above standards for unrestricted use may still be present. Additional deed restrictions preventing unrestricted use of these properties would limit but not necessarily eliminate potential for exposure to soil containing radionuclides above acceptable risk-based levels. Use of institutional controls as an alternative to engineered measures is inconsistent with NCP expectations.	Presuming impacted soil still remains on Lot 2A2 and/or the buffer zone, No Action would not meet the UMTRA chemical-specific ARARs for cleanup of soil on adjacent properties. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, floodplain or wetlands, these ARARs would be met. Would not meet the UMTRA standards for cleanup of land to unrestricted use standard.	The calculated human health risks to a potential current or future receptor working in buffer zone/Lot 2A2 were determined to be within the generally accepted risk range of 10^{-4} to 10^{-6} used by EPA; however, the uncertainty regarding the levels and extent of radionuclides that may remain in the soil created by the most recent grading by AAA Trailer necessitates an assumption that impacted soil above standards for unrestricted use may still be present. This alternative relies on implementation of deed restrictions to eliminate potential exposures rather than engineered measures and therefore is not considered permanent.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	No short-term impacts. RAO of preventing exposure to radiation above health-/risk-based levels would be met immediately upon implementation of additional deed restrictions.	Implementation of deed restrictions will require consent of owner(s) of Crossroad Lot 2A2. This alternative would require a soil sampling program to assess the current conditions of radionuclide occurrences on Lot 2A2 and the buffer zone. Performance of soil sampling would require the cooperation of and a granting of access by the current owner and possibly lessee of Lot 2A2.	Capital: $210,000 Annual O&M: $6,000 to 14,000 Present Worth: $290,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
F3: Capping and Institutional and Access Controls	Uncertainty regarding the disposition of the soil piles created by prior grading by AAA Trailer would be addressed by capping and institutional controls which would prevent direct exposure to radionuclides. Therefore, this alternative would be protective of human health and the environment. Capping would prevent direct contact with surface soil, eliminate potential for windblown dust and stormwater/ snowmelt erosion of surface materials and subsequent transport.	Presuming impacted soil still remains on Lot 2A2 and/or the buffer zone, No Action would not meet the UMTRA chemical-specific ARARs for cleanup of soil on adjacent properties. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, or wetlands, these ARARs would be met. Minimization of impacts to the floodplain would be addressed during design of the cap. May not meet the UMTRA standards for cleanup of land to unrestricted use standard. Missouri Radiation Regulations and Noise Control Act action-specific ARARs would require monitoring prior to placement of soil cover and limit amount of noise that could occur at the property boundaries.	All current or future risks would be within the generally accepted risk range of 10^{-4} to 10^{-6}. Placement of a gravel, asphalt or other cap would eliminate exposure pathways. Permanence would be improved with long-term cap maintenance and institutional controls restricting future uses and activities to industrial/commercial uses.	There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Short-term impact to the community and workers would be minimal during construction of the cap. Cap installation would require workers and equipment that would initially disturb the soil. Dust control measures would probably be required. All RAOs would be met immediately upon construction of soil cover.	Technically feasible. Will require consent of owner(s) of Crossroad Lot 2A2.	Capital: $340,000 Annual O&M: $6,000 to 14,000 Present Worth: $420,000

Table 6-1: Comparative Analysis of Alternatives (continued)

Alternative	Threshold Criteria		Primary Balancing Criteria				
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Estimated Costs
F4: Soil Excavation and Consolidation in Area 2	Protective of human health and environment. Excavation of radiologically-impacted soil and consolidation on Area 2 would address uncertainty regarding the disposition of the soil piles created by prior grading by AAA Trailer. Excavation of radiologically-impacted soil and consolidation on Area 2 would prevent direct contact with surface soil, eliminate potential for windblown dust and stormwater/snowmelt erosion of surface materials and subsequent transport.	Would meet all chemical-specific ARARs including UMTRA standards for unrestricted use. As no activities would occur that would affect potential location-specific ARARs regarding archeological resources, endangered species, or wetlands, these ARARs would be met. Minimization of impacts to the floodplain would be addressed during design of the soil removal action Missouri Radiation Regulations and Noise Control Act action-specific ARARs would require monitoring prior to soil excavation and limit amount of noise that could occur at the property boundaries.	All current or future risks would be within the generally accepted risk range of 10^{-4} to 10^{-6}. Excavation of soil above UMTRA standards would eliminate exposure pathways. Allows for unrestricted use of the property without institutional controls. No long-term O&M would be required under this alternative.	Would provide a reduction in toxicity, mobility and volume of radiologically-impacted material on the buffer zone and Crossroad Lot 2A2. There would be no reduction in contaminant toxicity, mobility or volume through treatment. Therefore, no treatment residuals would be generated.	Short-term impact to the community and workers would be minimal during soil excavation and consolidation. Soil excavation and consolidation would require workers and equipment that would disturb the soil. Dust control measures would probably be required. All RAOs would be met immediately upon completion of the soil excavation and consolidation activities.	Technically feasible. Will require consent of owner(s) and possibly lessee(s) of Crossroad Lot 2A2. This alternative would require a soil sampling program to assess the current conditions of radionuclide occurrences on Lot 2A2 and the buffer zone. Performance of soil sampling would require the cooperation of and a granting of access by the current owner and possibly lessee of Lot 2A2.	Capital: $600,000 Annual O&M: $0 Present Worth: $600,000



Source: St. Charles, MO USGS
7.5' Quadrangle, 1994

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SCALE IN FEET

N

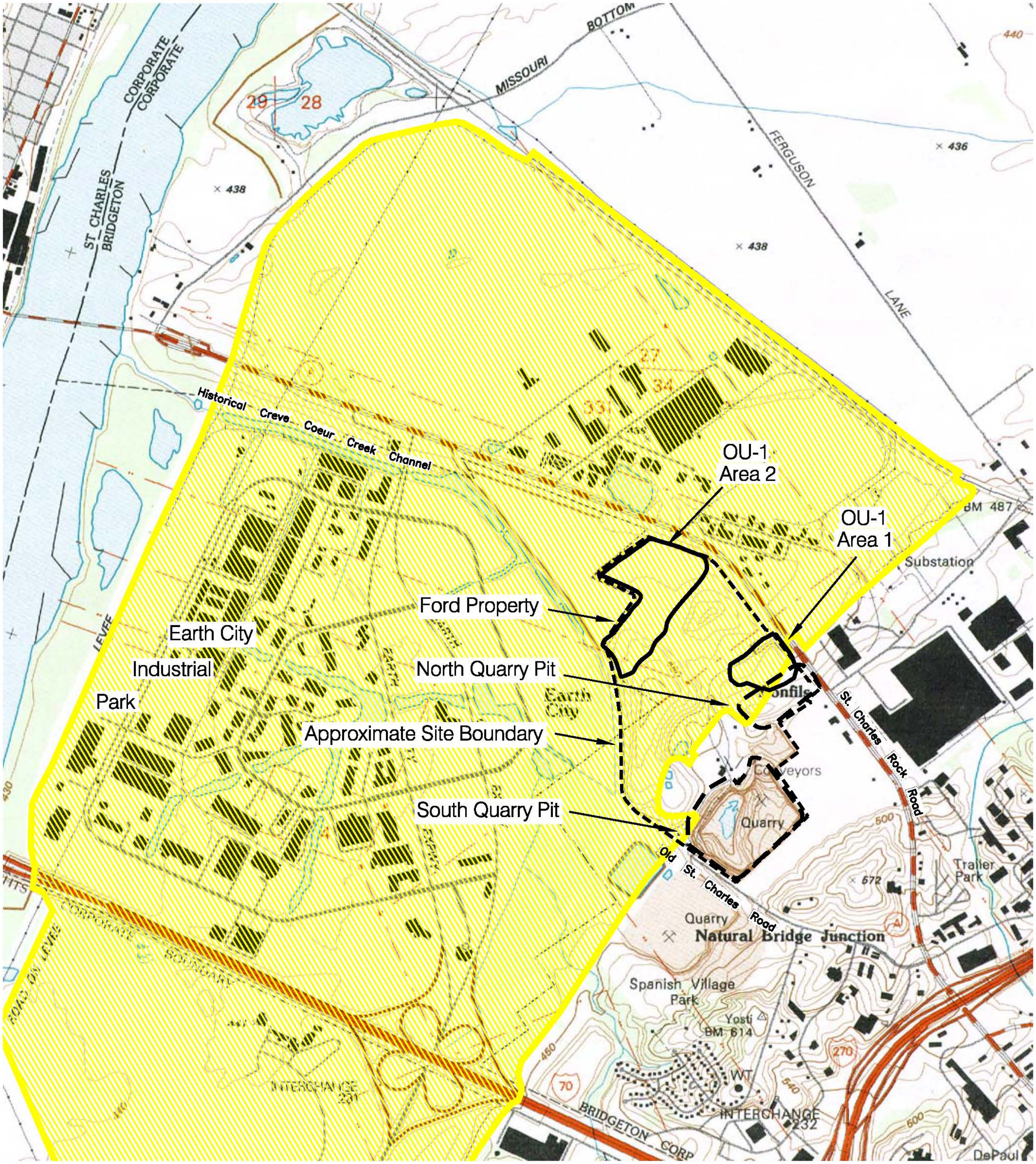
Figure 2-1

Site Location Map

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\4-04\fig2-1.DWG plotted: 04/05/2005



Source: St. Charles, MO USGS
7.5' Quadrangle, 1994

Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100 year flood.

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Figure 2-2

Flood Zone Map

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\11-04\fig2-2-Flood Zone Map.dwg plotted: 04/05/2005

M:\clients\EMSI\westlake\11-04\fig-2-3-Surf-Drain-Pat.dwg plotted: 04/05/2005

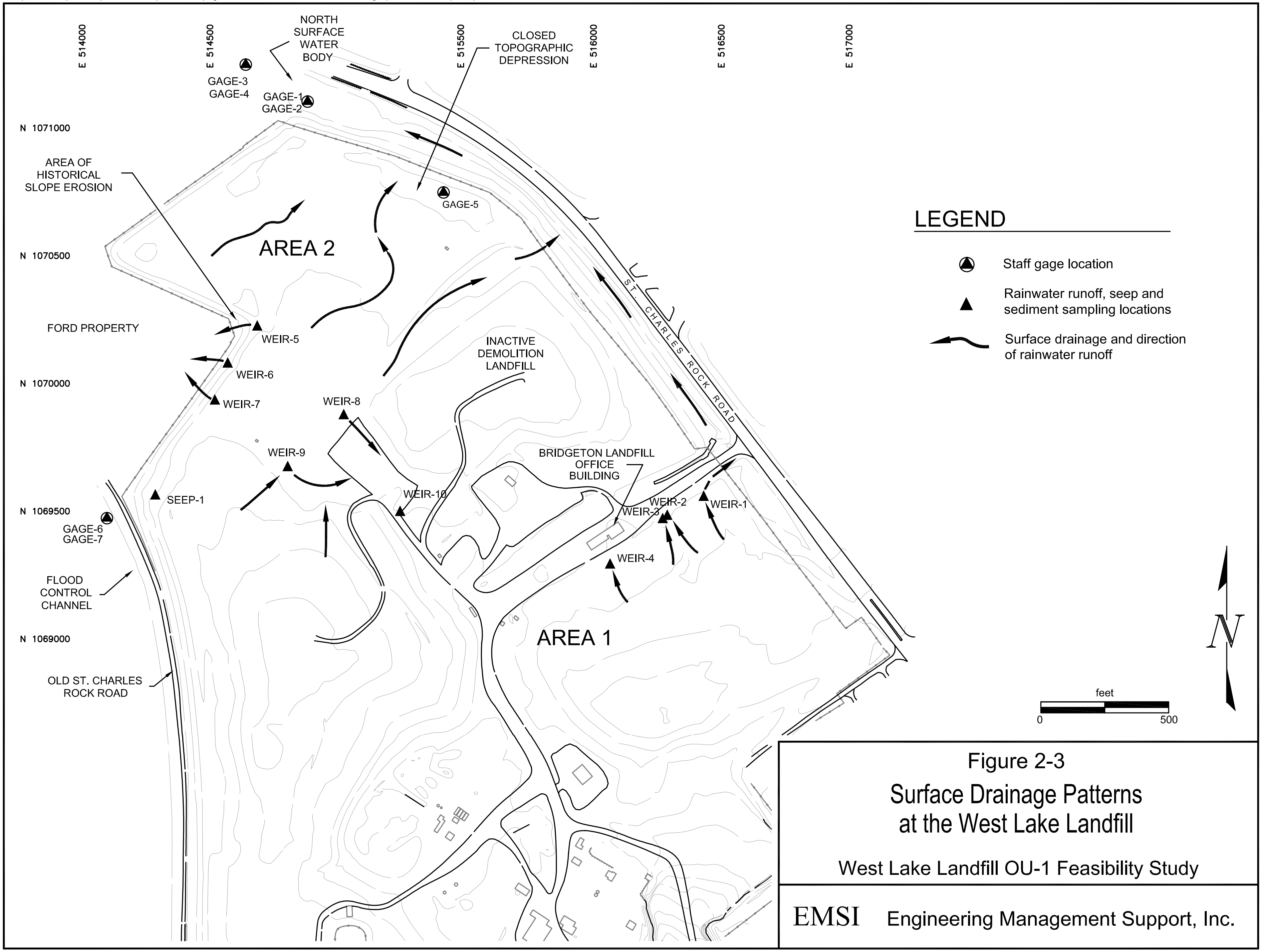


Figure 2-3
Surface Drainage Patterns at the West Lake Landfill

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\11-04\fig-2-4-Site Layout.dwg plotted: 04/05/2005

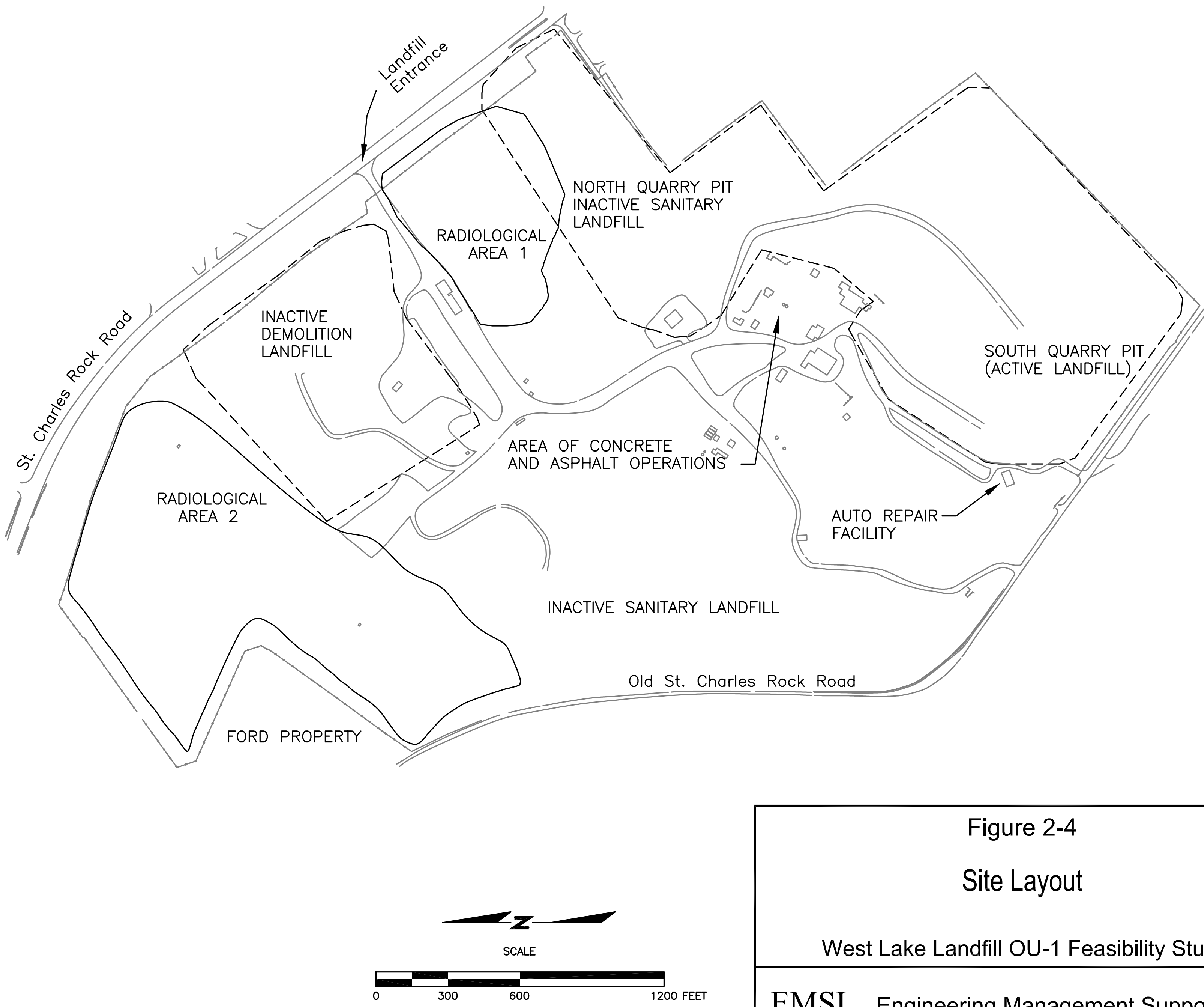


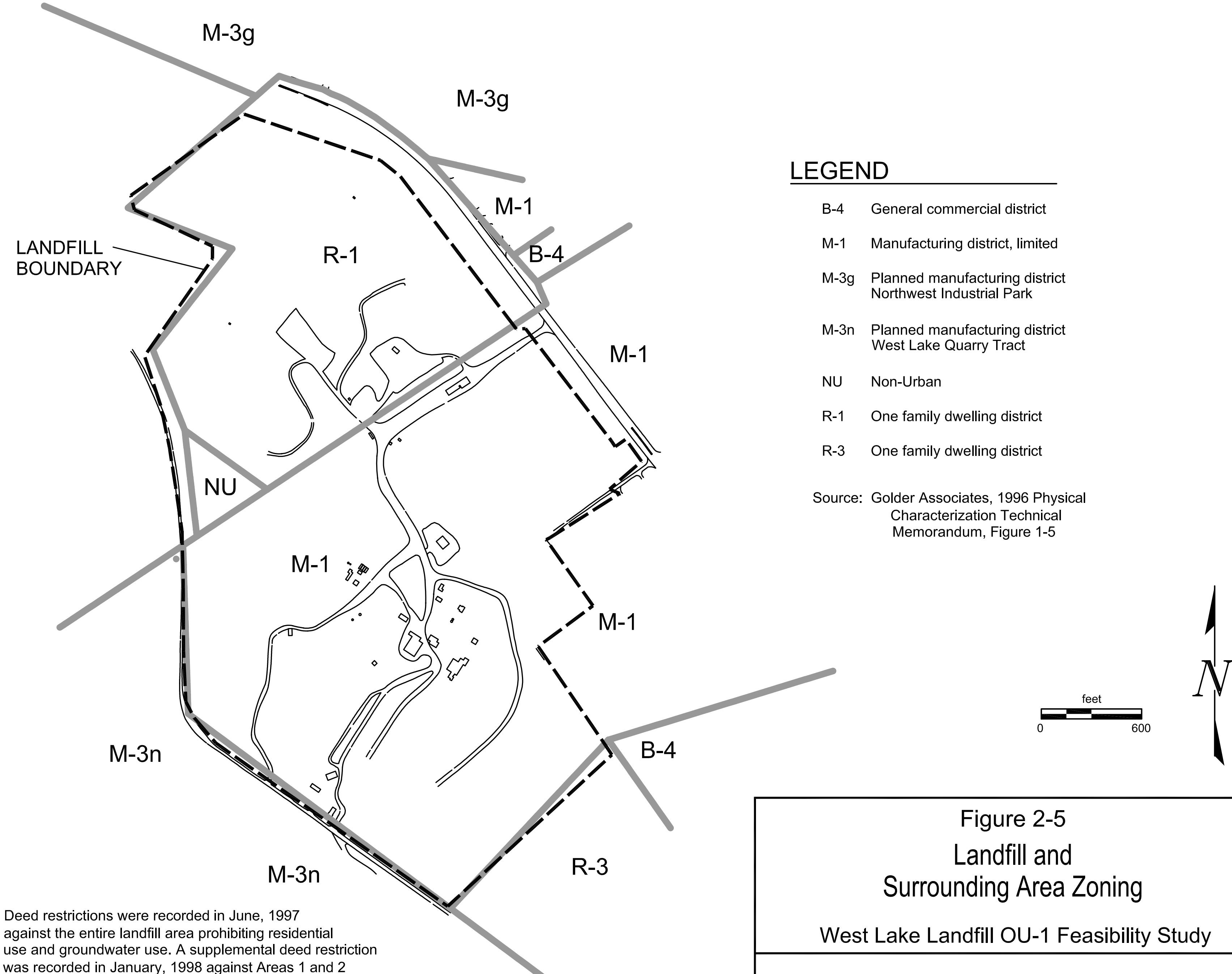
Figure 2-4

Site Layout

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\11-04\fig-2-5-Landfill-Zoning.dwg plotted: 04/05/2005



LEGEND

B-4	General commercial district
M-1	Manufacturing district, limited
M-3g	Planned manufacturing district Northwest Industrial Park
M-3n	Planned manufacturing district West Lake Quarry Tract
NU	Non-Urban
R-1	One family dwelling district
R-3	One family dwelling district

Source: Golder Associates, 1996 Physical Characterization Technical Memorandum, Figure 1-5

Note: Deed restrictions were recorded in June, 1997 against the entire landfill area prohibiting residential use and groundwater use. A supplemental deed restriction was recorded in January, 1998 against Areas 1 and 2 prohibiting the placement of buildings and restricting the installation of underground utilities, pipes, and/or excavation.

Figure 2-5
Landfill and
Surrounding Area Zoning

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\11-04\fig-2-6-Extent of Radio-Nuc.dwg plotted: 04/05/2005

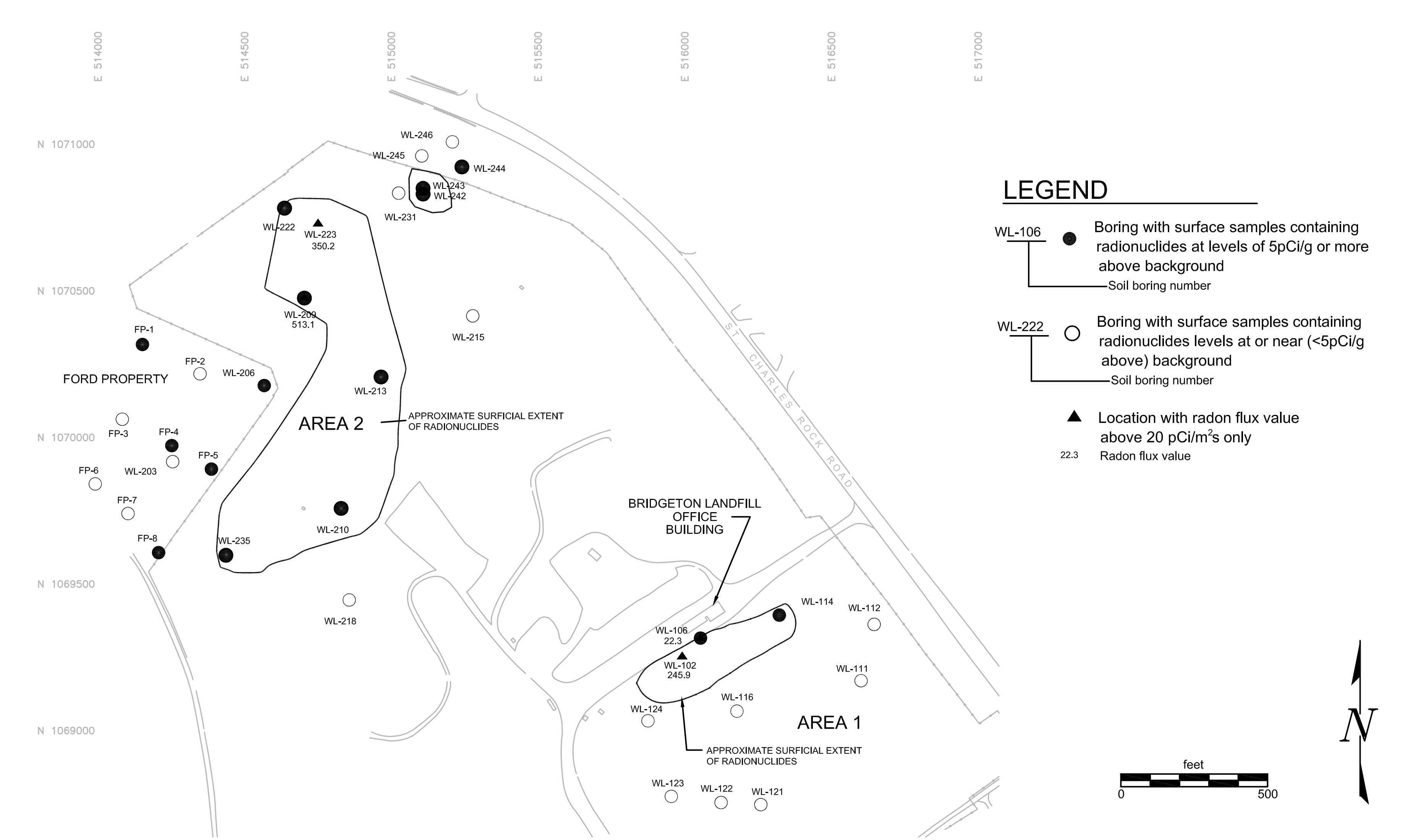
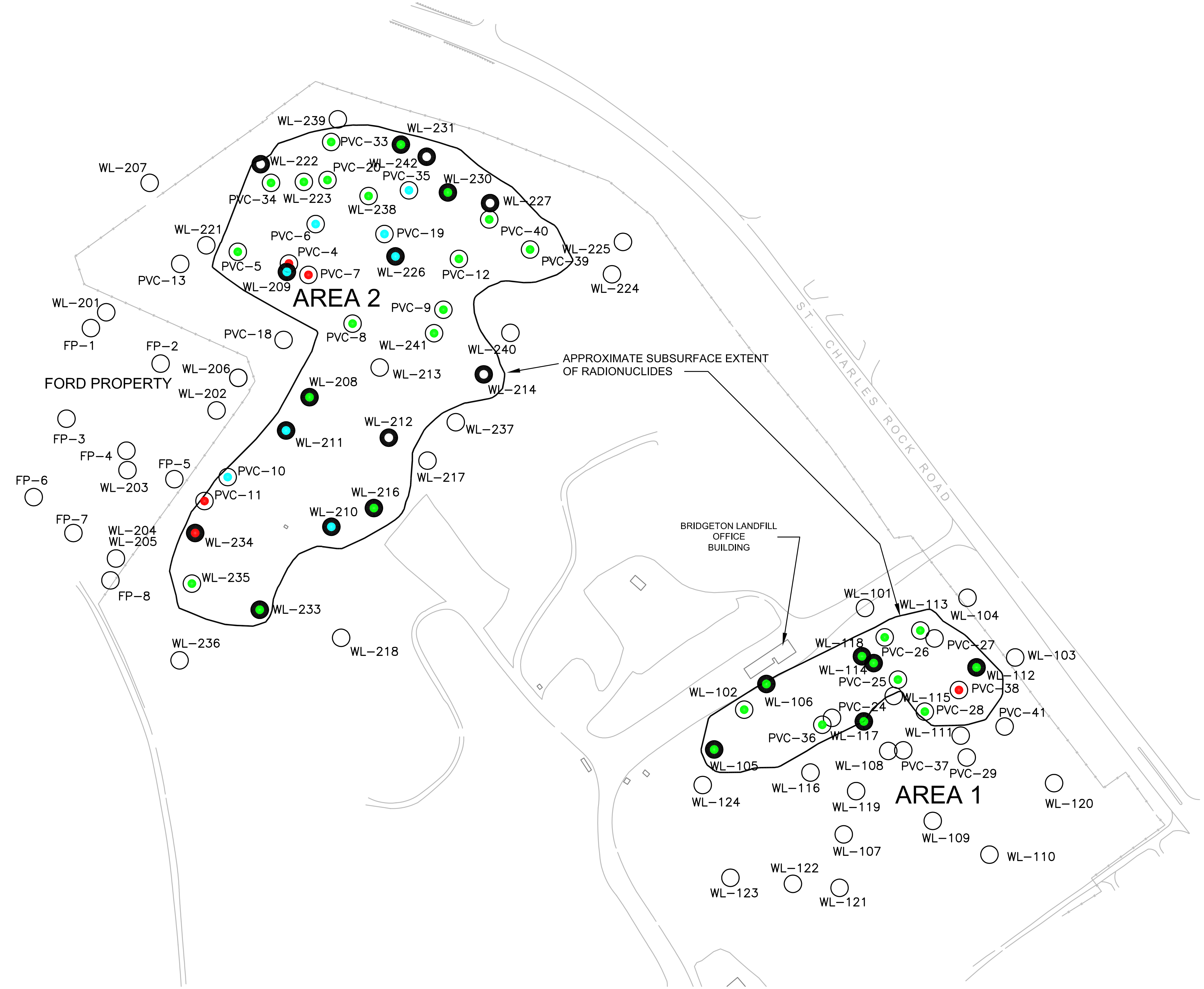


Figure 2-6

Approximate Extent of Radionuclide Impacted Materials at the Landfill Surface

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.



LEGEND

WL-106 — Boring with subsurface samples containing radionuclides at levels of 15pCi/g or more above background (Soil boring number)

WL-222 — Boring with subsurface samples containing radionuclides levels at or near (<15pCi/g above) background (Soil boring number)

WL-102 — Boring with elevated downhole gamma readings

Note: color of circle denotes maximum reading
- Red: >760,000 counts per minute (CPM)
- Blue: >160,000 and <760,000 CPM
- Green: >6,000 and <160,000 CPM

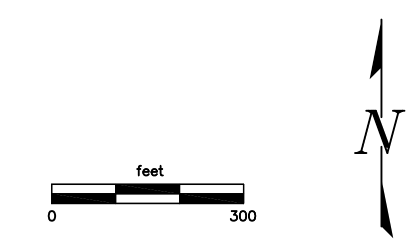


Figure 2-7
Approximate Extent of Radionuclide Impacted Materials in the Subsurface at the Landfill

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\11-04\FIG-2-8-Buffer Zone.dwg plotted: 04/05/2005

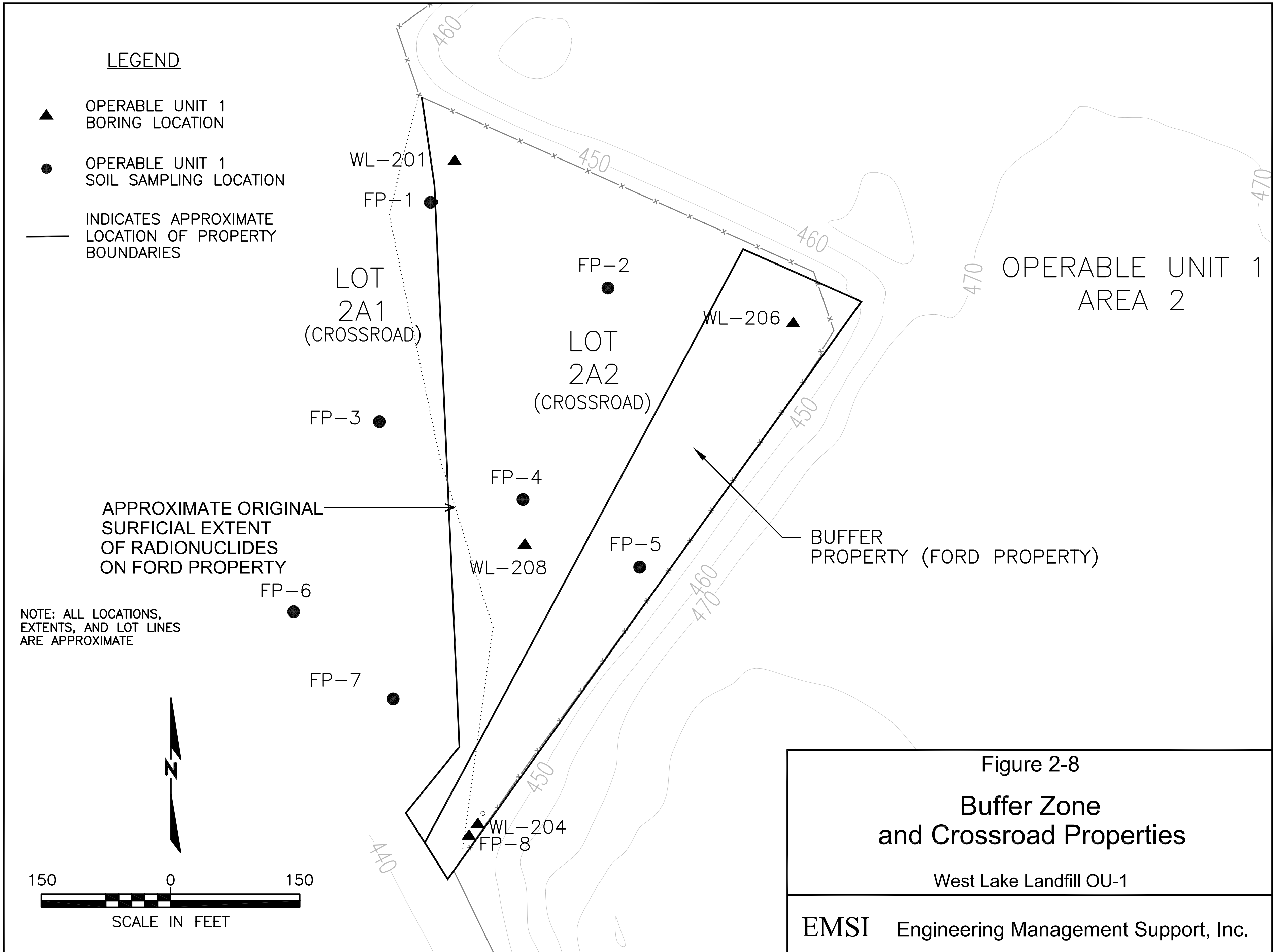


Figure 2-8

Buffer Zone
and Crossroad Properties

West Lake Landfill OU-1

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2005\Fig2-9_Monitoring Wells.dwg plotted: 08/09/2005

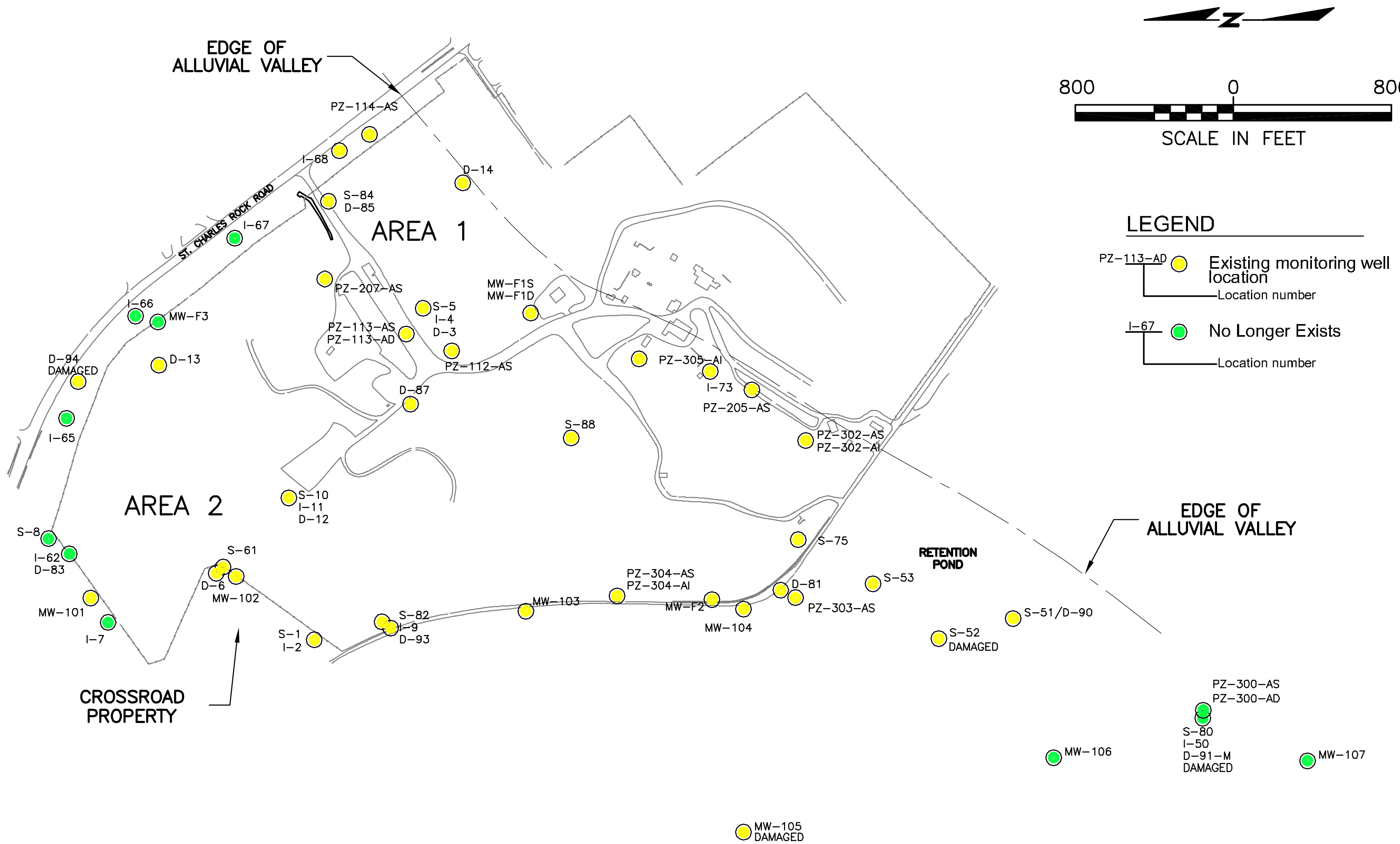
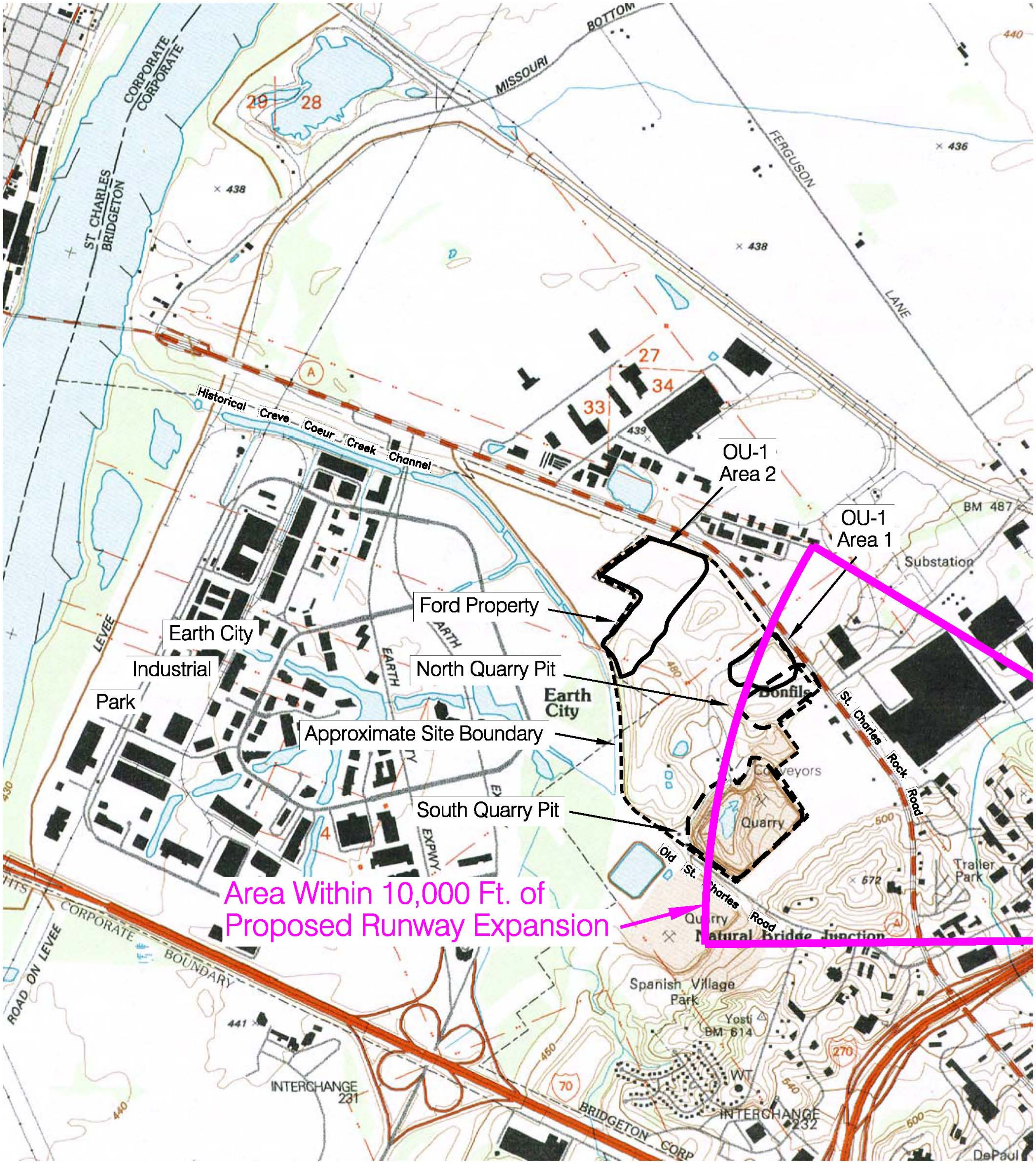


Figure 2-9

Groundwater Monitoring Well Locations

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.



Source: St. Charles, MO USGS
7.5' Quadrangle, 1994

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SCALE IN FEET

Figure 3-1

Area within 10,000 Feet of Proposed Runway Expansion St. Louis Lambert International Airport

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\11-04\fig3-1-Proprunway.dwg plotted: 04/05/2005

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
No Action	None	None	No action taken.	Required for consideration by the NCP.
Institutional Controls*	Access Restrictions	Fences and guards	Access restrictions can mitigate exposures by limiting access and use.	Already existing or planned.
	Proprietary Controls	Deed restrictions	Proprietary controls restricting land use that are legally enforceable against subsequent owners.	Already Existing. Covenant restrictions have been recorded by each of the owners against their respective parcels and the entire West Lake Landfill (including Areas 1 and 2) prohibiting residential use. Construction work, as well as commercial and industrial uses, have been precluded on Areas 1 and 2 by a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc., prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation upon its property.
		Deed notices	Non-enforceable informational document filed in public land records alerting anyone searching records to important information about property.	Potentially applicable.
		Easements	Property right conveyed by a landowner to another party which gives the second party rights with regard to the land of the first party.	Potentially applicable in conjunction with other response actions.
		Covenants	Promise by one landowner to another made in connection with conveyance of property. Promise to refrain from using property in a certain manner.	Potentially applicable in conjunction with other response actions.
		Groundwater use restrictions	Water or well use restrictions such as limitations on the drilling of new wells.	Already Existing. Restrictive covenants recorded by each of the fee owners against their respective parcels prohibit use of groundwater from beneath the landfill. These deed restrictions cannot be terminated without the written approval of the then owners, the Missouri Department of Natural Rescources (MDNR), and the EPA.
		Advisories	Publicly-issued warnings that provide notice to potential users of groundwater of some existing or impending risk associated with its use.	Not applicable as there is no groundwater use at or in the vicinity of the site.
Monitoring	Monitoring	Groundwater, surface water, and sediment monitoring	Monitoring to evaluate site conditions over time and/or remedial action performance.	Potentially applicable.

LEGEND

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-1

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
In-situ Containment	Surface Controls/Diversions	Diversion/collection, grading, graded contours, swales and berms, and vegetation to isolate storm water from Areas 1 and 2	Surface controls can limit contaminant mobility and mitigate potential exposures and migration via surface water by attenuating storm water run-on and runoff. These processes can be implemented with conventional equipment.	Potentially applicable.
	Surface Water/ Sediment Control Barriers	Sediment traps, sedimentation basins	Surface water/sediment control barriers can limit contaminant mobility and mitigate potential exposures by preventing sediment from storm water run-on and runoff from migrating. These processes can be implemented with conventional equipment.	Potentially applicable.
	Dust Controls	Revegetation, capping	Dust controls can limit contaminant mobility and mitigate potential migration via air and storm water by attenuating radon emissions and controlling particulate resuspension. These processes can be implemented with conventional equipment.	Potentially applicable.
	Capping and Covers*	Soil, clay, and vegetation; asphalt or concrete; synthetic membrane material; and multilayer, multimedia material	Capping can limit contaminant mobility and mitigate potential migration via air, surface water, and groundwater by attenuating radon emissions and controlling particulate resuspension, storm water run-on and runoff, and precipitation-enhanced percolation and leaching. These processes can be implemented with conventional equipment.	Potentially applicable.

LEGEND

Technology and/or Process Option screened out on the basis of technical implementability.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-1 (cont.)

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
Physical Treatment/ Pretreatment In-Situ	Dewatering/Drying	Solar evaporation, pumping, and gravity drainage trenches	For sediment, dewatering/drying can limit the mobility and reduce the volume of radiologically impacted material and mitigate potential exposure and migration at the affected area. These processes can be implemented with conventional methods.	Eliminated. Offsite buffer/Crossroad properties surface soil to be incorporated within existing Areas 1 and 2 is not expected to require or justify the addition of this technology insitu.
	Nonthermal Extraction	Vacuum extraction and aqueous soil flushing	Vacuum extraction can be used to remove radon gas from soil but may require a point source treatment system such as vapor phase granular activated carbon prior to discharge to the atmosphere. The primary action associated with soil flushing with water is a physical "sweeping" to accelerate contaminant migration by injection wells or spraying/ponding (surface application); thus it is discussed here as a physical technology. Water alone is typically a poor flushing solution and this process is generally ineffective for complex wastes or for treating soil with moderate to high adsorption capacity, low permeability, or the nature of subsurface soil at Areas 1 and 2 that includes refuse, debris, and fill materials.	Eliminated. Radon gas levels are below potential standards and no structures are present on Areas 1 and 2.
	Thermal Destruction	In-situ vitrification (ISV)	In-situ thermal destruction can reduce the toxicity, mobility, and volume of contaminated soil and mitigate potential exposures and migration by physically altering the contaminant source. For in-situ vitrification, an electric current is passed through electrodes to melt the soil or sediment and upon cooling, a glassy crystalline matrix is formed that incorporates inorganic contaminants such as radionuclides. In-situ vitrification has been implemented at a limited number of sites. Obtaining a continuous matrix after the melt with the nature of the subsurface soil at Areas 1 and 2 may be difficult.	Eliminated. Soils containing radionuclides are commingled with municipal wastes and construction debris. Potentially adverse effects of inducing an electric current in and heating of materials containing explosive gases.
Chemical Treatment Pretreatment In-Situ	Soil Flushing	Acid/base, surfactant, chelating agent, and organic solvent solution via surface application and injection/extraction wells	In-situ chemical flushing can reduce the mobility and volume of contaminated soil via desorptive reactions and mitigate potential exposures and migration by altering the contaminant source. This technology can be used as an initial treatment step to leach contaminants from a waste matrix (e.g., via solution mining). The solubility of radionuclides can be enhanced by solvent application and the reagent solution can be sprinkled or ponded over the contaminated zone for aggressive treatment. This technology is ineffective for complex wastes because it is very contaminant-specific and the selection of a suitable flushing fluid for a combined waste is difficult. Full-scale site cleanup has not yet been demonstrated by these processes.	Eliminated because of the inability to control process given the the nature of the subsurface soil in Areas 1 and 2.
	Stabilization/solidification	Lime-based and Portland cement-based pozzolanic reactions, asphalt-based thermoplastic microencapsulation, and catalyzed polymerization	In-situ stabilization/solidification processes are typically used to treat soil contaminated with heavy metals and high molecular weight organic compounds by binding the contaminants in place in an insoluble matrix. Drills, augers, and paddles can be used to introduce chemical reagents.	Eliminated because of the nature of the subsurface soil in Areas 1 and 2.

LEGEND

(hatched box) Technology and/or Process Option screened out on the basis of technical implementability.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-1 (cont.)

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
Physical Treatment/ Pretreatment following Removal (subject to Removal being retained as a General Response Action)	Dewatering/Drying	Rotary drum, vacuum, and belt filtration; drying bed; filter press; pressure filtration; gravity thickening; centrifugation; and evaporation	Dewatering/drying can limit the mobility and reduce the total volume of contaminated material. These processes can be implemented with conventional methods.	Offsite buffer/Crossroad properties surface soils not expected to require dewatering.
	Solids Separation	Classification (mechanical and non-mechanical); soil sorting and screening wet/dry); flotation and gravity concentration/centrifugation; magnetic and paramagnetic separation; and electrostatic separation	Solids separation processes can limit the toxicity, mobility, and volume of contaminated material and mitigate potential exposures and migration. This technology could serve as a pretreatment step for a primary treatment process and it is considered developmental for waste treatment applications. Although certain solids separation processes have been used to extract radionuclides from original ores, they are generally ineffective for separating relatively low concentrations of contaminants from soil. Solids separation will be particularly challenging for the subsurface impacted soils in Areas 1 and 2 given that the soils consist of refuse, debris, and fill materials.	Originally eliminated for Areas 1 and 2 subsurface soils because the nature of the soils is commingled refuse, debris, and fill materials. Retained in conjunction with potential "hot spot" removal as requested by EPA.
	Volume Reduction	Impact crushers, shredders, pulverizers, tumbling and hammer mills, and compactors	These processes can reduce the size and volume of contaminated material (e.g., large chunks of soil or rock), which is often required as a pretreatment step for a primary treatment process (e.g., for a chemical extraction process).	Eliminated for Areas 1 and 2 subsurface soils because the nature of the soils is commingled refuse, debris, and fill materials.
	Nonthermal Extraction	Aqueous soil washing in a reactor vessel	Soil can be mixed with water in a contact vessel to wash contaminants from the waste matrix, but water alone is typically ineffective as a washing solution, especially when the soil includes radionuclides.	Eliminated for Areas 1 and 2 subsurface soils because the nature of the soils is commingled refuse, debris, and fill materials.

LEGEND

Technology and/or Process Option screened out on the basis of technical implementability.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-1 (cont.)

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	SCREENING COMMENTS
Chemical Treatment/ Pretreatment following Removal (subject to Removal being retained as a General Response Action)	Contact Extraction	Non-aqueous soil washing in a reactor vessel	Various solutions can be used to separate oils, organic compounds, radionuclides, and metals from soil in an agitated vessel.	Eliminated for Areas 1 and 2 subsurface soils because the nature of the soils is commingled refuse, debris, and fill materials.
	Stabilization/Solidification	Lime-based and Portland cement-based pozzolanic reactions, asphalt-based thermoplastic microencapsulation, catalyzed polymerization, and silicate and adsorbent binding in a reactor vessel such as a pug mill blender	As described for the in-situ application except that process effectiveness is less constrained because various pretreatment options are available (e.g., dewatering and crushing) and the mix can be better controlled. This technology has been implemented for radiologically-impacted materials treatment applications and can be implemented with conventional equipment.	Eliminated for Areas 1 and 2 subsurface soils because the nature of the soils is commingled refuse, debris, and fill materials.
Removal	Excavation	Backhoe, bulldozer, scraper and front-end loader	Excavation can limit contaminant mobility and mitigate potential exposures at the affected area by removing the contaminant source. This technology can be implemented with conventional equipment.	Eliminated for Areas 1 and 2 subsurface soil because of the nature of subsurface soil (i.e., there are no obvious hot spots and soils consist of commingled refuse, debris, and fill materials) and the potential physical and exposure hazards to workers. Also, inconsistent with presumptive remedy guidance for municipal landfills. Potentially applicable for offsite buffer/Crossroad properties surface soils. Retained in conjunction with potential "hot spot" removal as requested by EPA.
Disposal (subject to Removal being retained as a General Response Action)	Offsite Disposal	Offsite disposal facility	This option would involve incorporation of removed material at an existing acceptable permitted commercial disposal facility. Land-based disposal can reduce the mobility of contaminated material and mitigate potential exposures and migration by controlling the contaminant source. In addition to engineering requirements, constraints include issues such as transportation routes and risks, costs for off-site disposal and regulator/ community acceptance.	Eliminated. In accordance with the presumptive remedy guidance, excavation and offsite disposal of all of the material in Areas 1 and 2 is not considered to be feasible. Excavation and offsite disposal of smaller "hot spot" material that may be identified in Areas 1 and 2 is also not considered to be feasible. Excavation of the radiologically-impacted soil would require screening to separate the impacted soil from the overall matrix of solid waste, debris, and other fill material and the attendant difficulties and risk associated with screening of these materials. Retained in conjunction with potential "hot spot" removal as requested by EPA. The implementability of land disposal at an off-site facility is further affected by the availability of suitable sites for disposal of the radiologically-impacted material from OU-1. In addition, the increased risk of accidents and exposures associated with off-site transport of the material and the increased cost for off-site transport and disposal would have to be balanced by an increased effectiveness compared with leaving materials onsite.

LEGEND

Technology and/or Process Option screened out on the basis of technical implementability.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-1 (cont.)

Technical Implementability Screening of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
No Action	None	None	Does not achieve all remedial action objectives.	May be implemented with regulatory acceptance.	No cost.	Provides a baseline for comparison with action alternatives.
Institutional Controls*	Access Restrictions	Fences and guards	The perimeter of the West Lake Landfill site is fenced, and entry to the West Lake Landfill is controlled at the landfill office/weigh station; these measures mitigate potential public exposure to contamination on-site by restricting entry. A six foot high chain-link fence with a three-strand barbed wire canopy encloses the entire West Lake Landfill. The main access gate is located on the northeastern perimeter, off of St. Charles Rock Road. An additional gate is located on the southwestern perimeter to provide access to the automobile repair shop.	Fences and other such measures are easy to implement, and resources are readily available.	Low	Can effectively limit entry to contaminated areas and can be used to support other remedial actions, if any.
	Proprietary Controls	Deed restrictions	Covenant restrictions have been recorded by each of the owners against their respective parcels and the entire West Lake Landfill (including Areas 1 and 2) prohibiting residential use. Construction work, as well as commercial and industrial uses, have been precluded on Areas 1 and 2 by a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc., prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation upon its property. The recording information for the restrictive covenants precluding residential use is Book 11208 pages 2499, 2507, and 2514, in the Recorder of Deeds Office for St. Louis County, Missouri. The recording information for the restrictive covenant prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation is Book 11427 page 1633 in the Recorder of Deeds Office for St. Louis County, Missouri. Covenant restrictions cannot be terminated without the written approval of the then owners, the Missouri Department of Natural Resources (MDNR), and the EPA.	Deed restrictions are easy to implement, and resources are readily available.	Low	Can minimize exposures to site contaminants by limiting use of contaminated areas and can be used to support other remedial actions, if any.
		Deed notices	Long term effectiveness depends on continued future implementation.	Potentially implementable.	Low	None

(continued on next page)

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-2

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
(continued from previous page)		Easements	Long term effectiveness depends on continued future implementation.	Implementability will depend on activity to be undertaken under easement and ease of negotiation with landowner.	Moderate capital costs depending on extent of easements required. Low O&M costs.	None
		Covenants	Long term effectiveness depends on continued future implementation.	Potentially implementable.	Low	None
		Groundwater use restrictions	Restrictive covenants recorded in June 1997 by each of the fee owners against their respective parcels prohibit use of groundwater from beneath the landfill. These deed restrictions cannot be terminated without the written approval of the then owners, the Missouri Department of Natural Rescources (MDNR), and the EPA.	These measures are easy to implement, and resources are readily available.	Low	Can minimize exposures to site contaminants by limiting use of contaminated areas and can be used to support other remedial actions, if any.
Monitoring	Monitoring	Groundwater, surface water, and sediment monitoring	This measure can support the mitigation of potential measures by providing data on the nature and extent of contamination and the effectiveness of any remedial action.	Monitoring is easy to implement, and resources (e.g., surface water and sediment sampling equipment and groundwater monitoring wells) are readily available.	Low capital costs. Low to moderate O&M costs.	Can provide data useful for minimizing exposures and can be used to support other remedial actions, if any.
In-situ Containment	Surface Controls/Diversions	Diversion/collection, grading, graded contours, swales and berms, and vegetation to isolate storm water from Areas 1 and 2	Diversions - such as graded contours, swales, or berms - can effectively reduce contaminant mobility at the Site. Such measures would not be effective for containing off-site surface water.	Can be implemented with conventional equipment and procedures, and resources are readily available.	Low	Can limit contaminant mobility by directing surface runoff around contaminated areas on-site.
	Surface Water/ Sediment Control Barriers	Sediment traps, Sedimentation basins	Sediment traps and sedimentation basins can limit mobility of contaminants in surface soil that may be mobilized via storm water run-on and run-off.	Can be implemented with conventional equipment and procedures, and resources are readily available.	Low to moderate capital costs. Low O&M costs.	Can limit contaminant mobility by containing contaminated sediment on-site.
	Dust Controls	Revegetation, capping	Revegetation and capping can limit contaminant mobility and mitigate potential migration via air and stormwater by controlling particulate resuspension.	Can be implemented with conventional equipment and procedures, and resources are readily available.	Low to moderate capital costs. Low O&M costs.	Can limit airborne emissions.
	Capping and Covers*	Soil, clay, and vegetation; asphalt or concrete; synthetic membrane material; and multilayer, multimedia material	Caps and covers can effectively limit airborne emissions (including radon) and external gamma radiation, and they can also reduce precipitation-enhanced percolation and leaching.	Can be implemented with conventional equipment and procedures. Resources are readily available. Consideration must be given to settlement of filled materials in OU-1 after a cover is placed. Surface depressions must be filled-in.	Moderate to high capital costs. Moderate O&M costs.	Soil, clay and vegetation layer covers retained. Asphalt or concrete covers screened-out because of potential settlement concerns if a cover were to be placed over Areas 1 and 2. Synthetic membrane and multilayer/multimedia material covers screened out because they are inconsistent with the existing landfill cover requirements.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-2 (cont.)

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST	SCREENING COMMENTS
Removal	Excavation	Backhoe, bulldozer, scraper and front-end loader	Can effectively remove the source of contamination to limit contaminant mobility and volume at the affected area and reduce related exposures.	Can be implemented with conventional equipment and procedures, and resources are readily available. Consideration must be given to excavations at depths greater than 25 feet, as special excavation equipment may be required. Also, consideration must be given to the type and composition of material to be excavated, which can affect the size of the excavation and ability to separate the radiologically-impacted soil from other filled materials.	Moderate if shallow. High if deep.	Needs to be combined with Disposal. Retained for surface soil from buffer/Crossroad properties. Originally screened out for subsurface soil in Areas 1 and 2 based on implementability and cost because of commingled nature of the radiologically-impacted subsurface soils and the areal extent and depth of radiologically-impacted soils in areas 1 & 2 present implementablility issues. Retained in conjunction with potential "hot spot" removal as requested by EPA.
Disposal	Offsite Disposal	Offsite Disposal Facility	Can effectively remove the source of contamination to limit contaminant mobility and volume at the affected area and reduce related exposures.	Difficult to implement; only two facilities in U.S. will accept wastes. Will require construction of a truck-to-railcar transfer facility. Will require transportation of radiologically-impacted materials by truck and railroad and the attendant risks.	High	Needs to be combined with Removal. Retained for potential small "hot spot" areas but difficult to implement and costs extremely high.
	Onsite disposal	Disposal on Area 2	Can effectively remove the source of contamination to limit contaminant mobility and volume at the affected area and reduce related exposures.	Can be implemented with conventional equipment, and procedures and resources are readily available.	Low	Needs to be combined with Removal. Retained for surface soil from buffer/Crossroads properties.

* Indicates that General Response Action or remedial technology is component of presumptive remedy for CERCLA municipal landfill sites (USEPA, 1993)

Figure 4-2 (cont.)

Evaluation of Remediation Technologies and Process Options

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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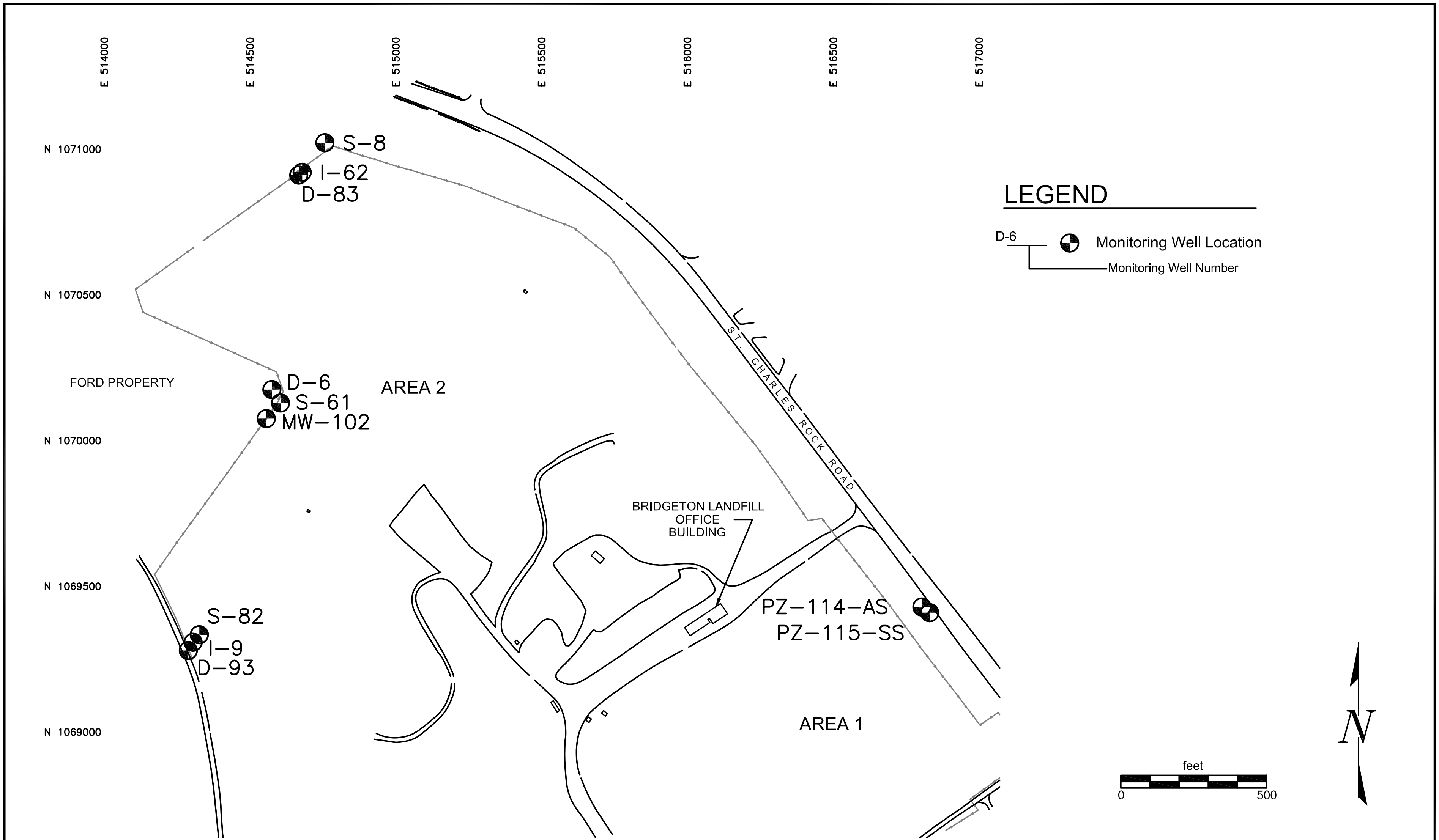

Figure 4-3

Groundwater Monitoring Locations

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

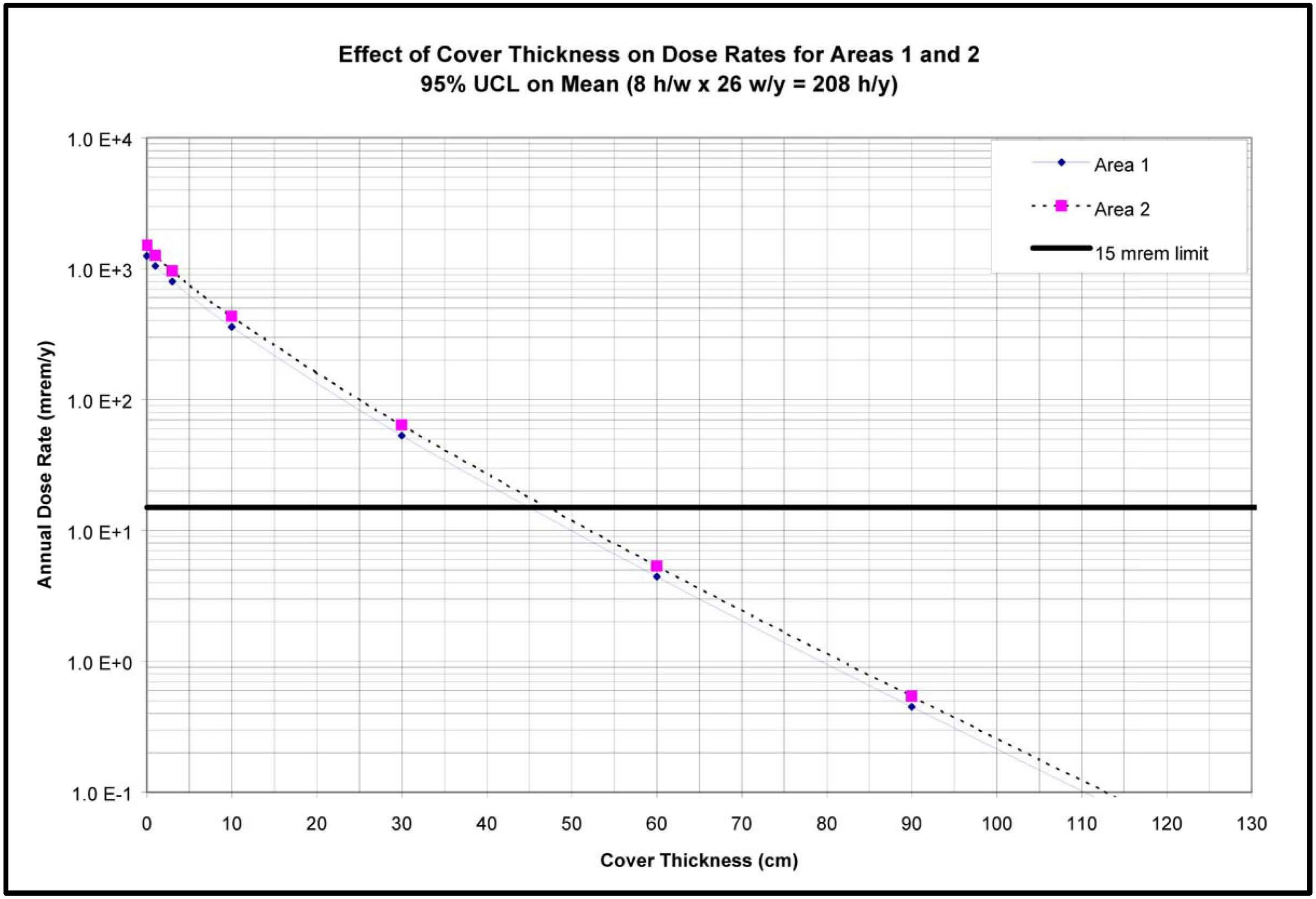

Figure 4-4
Cover Thickness Necessary For Protection Of Groundskeeper Working In Areas 1 and 2
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

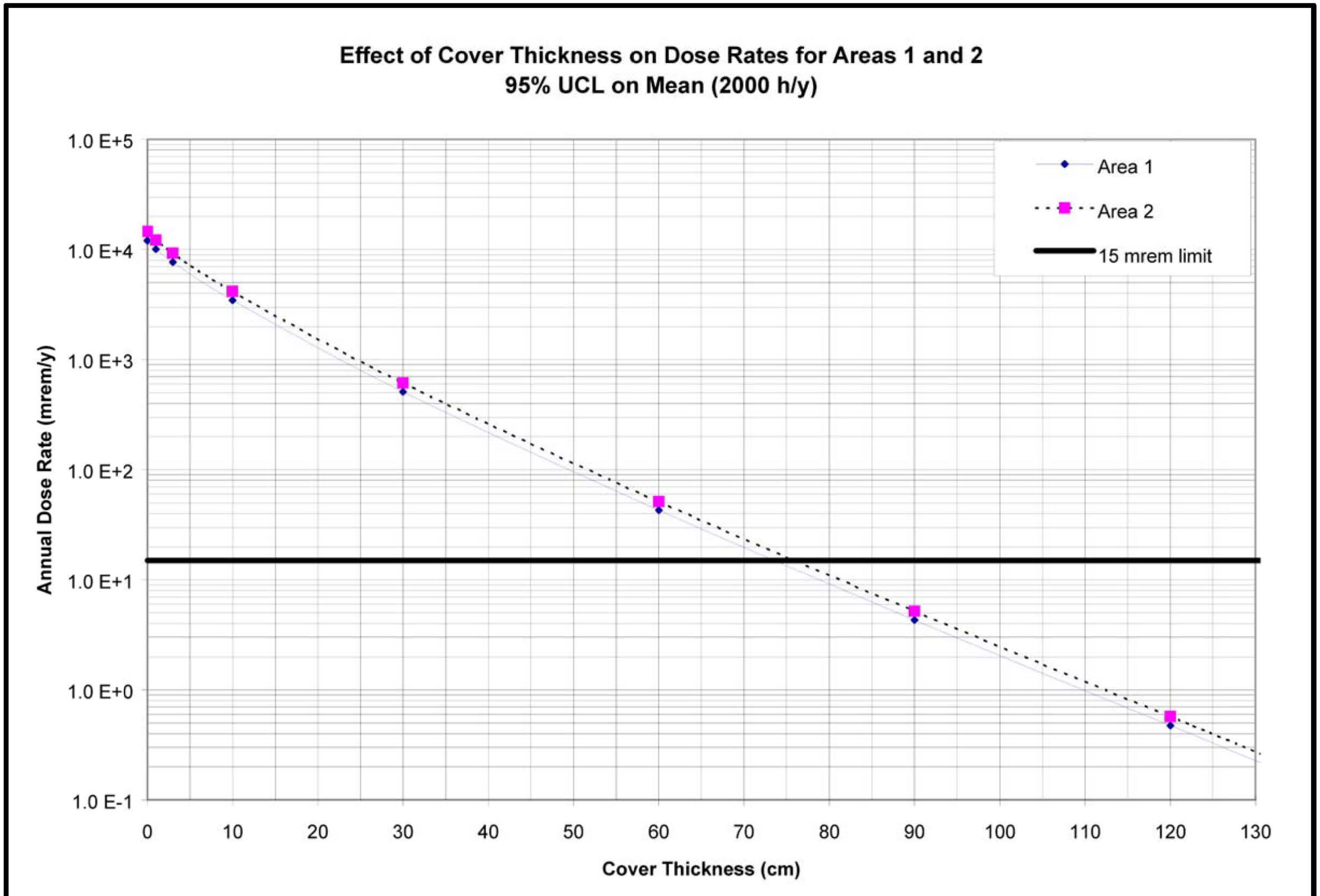

Figure 4-5
Cover Thickness Necessary For Protection Of Outdoor Storage Yard Worker Working In Areas 1 and 2
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

Figure 4-6
Approximate Extent of Soil or Landfill Cover
Alternative L3

West Lake Landfill OU-1 Feasibility Study

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Figure 4-7
Portions of Areas 1 and 2
With Slopes <2% and <5%
Or >25% and >33%
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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Figure 4-8
Thickness of Fill
(Exclusive of Cover System)
To Achieve 2% Minimum Slopes
Alternative L4

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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M:\CLIENTS\EMSI\WESTLAKE\5-04\2 PERCENT CUT FILL ISOPACH-FIG4-9A.DWG-LAYOUT1 05/08/2006 2:58PM

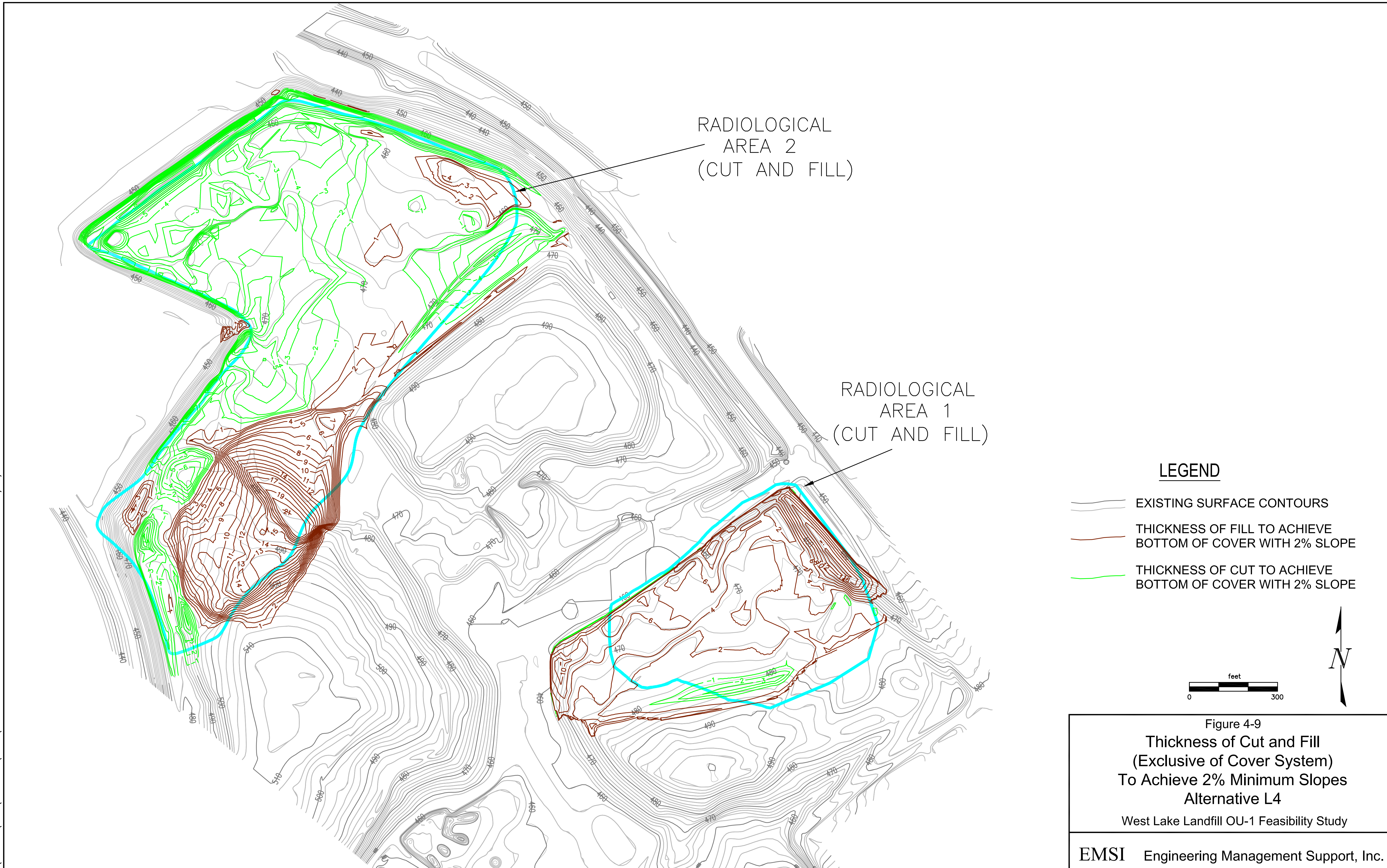

Figure 4-9
Thickness of Cut and Fill
(Exclusive of Cover System)
To Achieve 2% Minimum Slopes
Alternative L4

West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

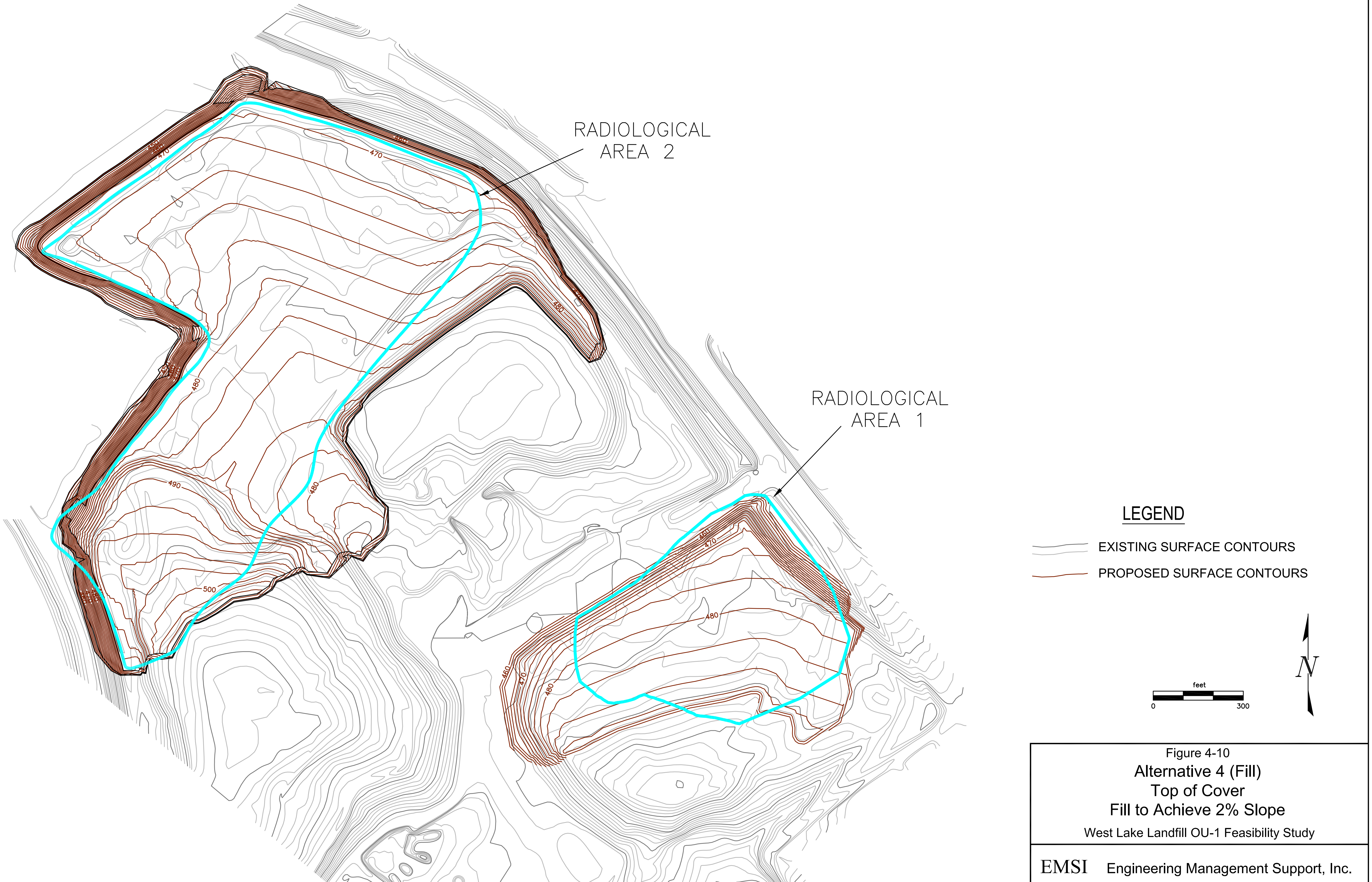

Figure 4-10
Alternative 4 (Fill)
Top of Cover
Fill to Achieve 2% Slope
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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Figure 4-11
Alternative 4 (Cut/Fill)
Top of Cover
Cut/Fill to Achieve 2% Slope
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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Figure 4-12
Thickness of Fill
(Exclusive of Cover System)
To Achieve 5% Minimum Slopes
Alternative L5
West Lake Landfill OU-1 Feasibility Study

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Figure 4-13
Thickness of Cut and Fill
(Exclusive of Cover System)
To Achieve 5% Minimum Slopes
Alternative L5

West Lake Landfill OU-1 Feasibility Study

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Figure 4-14
Alternative L5 (Fill)
Top of Cover
Fill to Achieve 5% Slope
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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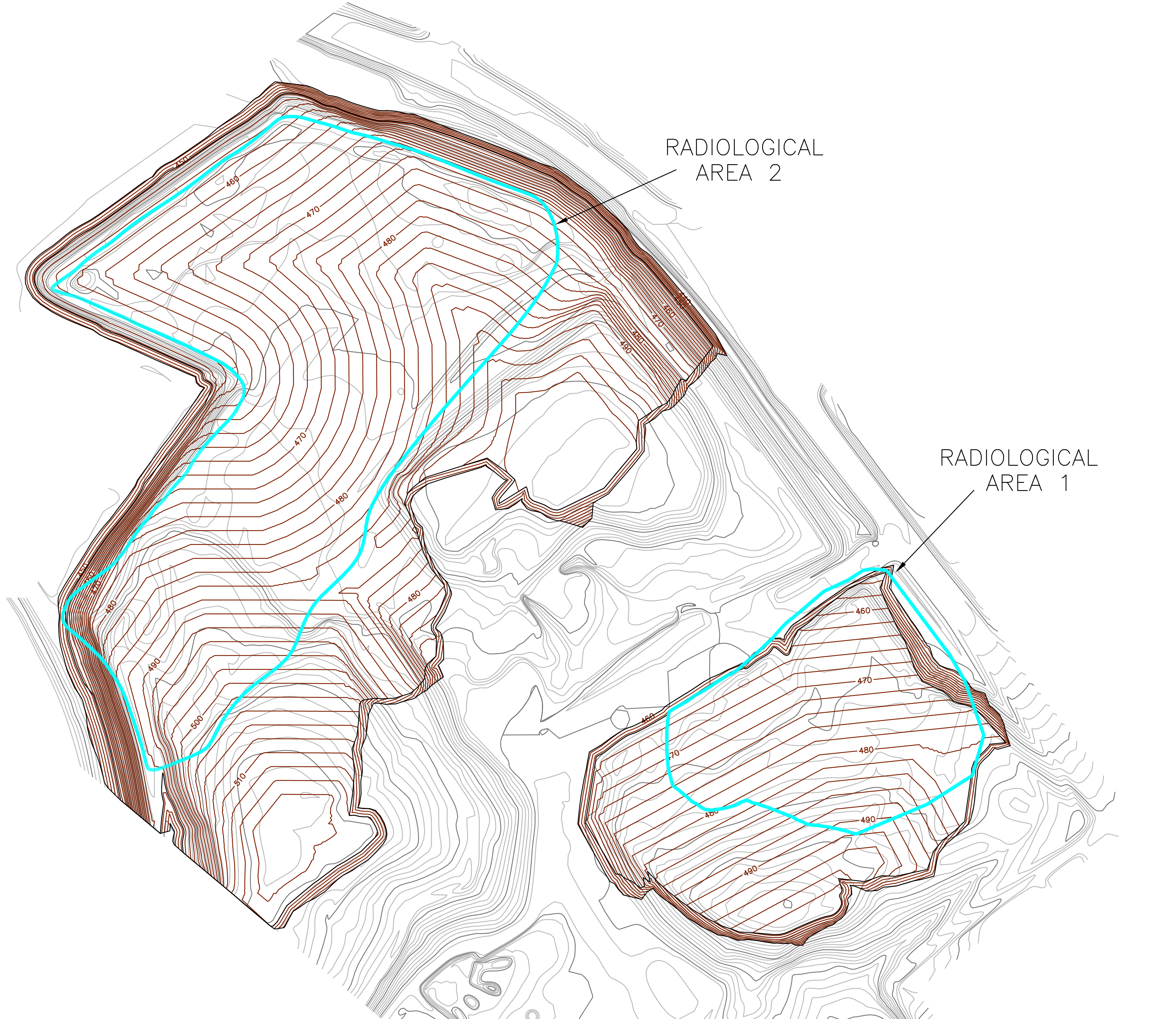

Figure 4-15
Alternative 5 (Cut/Fill)
Top of Cover
Cut/Fill to Achieve 5% Slope
West Lake Landfill OU-1 Feasibility Study

EMSI Engineering Management Support, Inc.

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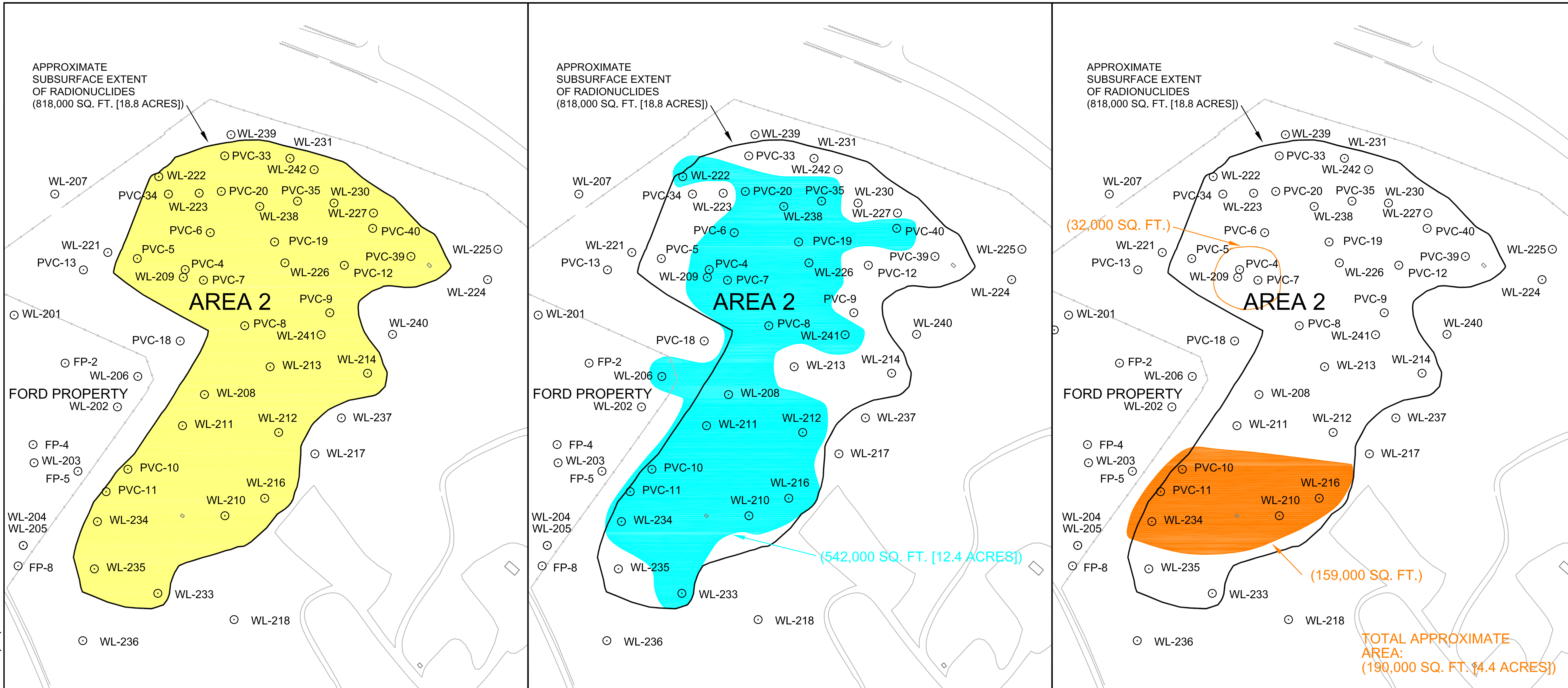

Area with downhole gamma readings above 6,000 cpm and/or occurrences of individual radionuclides above background plus 15 pci/g

Area with downhole gamma readings above 100,000 cpm and/or occurrences of individual radionuclides above 100 pci/g

Area with downhole gamma readings above 500,000 cpm and/or occurrences of individual radionuclides above 1,000 pci/g

feet
0 300

N

Figure 4-16

Approximate Extent of Area 2 with Elevated Downhole Gamma/Radionuclide Occurrences (Alternative L6)

West Lake Landfill OU-1 Feasibility Study

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