

What the public should know about on-site radioactive and hazardous waste disposal before the next landfill is built on the Department of Energy Oak Ridge Reservation



The Environmental Management Waste Management Facility (EMWMF), the active landfill for radioactive and hazardous waste disposal on the Oak Ridge Reservation



How and why did things go wrong at the EMWMF?
How can mistakes be avoided at a future radioactive and hazardous waste landfill on the Oak Ridge Reservation?

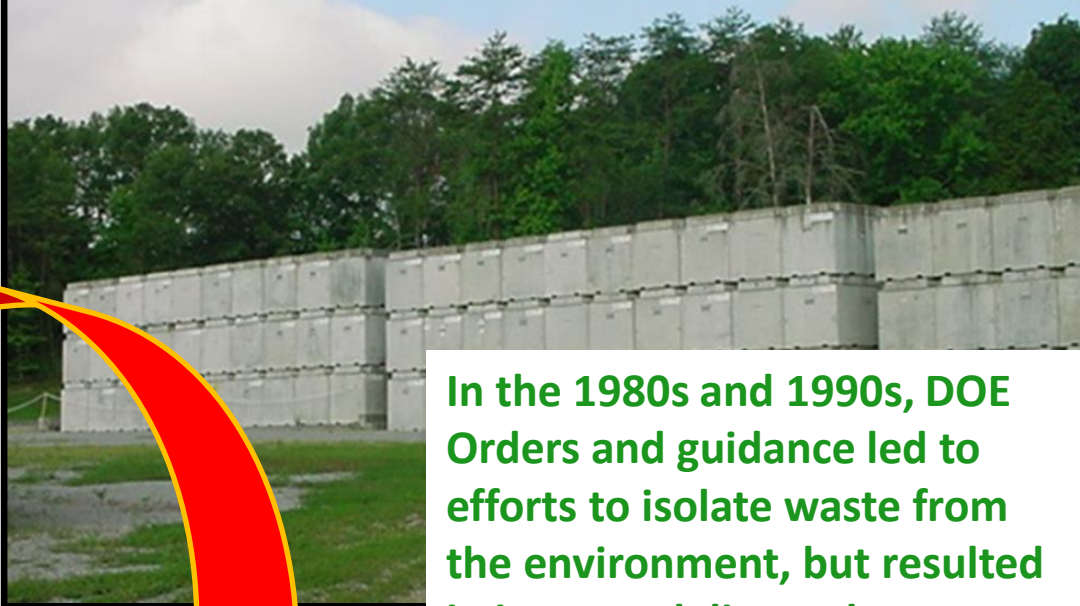
Historically, DOE disposed of waste in Oak Ridge under the authority of the Atomic Energy Act with minimal attention to environmental releases.



Waste dumped into trenches in Bear Creek Valley prior to DOE establishing requirements for disposal

Radioactive waste generated from plant operations is now shipped off site for disposal, but large volumes of waste generated by cleanup activities in Oak Ridge have been buried on site. Disposal of radioactive and hazardous waste was authorized through an agreement between DOE, EPA, and the State of Tennessee.

Radioactive waste in vaults in the Interim Waste Management Facility in Melton Valley near highway 95 in the late 1990s

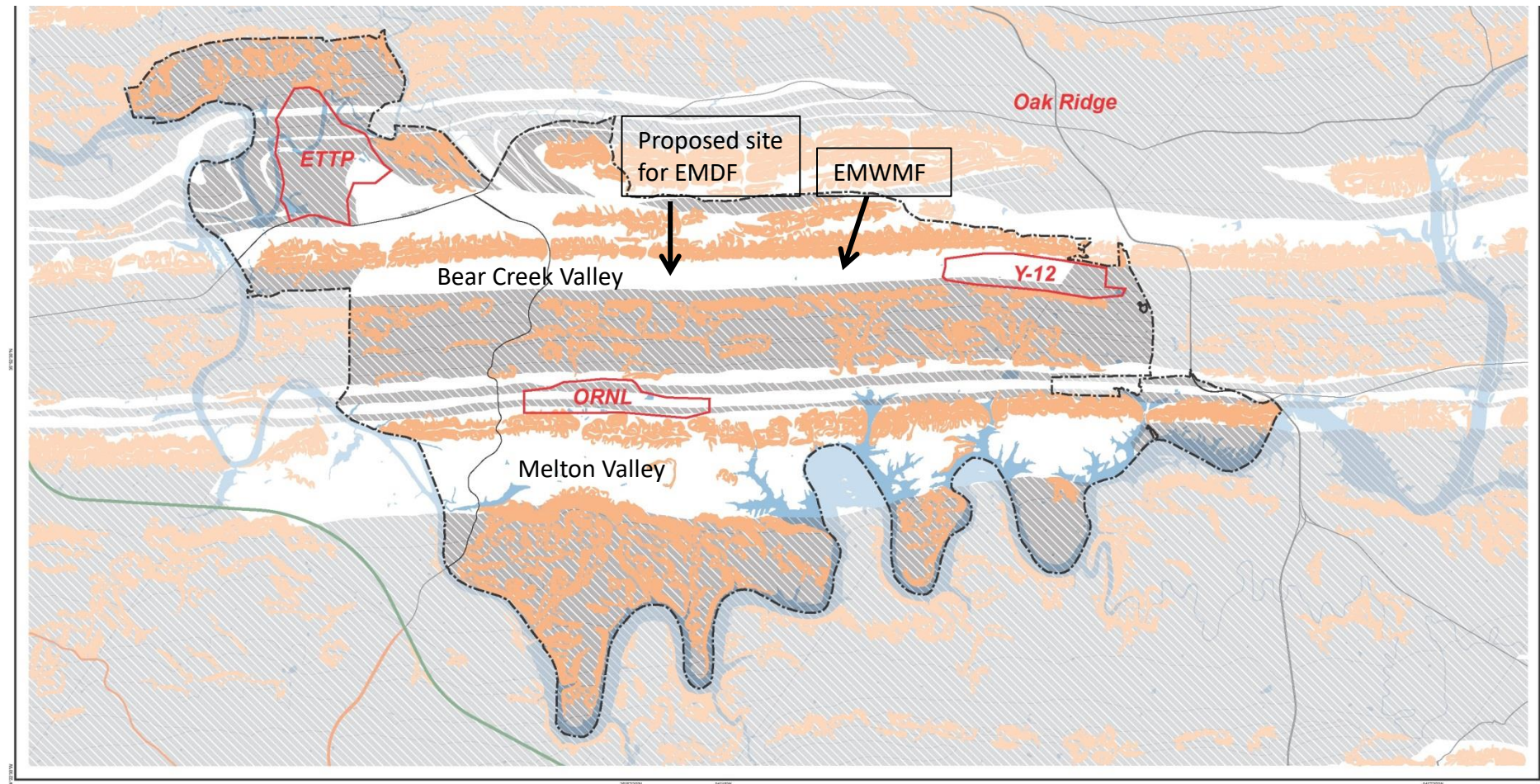


In the 1980s and 1990s, DOE Orders and guidance led to efforts to isolate waste from the environment, but resulted in increased disposal cost



Demolition and remediation waste landfilled in 2002 at the Environmental Management Waste Management Facility (EMWMF)

ORNL studies as far back as the 1980s identified areas with steep slopes (orange) and areas of carbonate rocks that can develop caves and other karst features (hatched in gray) as poor candidates for radioactive waste disposal. Even the areas that are less problematic for waste disposal (shown in white) have high water tables, many small streams, and are close to roads and property boundaries. Large quantities of radioactive waste were buried in some areas. Wastes disposed in Melton Valley contain millions of Curies of radioactivity. Millions of pounds of uranium are buried near the current disposal facility (EMWMF) in Bear Creek Valley.



Preliminary Geologic Map of the Oak Ridge, Tennessee Area

Radioactive, hazardous, and toxic waste generated by demolition and remediation activities is currently disposed on site at the Environmental Management Waste Management Facility (EMWMF) in Bear Creek Valley. DOE sometimes refers to the EMWMF as a permitted landfill. This may be misleading. Although the EMWMF was authorized by agreement with regulatory agencies, it does not operate under a State or EPA permit for waste disposal. Instead, the authorization is implemented through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, and associated laws and rules. These regulations deal with environmental cleanup rather than waste disposal. When the EMWMF was legally authorized, it was through a CERCLA Record of Decision (ROD) rather than a permit.



To obtain an actual permit for EMWMF, it would have been necessary to submit a permit application to a regulatory agency that could license the facility. The permit application would have provided information on the characteristics of the waste to be disposed, a detailed characterization of the site, and plans for facility design and closure. The CERCLA documents that should have provided most of the information normally in a permit application are the Remedial Investigation (typically used to report contaminant nature and extent and exposure pathways at a contaminated site) and the Feasibility Study (typically the basis for choosing a cleanup method).

**Remedial Investigation
Feasibility Study (RI/FS) -
evaluates disposal options**

**Proposed Plan - summarizes
the RI/FS information and
identifies the preferred option**

**Record of Decision - presents
and describes the alternative
chosen by DOE, EPA, and State**

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The review resulted in a determination that this document is not of a nature that it is a CERCLA or EPCRA public release approval is valid.</p> </div> <div data-bbox="647 714 917 735" data-label="Text"> <p>U.S. DEPARTMENT OF ENERGY Environmental Management Program</p> </div> <div data-bbox="753 742 859 828" data-label="Image"> </div> <div data-bbox="705 839 846 853" data-label="Section-Header"> <p>This Fact Sheet Describes:</p> </div> <div data-bbox="705 861 888 982" data-label="List-Group"> <ul style="list-style-type: none"> • The need for a decision on the disposal of waste from cleanup of the Oak Ridge Reservation • Waste disposal alternatives considered • The alternative preferred by DOE • How to become involved in selecting the final waste disposal alternative • Where to get more information </div> <div data-bbox="730 1011 865 1028" data-label="Section-Header"> <p>Your opinion is invited</p> </div> <div data-bbox="730 1028 888 1142" data-label="Text"> <p>DOE invites the public to comment on all alternatives presented in this fact sheet. Comments should be submitted to the DOE Office of Environmental Response, Compensation, and Liability Act of 1980 (ORR) at the Oak Ridge Reservation. A fee is charged for comments. For you are not required to pay. Comments should be submitted to the DOE Office of Environmental Response, Compensation, and Liability Act of 1980 (ORR) at the Oak Ridge Reservation. A fee is charged for comments. For you are not required to pay.</p> </div> <div data-bbox="730 1142 888 1220" data-label="Text"> <p>Comments should be submitted to the DOE Office of Environmental Response, Compensation, and Liability Act of 1980 (ORR) at the Oak Ridge Reservation. A fee is charged for comments. For you are not required to pay.</p> </div> <div data-bbox="730 1220 888 1292" data-label="Text"> <p>NOVEMBER November-December 7:00 a.m. to 5:00 p.m. Public Comment Period January 21, 1994 March 8, 1994</p> </div> <div data-bbox="730 1292 888 1320" data-label="Text"> <p>A public meeting will be held on February 23, 1994.</p> </div> <div data-bbox="1110 664 1217 685" data-label="Text">114297</div> <div data-bbox="1110 685 1217 721" data-label="Image"> </div> <div data-bbox="1110 721 1217 735" data-label="Text">EMEF DMC</div> <div data-bbox="1110 742 1217 763" data-label="Text">DOE/OR/01-1791&D3</div> <div data-bbox="917 771 1207 849" data-label="Section-Header"> <p>Proposed Plan for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste January 1993</p> </div> <div data-bbox="917 863 1033 878" data-label="Section-Header"> <p>INTRODUCTION</p> </div> <div data-bbox="917 885 1207 1092" data-label="Text"> <p>This proposed plan identifies the preferred alternative for disposal of wastes that will result from future cleanup of the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR). Studies of various DOE sites show they may pose unacceptable risks. Such sites will require cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) to reduce risks. Cleanup is required to generate waste containing radioactive and hazardous contamination. DOE has conducted a feasibility study (FS), summarized in this proposed plan, to evaluate alternative strategies for managing this future cleanup waste. DOE, the U.S. Environmental Protection Agency (EPA), and the Tennessee Department of Environment and Conservation (TDEC) are issuing this proposed plan to provide information on issues regarding future waste disposal at ORR and to provide the opportunity for public input. Citizens may take part in the remedy selection decision by commenting on this plan or attending the public meeting.</p> </div> <div data-bbox="917 1092 1207 1278" data-label="Text"> <p>This proposed plan describes the waste disposal alternatives evaluated in Remedial Investigation/Feasibility Study for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste (DOE/OR/02-1637&D2). The remedial investigation (RI) estimated the amount and types of wastes potentially requiring disposal. The FS identified a range of disposal alternatives and compared these alternatives using the CERCLA evaluation criteria. The DOE Remedial Policy (June 1989), National Environmental Policy Act of 1969 (NEPA) values have been incorporated into CERCLA documentation prepared for this project. For DOE policy opportunities for public involvement under CERCLA also provided opportunities for public involvement under NEPA. Information in this proposed plan should be reviewed in conjunction with the RI/FS.</p> </div> <div data-bbox="917 1278 1207 1335" data-label="Text"> <p>Three waste disposal alternatives were evaluated in the FS: (1) no action; (2) disposing of waste in a new ORR on-site facility; and (3) off-site disposal of waste at commercial and/or DOE facilities in other states. The preferred</p> </div> <div data-bbox="1033 1320 1159 1342" data-label="Text"> <p>EMEF DMC JBB 1 5 1993</p> </div>	<div data-bbox="1700 742 1835 763" data-label="Text">DOE/OR/01-1791&D3</div> <div data-bbox="1400 792 1787 921" data-label="Section-Header"> <p>OU-13 Record of Decision for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste, Oak Ridge, Tennessee</p> </div> <div data-bbox="1516 963 1680 1113" data-label="Image"> </div> <div data-bbox="1497 1213 1671 1242" data-label="Text"> <p>This document has received the appropriate reviews for release to the public.</p> </div>
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CERCLA provides a logical framework for evaluating environmental cleanup but must be adapted when used to authorize waste disposal. The EMWMF ROD was approved before some critical information was available, perhaps because the CERCLA process is not designed for approving a disposal facility. Because regulatory decisions were based on limited information, significant problems arose at EMWMF. Some of these problems have persisted. The most significant include:

- Inadequate information was collected about site hydrogeology before deciding the landfill location, size, layout and design. This has led to groundwater intrusion into the facility buffer and liner.**
- The need to treat large quantities of landfill wastewater was not anticipated, and requirements for wastewater treatment were not included in the ROD. Adequate facilities to manage wastewater were not built at EMWMF.**
- EMWMF risks were evaluated assuming a restricted set of exposure pathways. Contaminant fate and transport modeling in the risk assessment was flawed. As a result, the landfill does not have reasonable limits on the inventory of some radionuclides.**

While Melton Valley and Bear Creek Valley have been considered to be the least problematic locations for radioactive waste disposal on the Oak Ridge Reservation, these areas have high water tables and areas of groundwater discharge that restrict their use for shallow disposal of radioactive waste. The EMWMF site was not studied enough to identify areas where groundwater is near the ground surface. The landfill was designed as if there was no shallow water table. As a result the facility footprint was moved uphill from its planned location, and a drain was built under the facility to suppress groundwater levels. Prior to construction of the EMWMF underdrain, modeling suggested that groundwater was in the clay liner beneath the disposal facility. Groundwater levels under some areas of the landfill remain uncertain, and some data indicate that the levels may remain in the buffer below the landfill liner.

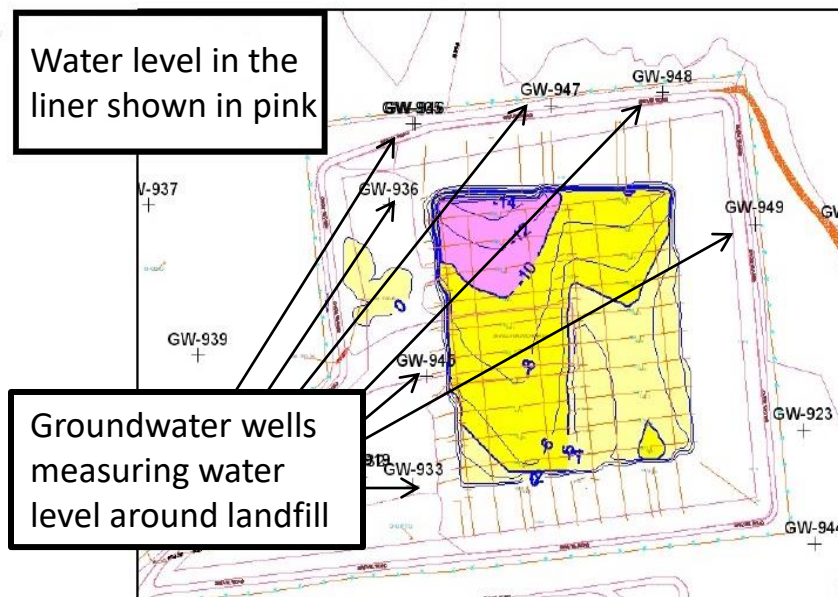


Fig. 9. Modeled hydrogeologic conditions prior to placement of the underdrain.

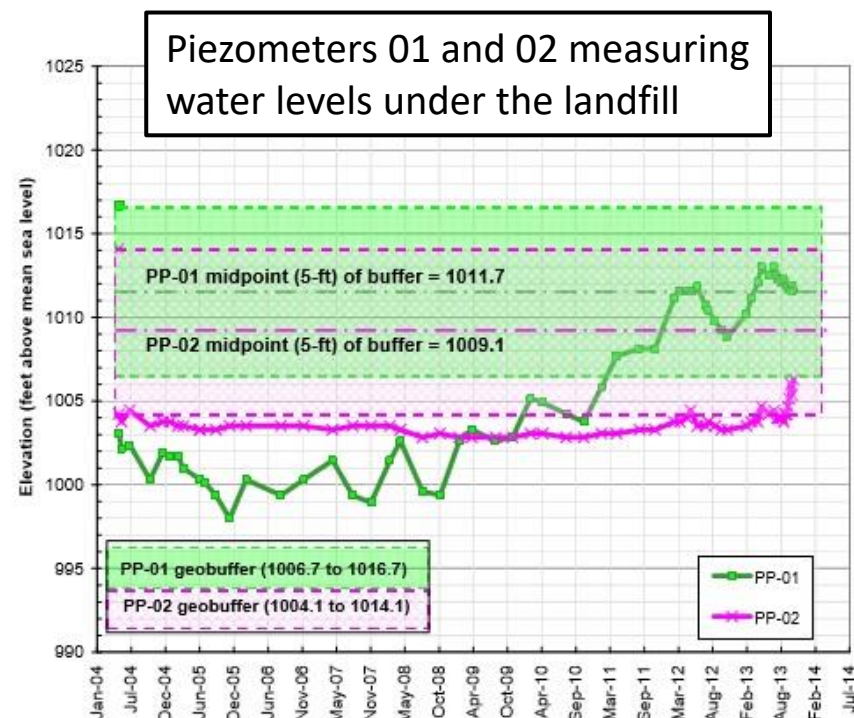
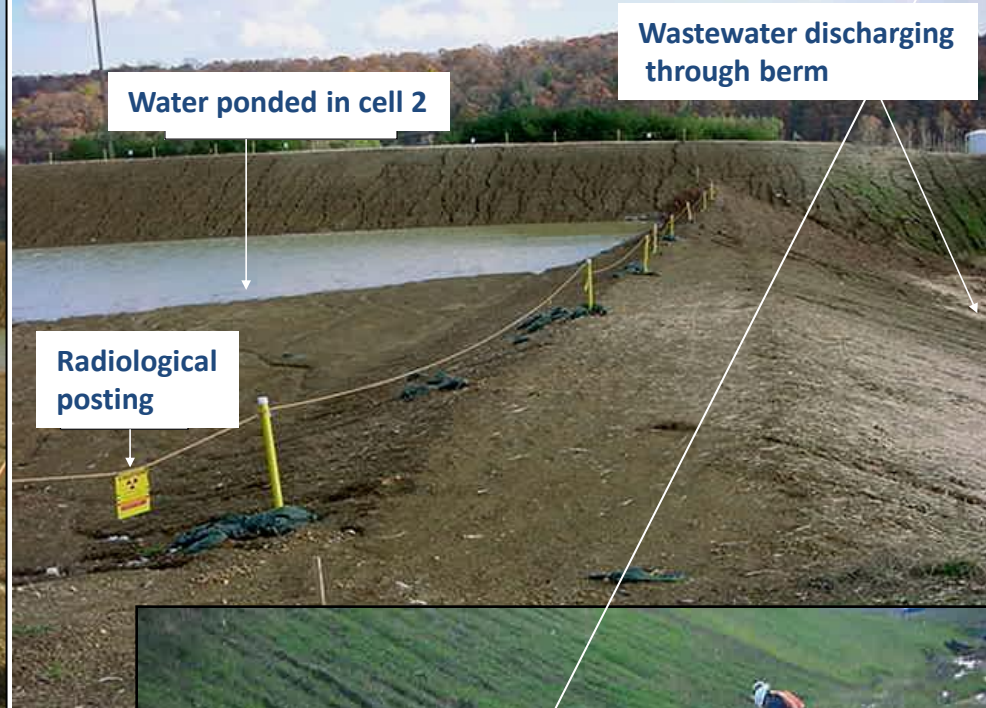
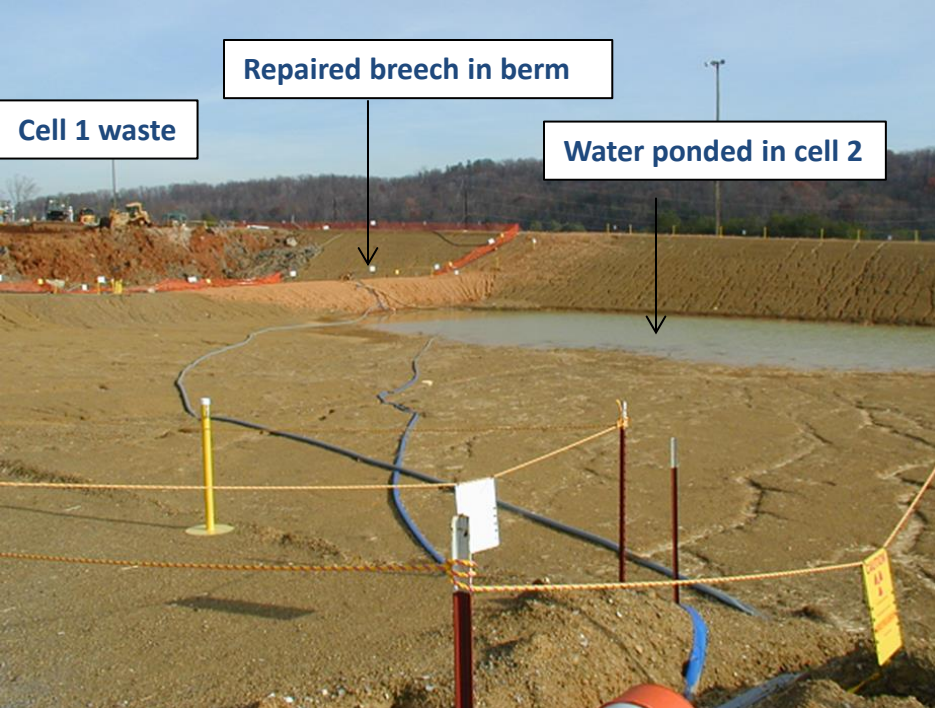


Fig. 6. Groundwater elevations over time for PP-01 and PP-02.



The EMWMF was approved and constructed without adequate planning for wastewater management. In 2002, excessive generation of leachate and contaminated stormwater led to the flooding of Cell 1 and washout of the berm separating Cells 1 and 2. Wastewater pooled in Cell 2 and was directly released to the environment when it ran through a berm around the cell. The landfill operator was ultimately fined for this release, but the ROD that authorized the EMWMF has still not been modified to reflect the current practices of wastewater management at the facility.

The risk assessment for the EMWMF led to some absurd conclusions. Most hazardous chemicals and radionuclides present at Oak Ridge were alleged to never pose a significant risk, even if they were buried in the landfill without any limits on concentration or radioactivity. According to the risk analysis , waste acceptance limits were not necessary for waste contaminated with mercury, most fission products, and many transuranic radionuclides.



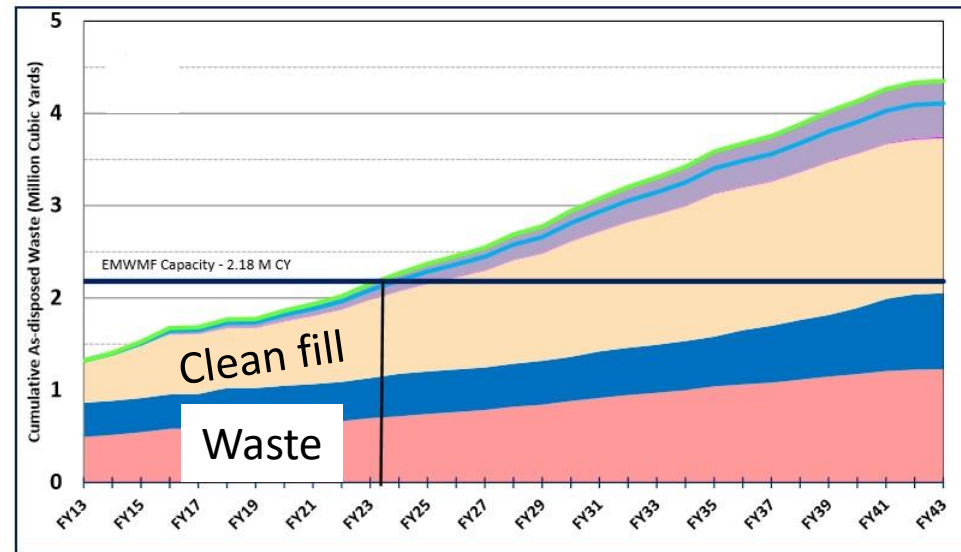
This analysis could not pass a reality check. DOE, EPA, and the State negotiated administrative limits. But even these limits allowed disposal of billions of Curies of fission products, comparable to the inventory of fission products proposed for the geologic repository for spent nuclear reactor fuel at Yucca Mountain. The administrative waste acceptance criteria (WAC) at EMWMF aren't based on a CERCLA site specific risk assessment and still don't make sense.

The failure to develop waste acceptance criteria (WAC) that would clearly protect human health and the environment and the failure to rigorously enforce the EMWMF WAC led to a number of problems, especially during the early years of operation. Examples include:

- Liquid radioactive waste was not properly solidified and leaked onto a public highway during transport to EMWMF.
- High activity waste was apparently buried in EMWMF in Waste Lot 84.4. This should have been disposed in a geologic repository like the one that was proposed at Yucca Mountain.
- Waivers of size requirements led to excessive use of clean soil to fill around large pieces of structural steel, wasting landfill capacity



Radiation survey on Hwy. 95 after liquid waste leaked during transit (DOE/ORO-2183, Type B Accident Investigation Board Report).



Burial of large steel beams from the gaseous diffusion buildings such as K-33 without size reduction to meet the EMWMF physical WAC led to the need for excessive use of clean fill and loss of landfill capacity

Protection of human health and the environment from buried radioactive and hazardous waste depends primarily on:

- **Ability of the site to isolate contaminants from the environment**

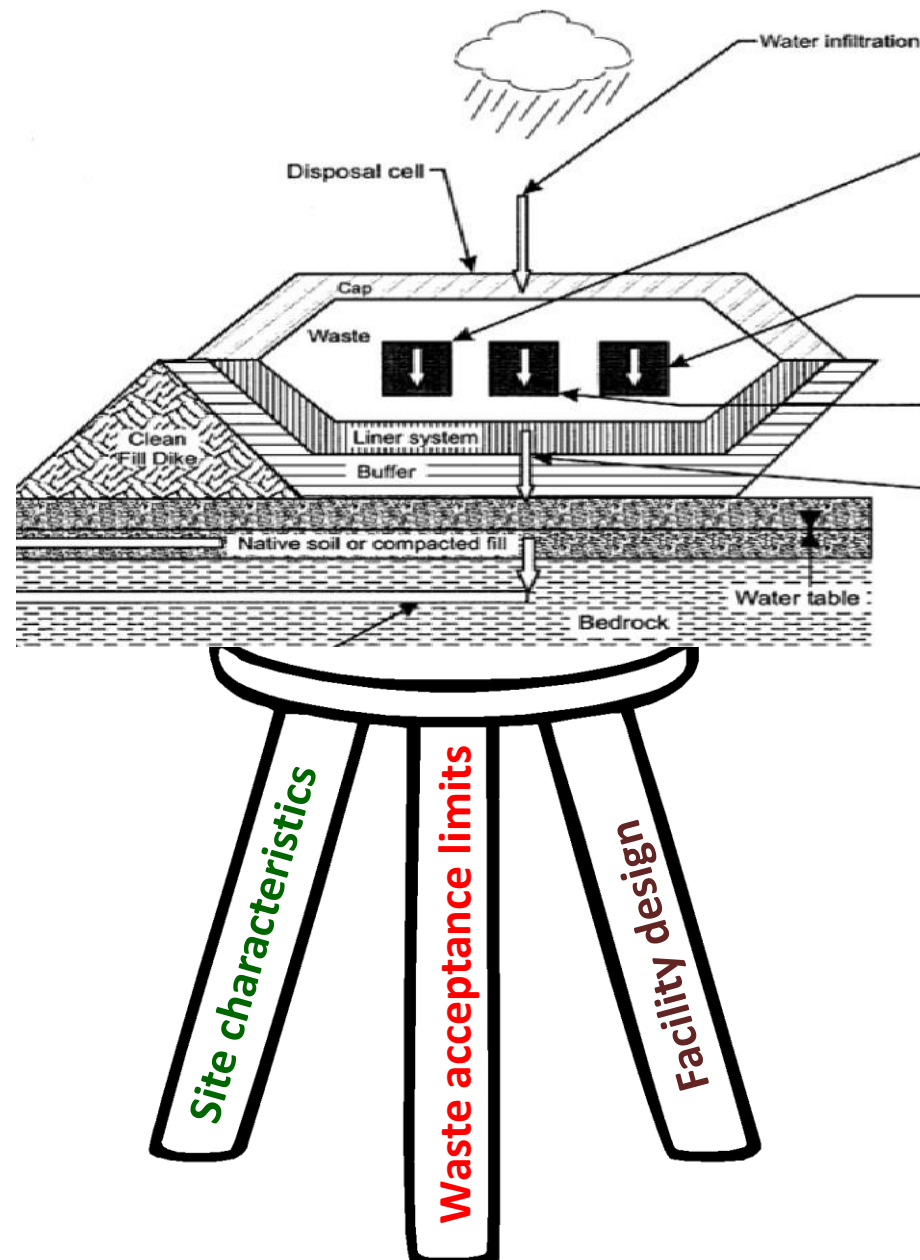
A site with desirable geologic and hydrologic characteristics can minimize the potential for a significant release indefinitely.

- **Waste limits**

Limits on the amount of radioactive and hazardous material that can be disposed in the landfill will mitigate the effects of any release to the environment or any exposure of humans to contamination over both short and long timeframes.

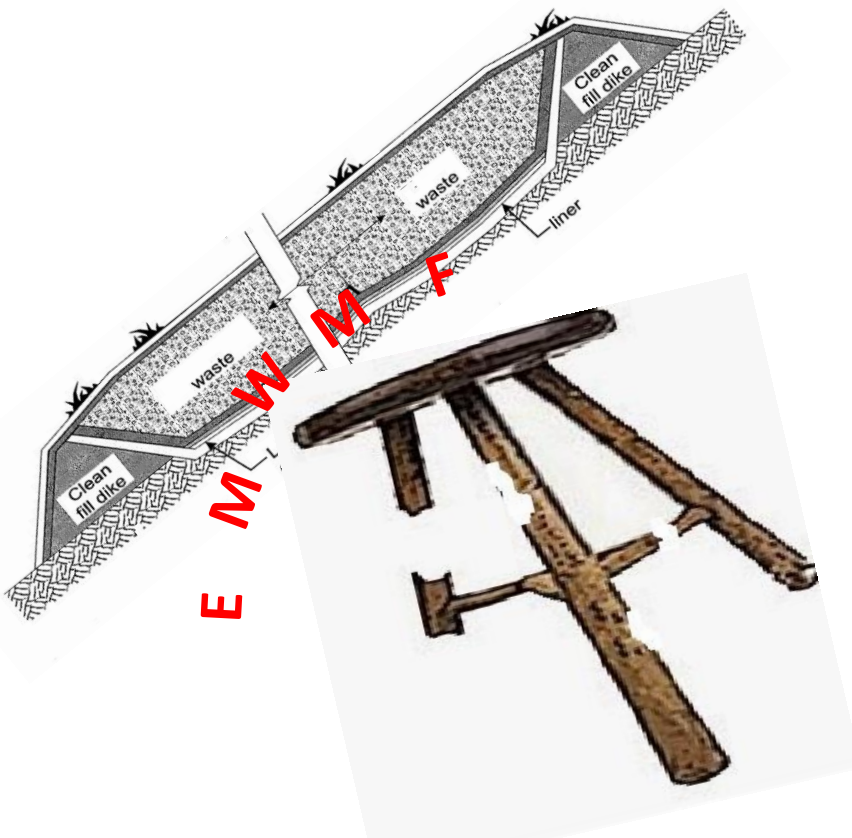
- **Ability of engineered barriers to isolate contaminants from the environment**

These barriers have proven to be quite effective for time scales of decades, but they may not be effective for longer periods.



The Oak Ridge Reservation does not provide good sites for radioactive waste disposal due to geologic, hydrologic, and demographic characteristics.

Protection of human health and the environment from wastes buried in Oak Ridge must rely on a robust facility design, adequate quality control during construction, careful operation of the landfill, and restrictions on the waste inventory.



At EMWMF, the facility design was compromised by inadequate site characterization. The facility was consequently built over, rather than around, areas with streams and shallow groundwater. Waste acceptance criteria were compromised due to limited evaluation of potential exposure pathways and inaccurate assumptions in the contaminant migration models that were fundamental to assessing the potential risks posed by the facility.

A CERCLA remedy selected to remediate contaminated sites is required to meet, at a minimum, two threshold criteria:

- Protect human health and the environment**
- Comply with applicable or relevant and appropriate regulations**

Did the “remedy” that became EMWMF meet the these criteria?

NO. For example, the landfill was built over an area of groundwater discharge, prohibited by rules for siting a radioactive waste disposal facility that are listed in the EMWMF Record of Decision.

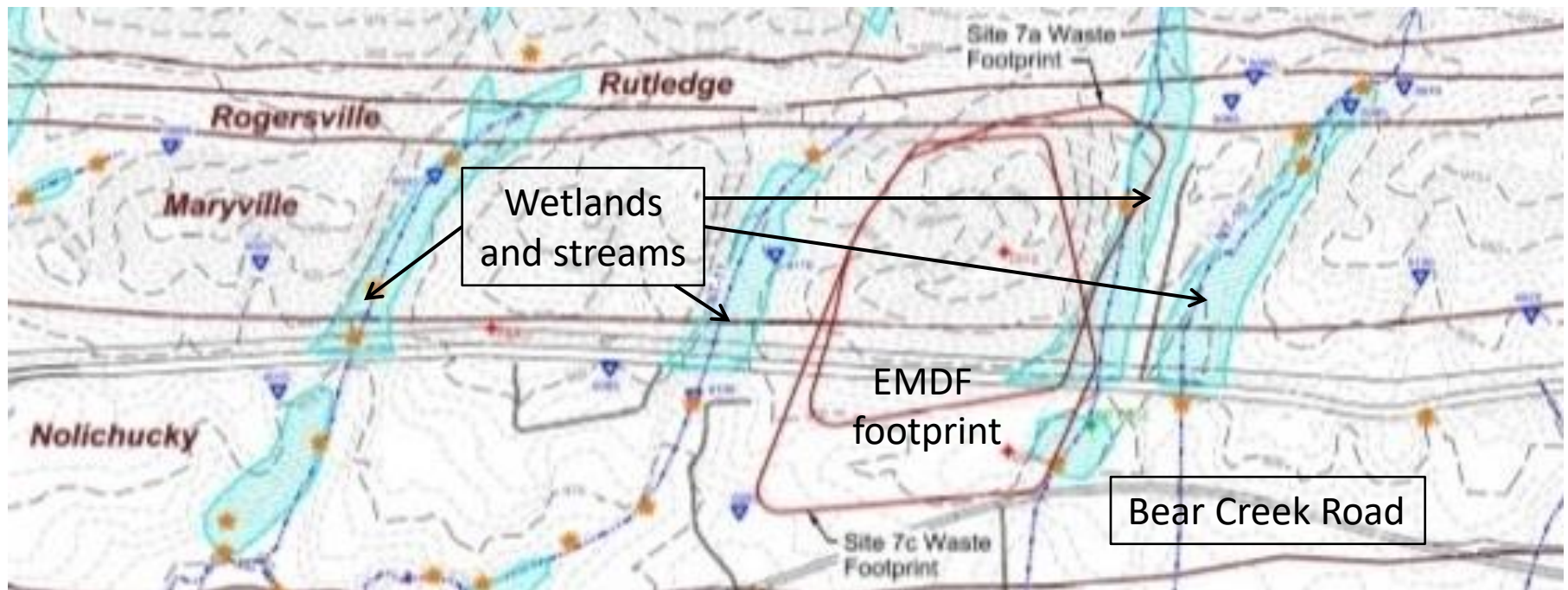
Will it nevertheless protect human health and the environment?

Maybe. People will find out sometime in the future.

But any new radioactive and hazardous waste disposal facility on the Oak Ridge Reservation should not repeat the same mistakes!

DOE now plans to build another radioactive and hazardous waste landfill in Bear Creek Valley, the Environment Management Disposal Facility (EMDF), and is asking for regulatory approval:

- Without adequate site characterization to avoid areas where groundwater might intrude into the landfill buffer or liner
- Without waste acceptance limits based on a defensible risk assessment
- Without resolution of wastewater treatment issues
- Using cost savings that presume maximum economy of scale for on-site disposal as justification, despite uncertainties about the facility footprint and waste acceptance limits that may be driven by CERCLA requirements to protect human health and the environment and limit the landfill capacity

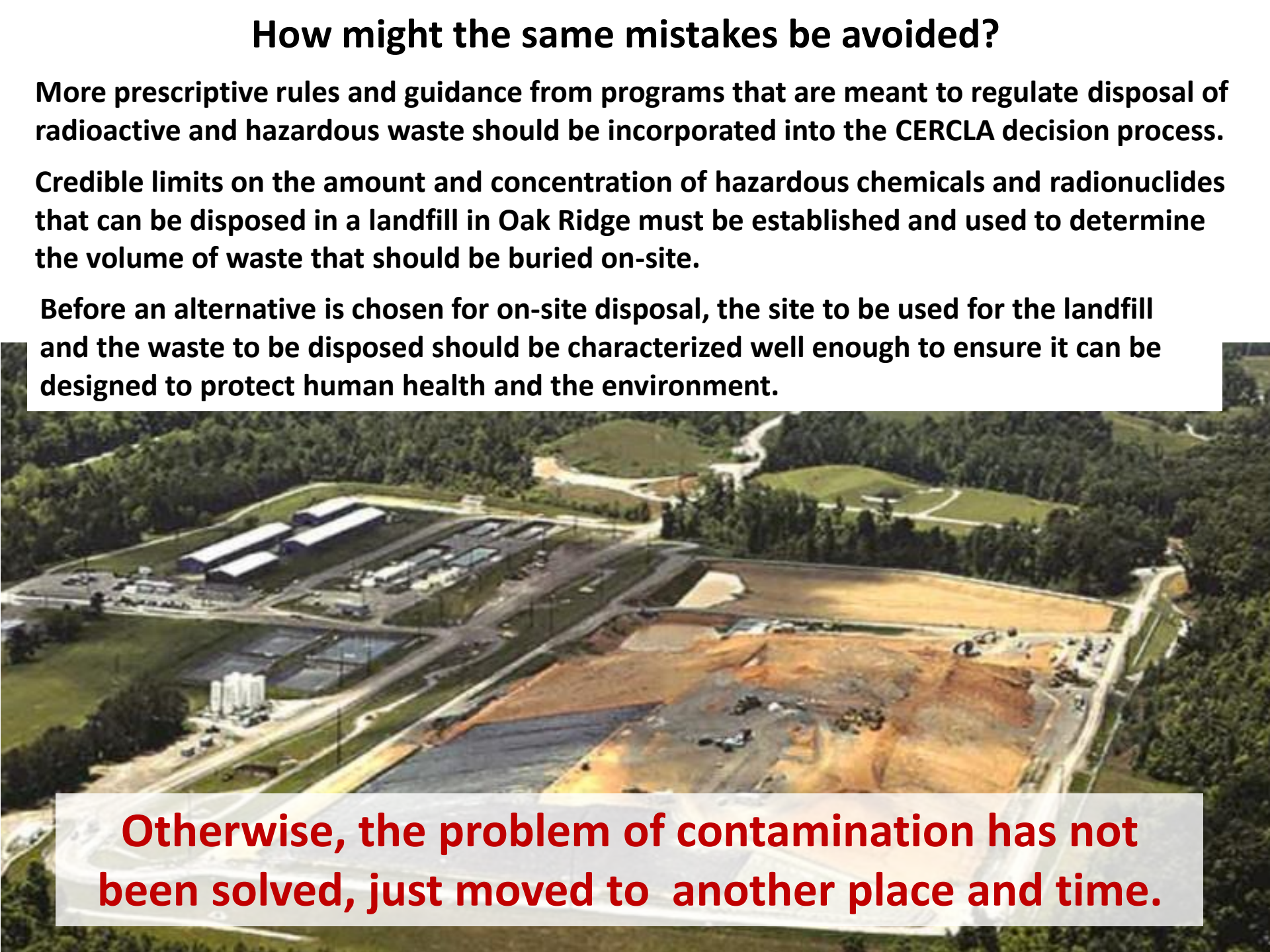


How might the same mistakes be avoided?

More prescriptive rules and guidance from programs that are meant to regulate disposal of radioactive and hazardous waste should be incorporated into the CERCLA decision process.

Credible limits on the amount and concentration of hazardous chemicals and radionuclides that can be disposed in a landfill in Oak Ridge must be established and used to determine the volume of waste that should be buried on-site.

Before an alternative is chosen for on-site disposal, the site to be used for the landfill and the waste to be disposed should be characterized well enough to ensure it can be designed to protect human health and the environment.



Otherwise, the problem of contamination has not been solved, just moved to another place and time.

The summary presented here was compiled by staff retired from the Oak Ridge office of the Tennessee Department of Environment and Conservation – Division of Remediation, including:

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Information, photographs, and illustrations were extracted from digital copies of publicly available U.S. Department of Energy (DOE) and Tennessee Department of Environment and Conservation (TDEC) documents and presentations. Conclusions were based on our involvement with radioactive waste management decisions on the Department of Energy Oak Ridge Reservation over the past two decades.

For additional details or specific references
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