
**EVALUATION OF THE EPA
SELECTED REMEDY FOR
OPERABLE UNIT-1 (OU-1)
AT THE WEST LAKE LANDFILL**

BRIDGETON, MISSOURI

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This report provides a summary of observations based on internal communications and recommendations provided by Environmental Protection Agency (EPA) experts in documents published by Agency, including technical experts from the EPA Office of Research and Development, Engineering Technical Support Center (ETSC)¹ in 2014 and from the EPA National Remedy Review Board (NRRB)² in 2013- which was withheld from the public until mid-2016.

BACKGROUND

In 1973, uranium ore processing residues from the production of nuclear weapons, mixed with contaminated soil from the Latty Avenue Site in Hazelwood, Missouri were transported and illegally dumped in the West Lake Landfill in Bridgeton, Missouri. Currently there are known concentrations of radiologically impacted material (RIM) in areas of the landfill designated by the US Environmental Protection Agency (EPA) as Operable Unit 1 Area 1 and Area 2. The full extent of the contamination relative to the potential impact of an adjacent underground fire* has not yet been determined. However, EPA experts indicate that sufficient data exists to support removal of these materials.

SUMMARY

In 2008, the Environmental Protection Agency (EPA) proposed a Record of Decision (ROD) related to the Operable Unit-1 (OU-1) at the West Lake Landfill (EPA 2008)³. The EPA remedy proposes “in-place” disposal with the installation of a cap/cover over portions of the landfill and long-term monitoring of groundwater at the site.

Internal communications from EPA’s expert reviewers reveal that the proposed remedy is unlikely to protect thousands of urban residents from concentrated radioactive wastes in the floodplain of the Missouri River.

EPA internal analyses find that:

1. The EPA cannot ensure the protectiveness of the cap/cover for toxic uranium processing wastes, in an unlined landfill, that become increasingly radioactive for thousands of years.
2. Radioactive materials attributable to the waste materials at the West Lake Landfill have already been detected in the air, groundwater, surface soils, sediments, and vegetation around the site -- at or above regulated standards.
3. An underground fire burning in the wastes in the adjacent Bridgeton Sanitary Landfill compromises the cap/cover remedy by increasing radiological emissions and offsite exposures.
4. The radioactive materials in the landfill can be removed and transported to a licensed radioactive waste landfill without unacceptable risk to the public. However, delays in removal will increase costs and long-term exposures to the public.

*U.S. Fire Administration, Topical Fire Research Series, Landfill Fires, Volume 1, Issue 18 March 2001 (Rev. December 2001)“Spontaneous heating is attributed to 5% of landfill fires. This occurs when underground, decomposing waste rising in temperature combusts as it comes in contact with a methane gas pocket. This is known as a “hotspot...”

<http://nfa.usfa.dhs.gov/downloads/pdf/statistics/v1i18-508.pdf>.

FINDINGS

1. The EPA cannot ensure the protectiveness of the cap/cover of toxic uranium processing wastes, in an unlined landfill, that become increasingly radioactive for thousands of years.

a. *The EPA's own experts pointed out the known shortcomings with the proposed remedy design and recommended that Region 7 look into alternative remedies;*⁴

In March 2013, EPA experts from the National Remedy Review Board (NRRB) stated that: “[the proposed remedy] lacked sufficient information on the long-term protectiveness of this alternative.” Furthermore, the NRRB stated: “both of the landfill designs (RCRA Subtitle D and UMTRCA) proposed in the 2008 ROD and 2011 SFS have known shortcomings for handling radioactive waste by itself, let alone handling radioactive waste in a humid region as it would be at the West Lake Landfill.”

The proposed remedy set an unprecedented limit for radiological contamination that was 18 times greater than previously allowed for such wastes located in an urban area.⁵

The NRRB recommended that instead of enclosing the wastes that Region 7 should excavate the radiological waste and transport it to facilities designed to provide long-term management for such materials.⁶

The NRRB also determined that the proposed long-term monitoring of the groundwater by itself is not a CERCLA remedy and so could not be a component of the ROD selected remedy.

b. *The radiologically-impacted material in the West Lake Landfill is highly toxic and will increase in radioactivity and toxicity over time leading to increased risk to the public;*⁷

The known radiologically-impacted material (RIM) disposed of in the West Lake Landfill is out of secular equilibrium and as daughter products grow back into normal concentrations, the waste materials will increase in radioactivity, toxicity, and risk to the public over time for the at least 10,000 years.

The EPA National Remedy Review Board (NRRB) detailed the dangerous nature of the materials noting, “Based on the package provided to the Board, it appears that there are potentially significant amounts of RIM that are highly toxic (e.g., based on NRC estimates in the 1982 and 1988 reports, radium of up to 22,000 pCi/g, bismuth-214 up to 19,000 pCi/g, and average thorium-230 concentrations of 9,000 pCi/g.” and; “Given the presence of highly radioactive material at this site, and the fact that its hazardous nature will continue to increase over time, the Board believes excavating and/or treatment of any amount of the RIM should lead to important risk reduction.”

The EPA's cap/cover remedy proposed in the 2008 ROD and 2011 Supplemental Feasibility Study (SFS) does not address the in-growth of radioactivity over time that will occur in the landfill.

c) *The EPA's proposed cap/cover would not protect the groundwater within and beyond around the landfill from becoming contaminated;*

The EPA has not demonstrated that the groundwater can be protected from contamination if the cap/cover remedy as proposed in the 2008 ROD and 2011 SFS is approved. Samples of groundwater at the landfill have found levels of contamination that greatly exceed federal permissible maximum contaminant levels (MCLs) and indicate both the off-site migration of groundwater as well as the potential impact on offsite vegetation.^{8 9} Exceeding an MCL in groundwater would require a response action according to CERCLA protocol.^{10,11}

The West Lake Landfill is an unlined landfill with no engineering barriers¹² in the alluvial floodplain waters that flow into the Missouri River, upstream of the confluence with the Mississippi River. Groundwater levels can highly fluctuate according to rainfall event, and river levels can interact directly with surface water and groundwater runoff near the landfill. Because of the lack of engineered protection at the landfill, groundwater at the site can come into contact with RIM material and spread contamination in the highly permeable alluvial aquifer, and into the deeper bedrock aquifer.

It is extremely difficult to clean up contaminated groundwater. Every available corrective action to prevent groundwater contamination by RIM material in the West Lake Landfill should be considered. As long as the radioactive material remains in the landfill, the groundwater will continue to be contaminated.

d) *EPA experts have raised serious concerns with the analysis and characterization of the RIM at West Lake;*

In 2013, the NRRB raised a number of serious concerns with “...*the way the nature and extent of the RIM at the site was characterized....*” The Board pointed out that most of the RIM is located at or near the surface of the landfill (within 10 feet of the surface) as opposed to characterizations made in the ROD and SFS that the materials would be difficult to excavate. The lack of cover materials increases risk to members of the public, because there few if any barriers preventing the migration of radioactive materials and gases from the landfill into the air, groundwater and local environment around the facility.¹³

The EPA Office of Research and Development (ORD) pointed out that the lack of accurate accounting of the radioactive wastes at West Lake increases the uncertainties related to the potential impacts of the underground fire, at the adjacent Bridgeton Landfill.¹⁴

e) *Alternative remedies could provide a more permanent remedy protective of the public;*

The EPA National Remedy Review Board (NRRB) pointed out that the latest technologies could be employed to sort RIM from Non-RIM materials. The radioactive wastes could be then be sent to a dedicated and regulated radioactive disposal facility,

“Given the presence of highly radioactive material at this site, and the fact that its hazardous nature will continue to increase over time, the Board believes excavating and/or treating any amount of the RIM should lead to important risk reduction. Where it appears that much if not all of the RIM is located near the surface, cleanup at this site appears less complicated than other sites....Radiological material is also easily sorted out in the field with portable instruments that provide instantaneous measurements to ensure that only contaminated material is retrieved which, in turn, minimizes disposal costs.”

2. Radioactive wastes from the West Lake Landfill have already been detected in the air, groundwater, surface soils trees and other vegetation around the site, at levels above federal permissible Maximum Contamination Levels (MCLs).

Uranium, thorium and their related decay products have been detected in off-site vegetation on private properties around the landfill.¹⁵

RIM material has migrated beyond the landfill by surface water transport during strong rainfall events.¹⁶

Samples of groundwater at and around the landfill have found levels of contamination that exceed standards.¹⁷

Measurements of radon in air conducted for the 2011 SFS found concentrations of radon that nearly exceeded UMTRCA standards.

Levels of unsupported lead have been detected in the local environment around the landfill out of equilibrium with background levels of radon and radium.¹⁸

3. An underground fire, burning in the adjacent Bridgeton Sanitary Landfill, could seriously compromise the cap/cover remedy by increasing radiological emissions and offsite exposures.

In December 2010, operators of the Bridgeton Sanitary Landfill detected elevated temperatures and carbon monoxide levels indicating an underground fire was burning in an area adjacent to and connected with known contaminated areas of the West Lake Landfill. The movement of the underground fire in the South Quarry has been unpredictable and there are no estimates of the length of time it would take for the underground fire to reach the RIM in Area 1.

The threat of an underground fire reaching the nuclear waste was of such concern that the Potential Responsible Parties (PRPs) contracted a company called Engineering Management Support, Inc. (EMSI) to prepare a report the potential risks that would be generated if the fire were to interact with the RIM materials. The EMSI report was released to the public in January 2014.

On March 28, 2014, at the request of the EPA, a technical review of the EMSI report on the potential impacts of fire was conducted by the Office of Research and Development – who predicted that an underground fire in OU-1 would:

- Create long-term risks to people and the environment;¹⁹
- Limit the effectiveness of the proposed remedy in the 2008 ROD and 2011 SFS, even with a proper cap/cover design, inspection and maintenance;^{20,21}
- Increase the temperature and pressure conditions within the landfill, generating large amounts of steam and forcing out a larger volume of gases (including radon) and fine particulates into the local environment;²²
- Increase production of contaminated leachate and dissolved gases that can migrate into the groundwater;²³

- Increase potential for releases of radon at levels of concern;
 - i. Measurements of radon around the landfill for the 2011 SFS recorded concentrations close to Uranium Mill Tailings Radiation Control Act (UMTRCA) standards.²⁴
 - ii. An underground fire in OU-1 would be expected to further reduce the ability of the waste materials to retain radon gas. By reducing the amount of moisture in the buried wastes, thereby increasing the space between soil particles, more radon will escape.²⁵
- A cap/cover installed over impacted areas at the West Lake Landfill could also hinder efforts to monitor and respond to future underground fire events.²⁶

4. The radioactive materials in the landfill can be removed and transported safely to licensed radioactive waste landfill. However, delays in removal will increase costs and long-term exposures to the public.

Downhole gamma logging and laboratory analyses conducted at the West Lake Landfill reveal that the radiologically impacted materials are generally found at depths ranging between the surface and top 6 feet of topsoil. There are also hot spots of contamination could be targeted for excavation and removal.

In February 2012 the EPA’s National Remedy Review Board (NRRB) conducted its review of the EPA’s Region 7 proposal for remedial action of Operable Unit 1 at the West Lake Landfill. In March 2013, the Board finalized its draft discussions, which concluded

“...based on the fact that the Agency has safely cleaned up numerous hazardous waste sites with radiological contamination across the country, including many in residential areas, the cleanup work can be done safely without unacceptable risk...”

The NRRB recommended that EPA Region 7 should:

“...develop an alternative that reflects an approach which surgically removes the RIM, which appears to be a discrete, reachable source term that will continue to increase in toxicity over hundreds and thousands of years...”

CONCLUSIONS

The EPA has yet to propose a plan for the excavation of highly radioactive materials from the West Lake Landfill, despite their own scientific evidence and recommendations from their own staff experts.

The Federal Government has been removing radiological contaminants from residential and commercial properties for the past seventy years in order to reduce hazards stemming from exposure to members of the public. The removal of radiologically-impacted source material is protective and should be an important objective of any proposed cleanup. These cleanup activities can be safely and efficiently completed with appropriate engineering controls and in accordance with approved health and safety plans.

In the near term, efforts should be made to:

1. Evaluate and implement immediate responses to prevent an underground fire from coming into contact with RIM material;
2. Identify current technologies which could be employed to sort RIM materials;
3. Determine the vertical and linear characterization of groundwater contamination and potential groundwater plume as opposed to isolated groundwater hot-spots;
4. Detect and characterize additional hot spots in the landfill outside of the known contaminated areas;
5. Facilitate the excavation of RIM material from the West Lake Landfill and its shipment and ultimate disposal at a dedicated and licensed disposal facility;

Finally, in accordance with expert evaluations, the proposed remedy in the 2008 ROD should be replaced with a more permanent and protective removal remedy that will reduce hazards to the public. Such a remedy should be developed with feedback from the community.

ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EMSI	Engineering Management Support, Inc.
EPA	Environmental Protection Agency
ETSC	EPA ORD Engineering Technical Support Center
MCL	Maximum Contaminant Level
NRRB	National Remedy Review Board
ORD	EPA Office of Research and Development
OU-1	Operable Unit-1
PRP	Primary Responsible Party
RCA	Recycled Concrete Aggregate
RIM	Radiologically-Impacted Material
ROD	Record of Decision
SFS	Supplemental Feasibility Study
UMTRCA	Uranium Mill Tailings Radiation Control Act

ENDNOTES

¹ U.S. Environmental Protection Agency, Memorandum, From: John McKernan, ScD, CIH Director, ORD Engineering Technical Support Center (ETSC), To: Dan Gravatt, RPM U.S. EPA Region 7, Subject: Observations on the EMSI report: Evaluation of Possible Impacts of a Potential Subsurface Smoldering Event on the Record of Decision – Selected Remedy for Operable Unit-1 at the West Lake Landfill, Dated January 14, 2014, March 28, 2014. <https://semspub.epa.gov/work/07/30284983.pdf>

² U.S. Environmental Protection Agency, National Remedy Review Board Discussions Regarding the Remedy at the West Lake Landfill Superfund Site, February 28, 2013.

http://moenvironment.org/files/WestLakeNRRB_MCEnotes.pdf (The National Remedy Review Board (NRRB) is a peer review group created to ensure that proposed Superfund cleanup decisions are consistent with Superfund law, regulations and guidance. NRRB members are EPA managers and senior technical and policy experts with significant experience in Superfund remedy selection issues.)

³ U.S. Environmental Protection Agency, Record of Decision, West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1, May 2008.

<http://westlakelandfill.com/Portals/0/Documents/West%20Lake%20ROD%20OU1%20signed%2005-29-08.pdf>

⁴ Comments from NRRB Reviewer John Frisco on PRP Scope of Work: Alternative Cover Designs and Fate and Transport Modelling, “*Not sure why an ET [evapotranspiration] Cover is even being considered at this site since its deficiencies have already been identified (Albright and Benson).*”

⁵ Inside EPA, EPA Orders Rare Review of Radioactive Cleanup Plan at Precedential Site, June 28, 2010

⁶ Internal E-Mail from NRRB Reviewer John Frisco dated February 15th, 2012 stated “*Radiological contamination remains active for a very long time and would require long-term management wherever it ends up. For this reason, where possible, we try to send such material to facilities designed specifically for this purpose (e.g., Idaho, Utah). If one could safely and efficiently extract the radiological waste that might be an option worth consideration.*”

⁷ Comments from NRRB Reviewer Charles Openchowski on PRP Scope of Work for groundwater, “*The NRC reports also discuss how the toxicity of this RIM will continue to increase over time...this increase in Ra-226 must be considered in evaluating the long-term hazard posed by this radioactive material.*” *The SFS also acknowledges this fact.*”

⁸ State of Missouri Attorney General’s Office, “Westlake Landfill Tree Core Analysis Report,” Dr. Joel G. Burken, Dr. Shoaib Usman, September 2, 2015 - *Scientific data published by the State of Missouri Attorney General’s Office, demonstrated the potential for RIM to transfer offsite. Tree coring analysis conducted around the West Lake Landfill observed elevated radiologic counts of U-238 and U-235 in many of the analyzed samples. These elevated levels indicate offsite migration of RIM into the local environment.*

⁹ Missouri Department of Natural Resources, “Bridgeton Sanitary Landfill Groundwater Investigation Report,” St. Louis County, Missouri, prepared for the Attorney General of Missouri - *Analysis of potentiometric contours published by the State of Missouri Attorney General’s Office indicate that groundwater flows in a westerly direction, angling away from the landfill toward the Missouri River.*

¹⁰ OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, April 22nd, 1991

¹¹ OSWER Directive 9283.1-33, *Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration*

¹² Robert E Criss, Risk and Character of Radioactive Waste at the West Lake Landfill, Bridgeton, Missouri, March 14, 2013 – “*Specifically, it has no basal clay liner, no plastic sheeting, no internal cells, no leachate collection system, nor any type of protective cap, all of which are standard requirements for modern landfills. Instead the West Lake Landfill is a chaotic pile of debris covered by unmanaged “natural” vegetation, surrounded by a fence with radioactive hazard signs. This landfill is an unsuitable host for any type of radwaste, industrial waste, chemical waste, or even ordinary domestic waste.*” http://moenvironment.org/images/West_Lake_Rept03142013.pdf

¹³ Environmental Protection Agency, West Lake Update - EPA to Conduct Additional Sediment Sampling at the West Lake Landfill, May 26th, 2016 - *EPA analysis has determined that RIM materials are being transported off-site with surface water after significant rain events and collecting in sediment around the landfill.*

¹⁴ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary Bullet Point #2, *“Since we do not have a full accounting of the material in OU-1, we cannot make a definitive assessment regarding the potential for chemical reactions between the RIM and non-RIM materials if an SSE (Sub-Surface Smoldering Event) were to occur. If these reactions were to occur, they could cause a rapid buildup of heat or gas, and subsequent reactions or reactive conditions in the landfill.”*

¹⁵ State of Missouri Attorney General’s Office, Westlake Landfill Tree Core Analysis Report, Dr. Joel G. Burken, Dr. Shoaib Usman, September 2nd, 2015

¹⁶ Environmental Protection Agency, West Lake Update -- EPA to Conduct Additional Sediment Sampling at the West Lake Landfill, May 26th, 2016.

¹⁷ Internal Comments by Charles O. on PRP Groundwater Scope of Work, *“Based on information presented to the [National Remedy Review] Board, it appears that there have been some samples of groundwater at this site that exceed standards considered as ARARs... Generally, under existing Agency guidance, exceeding a maximum contaminant level in groundwater normally would warrant a response action.”*

¹⁸ M. Kaltofen, R. Alvarez, L. Hixson, Tracking legacy radionuclides in St. Louis, Missouri, via unsupported 210Pb, Journal of Environmental Radioactivity, December 2015.

<http://www.coldwatercreekfacts.com/media/reports/Alvarez-Journal-2015.pdf>

¹⁹ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #4, *“We do not support the conclusion that no additional long term risks would be created in the event of a SSE at OU-1. There are at least two risk pathways that could exist from an SSE [subsurface smoldering event]. The first is through increased air exposures to contaminants such as radon. As airborne concentrations of radon increase, so would the risk to people. The second pathway is increased leachate production that could move contaminants and dissolved radon gas from OU-1 into the groundwater.”*

²⁰ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #2, *“...using the higher temperatures observed in the Bridgeton Landfill as a worse-case scenario, these temperatures may cause the structural integrity of the cap called for in the 2008 ROD to be adversely affected. This could potentially include surface cracks and fissures in the cap extending down into the waste material, and potentially cause permeation of the cover used.”*

²¹ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #2, *“...if a SSE occurs, short-term risks may be present even with proper cap design, inspection and maintenance.”*

²² Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary Bullet Point #3, *“A SSE in OU-1 would be expected to create increased pressure conditions within the landfill and force out entrained gases, including radon.”*

²³ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #5, *“Short-term effects of an SSE could also include greater amounts of leachate production, which has been observed at the Bridgeton Landfill from condensation of large amounts of steam. An SSE may result in increased emissions of radon and other contaminants in the air and groundwater, even with annual inspections and proper maintenance of designs discussed in the 2008 ROD and 2011 SFS.”*

²⁴ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #3, *“Given that measurements of radon in air during the SFS were close to a Uranium Mill Tailings Radiation Control Act (UMTRCA) standard, there is potential for radon releases at levels of concern if a SSE occurs in OU-1. This observation does not consider other environmental conditions that could cause radon and other landfill gas concentrations to increase at ground level, such as atmospheric inversions.”*

²⁵ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #4, *“We do not support the conclusion that no additional long term risks would be created in the event of a SSE at OU-1. There are at least two risk pathways that could exist from a SSE. The first is through increased air exposures to contaminants such as radon. As airborne concentrations of radon increase, so would the risk to people.”*

²⁶ Internal Comments from EPA ORD ETSC experts on EMSI Executive Summary, Bullet Point #3, *“...a SSE may be present in OU-1 for a long period of time before it is detected, because the only apparent means to detect a SSE after closure is through annual visual inspections.”*