FINAL REPORT
September 2016

EVALUATION OF CLOSURE, POST-CLOSURE, AND PERPETUAL CARE AND MAINTENANCE FOR COMMERCIAL HAZARDOUS WASTE AND COMMERCIAL RADIOACTIVE WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

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Legislative Management Committee

By

UTAH WASTE MANAGEMENT AND RADIATION CONTROL BOARD

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LIST OF ACRONYMS AND INITIALISMS

ALARA	As low as is reasonably achievable
LLRW	Low-level radioactive waste
mrem	millirem; 0.001 of a "roentgen equivalent man"
NAC	Nevada Administrative Code
NYSDEC	New York State Department of Environmental Conservation
OAC	Oklahoma Administrative Code
OIG	Office of Inspector General
URCB	Utah Radiation Control Board
SCCR	South Carolina Code of Regulations
UAC	Utah Administrative Code
UCA	Utah Code Annotated
UDRC	Utah Division of Radiation Control
UDSHW	Utah Division of Solid and Hazardous Waste
UDWMRC	Utah Division of Waste Management and Radiation Control
USHWCB	Utah Solid and Hazardous Waste Control Board
US DOE	United State Department of Energy
US EPA	United States Environmental Protection Agency
UWMRCB	Utah Waste Management and Radiation Control Board

EXECUTIVE SUMMARY

The report has been prepared as an update to the report of the same name dated September 2011 previously prepared by URS Professional Solutions, LLC (URS-PS), an AECOM affiliate. Appropriate updates and revisions have been made to sections of this report to reflect: (1) information that has become available for commercial hazardous waste management and low level radioactive waste (LLRW) management facilities in other states that are similar in nature to those commercial hazardous waste management and LLRW management facilities permitted or licensed in Utah; (2) new information for the commercial hazardous waste management and LLRW management facilities in Utah available after September 2011; (3) recent changes in rules in Utah regarding financial sureties that are provided by these Utah facilities; and (4) significant organizational changes instituted by statutory amendments. A summary of findings from the compilation and review of the above new information and recent rule changes is presented below.

COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES

Financial Assurances for Commercial Hazardous Waste Management Facilities

- ✓ The amount of financial assurance required and provided for closure and post-closure care of commercial hazardous waste treatment, storage, and disposal facilities under UCA § 19-6-108 is judged to be adequate at current levels and with current rules, controls, and practices.
- ✓ No financial assurance or funds are currently required by rule, and are therefore not provided for the perpetual care of, maintenance of, or corrective actions at commercial hazardous waste land disposal facilities should the need arise following the post-closure periods.

Commercial Hazardous Waste Treatment, Storage, and Disposal Facilities

Commercial hazardous waste management facilities[1] permitted in Utah and the financial assurances they presently provide are summarized in Table ES-1.

Table ES-1. Financial assurances presently provided by commercial hazardous waste management facility Owners/Permittees in Utah

Facility	Closure Financial Assurance Mechanism	Closure Financial Assurance Provided	Post-Closure Financial Assurance Mechanism	Post-Closure Financial Assurance Provided
Clean Harbors Grassy Mountain	Insurance	$21.3 million	Insurance	$15.6 million

[1] Commercial hazardous waste treatment, storage, and disposal facility means a facility that receives, for profit, hazardous waste for treatment, storage, or disposal. Numerous noncommercial hazardous waste management facilities exist in Utah but are not addressed in this report.

Table ES-1. Financial assurances presently provided by commercial hazardous waste management facility Owners/Permittees in Utah				
Facility	**Closure Financial Assurance Mechanism**	**Closure Financial Assurance Provided**	**Post-Closure Financial Assurance Mechanism**	**Post-Closure Financial Assurance Provided**
Energy*Solutions* Mixed Waste Facility[2]	Surety Bond and Standby Trust	$12 million	Surety Bond and Standby Trust	$2 million
Clean Harbors Aragonite[3]	Insurance	$13.4 million	Not Applicable	Not Applicable
Clean Harbors Clive[3]	Insurance	$8.9 million	Not Applicable	Not Applicable
Safety-Kleen Pioneer Road[3]	Insurance	$0.2 million	Not Applicable	Not Applicable
Nexeo Solutions[3]	Funded Trust	$0.4 million	Not Applicable	Not Applicable

Need for Legal/Regulatory Revisions for Commercial Hazardous Waste Land Disposal Facilities

The Utah Waste Management and Radiation Control Board (UWMRCB) has identified the following areas in which improvements might be made to address the issue of perpetual care at closed commercial hazardous waste disposal facilities:

- ✓ The UWMRCB recommends that the Legislature consider requiring perpetual care for ongoing monitoring and maintenance of commercial hazardous waste land disposal facilities after termination of the post-closure permit, provided that the funds for perpetual care do not impose additional costs to the facilities, and do not reduce the Division's budget appropriations.
- ✓ The UWMRCB recommends that additional funds not be required at this time to cover potential catastrophic failure of the landfill cells, ground water corrective action or major maintenance at commercial hazardous waste land disposal facilities. This determination is based on the engineering controls employed to build the landfill cells to current regulatory standards. All phases of landfill construction are reviewed, monitored, and approved by the Director. The design and construction of landfill cells provide reasonable assurance that wastes are contained as a means to prevent additional Superfund sites. Other factors include the remote location of current facilities, the lack of a nearby population center, the location of the facilities in the Tooele County Hazardous Waste Industries Corridor, which prevents residential development in

[2] Permitted in connection with Utah Hazardous Waste Permit UTD982598898.

[3] Commercial hazardous waste treatment and/or storage facility. No waste remains in place following closure; therefore, post-closure care is not applicable.

the area, the non-potable groundwater, the lack of precipitation, and the restricted access to the facilities. More details are provided in the discussion under Question 2-20 in this report.

COMMERCIAL RADIOACTIVE WASTE MANAGEMENT FACILITIES

Financial Assurances for Commercial Radioactive Waste Management Facilities

- ✓ The amounts of financial assurance required, provided, and currently approved for closure and institutional control of commercial radioactive waste disposal facilities are judged to be adequate at current levels and with current rules, controls, and practices.
- ✓ The future value of the Radioactive Waste Perpetual Care and Maintenance Fund at the end of 100 years of the institutional control period is projected to be $93 million, assuming that the Energy*Solutions* facilities continue active operations for at least 20 more years, that such funds are invested to produce a minimum assumed 2 percent per year real return, and that no monies are paid out from the Fund prior to the end of the 100-year institutional control period.
- ✓ Based on the current calculation and assumptions described in this report, the bounds of estimated probable costs (or financial risk) for unplanned or unexpected events above the minimal maintenance and monitoring for reasonable risks that may occur following closure of a commercial radioactive waste treatment or disposal facility could range from $1 million to $60 million. The financial risk ranges most probably between $5 and $32 million, and the Radioactive Waste Perpetual Care and Maintenance Account as established by UCA §19-3-106.2 is judged to be adequately funded at current levels and with current rules, controls, and practices.

Radioactive Waste Disposal Facilities

Low-level radioactive waste (LLRW) management facilities licensed in Utah and the financial assurances presently provided are summarized in Table ES-2.

Table ES-2. Financial assurances presently provided by commercial radioactive waste management facility Owners/Licensees in Utah

Facility	Closure Financial Assurance Mechanism	Closure Financial Assurance Provided	Institutional Control Financial Assurance Mechanism	Institutional Control Financial Assurance Provided
Energy*Solutions*; LLRW Facility	Surety Bond	$58.5 million[4]	Surety Bond	$6.2 million
Energy*Solutions* Mixed Waste Facility	Surety Bond	$12 million	Not Applicable	Covered Under Post-Closure

[4] Closure and Institutional Control Financial Assurances total $64,681,299 as of March 2015.

Table ES-2. Financial assurances presently provided by commercial radioactive waste management facility Owners/Licensees in Utah				
Facility	**Closure Financial Assurance Mechanism**	**Closure Financial Assurance Provided**	**Institutional Control Financial Assurance Mechanism**	**Institutional Control Financial Assurance Provided**
Energy*Solutions*; 11e.(2) Facility	Surety Bond	$11.8 million	US DOE Long-Term Stewardship Program[5]	$0.9 million

Need for Legal/Regulatory Revisions for Commercial Radioactive Waste Management Facilities

The UWMRCB recognizes the following:

- ✓ The Radioactive Waste Perpetual Care and Maintenance Fund was established by the Legislature to finance the perpetual care and maintenance of commercial LLRW disposal facilities at the conclusion of the institutional care period and to protect against the possibility of funding shortfall during the institutional control period. Annual payments of $400,000 are required by state law to be paid into this fund.
- ✓ Based on information provided in this report, a minimum amount of $13 million has been established in order for the fund to meet the intended obligations for perpetual care and maintenance.
- ✓ Since 2008, Energy*Solutions* has set aside the balance of $13 million utilizing the surety required for financial assurance for closure and institutional care. As the annual payment of $400,000 is made to the perpetual care fund, an equivalent reduction is made to the overall obligation of the liability for closure, institutional care, and perpetual care.

Therefore, the UWMRCB recommends the following:

- ✓ The Legislature should consider additional investment options for the State Treasurer in order to achieve a greater rate of return for the Radioactive Waste Perpetual Care and Maintenance Account.
- ✓ Additional funds not be required at this time to cover potential catastrophic failure of the landfill cells, ground water corrective action or major maintenance at commercial radioactive waste land disposal facilities. This determination is based on the engineering controls

[5] Under provisions of the Nuclear Waste Policy Act of 1982, the US Department of Energy (DOE) must by law provide long-term care of 11e.(2) facilities that have been closed and stabilized in compliance with US Nuclear Regulatory Commission requirements. An additional condition of accepting such facilities is that funds sufficient to cover all long-term care costs must be transferred to the US DOE. Accordingly, one disposal unit is subject to being transferred to DOE's care under these provisions: Energy*Solutions* 11e.(2) embankment at Clive, Utah. The Vitro embankment has already been transferred to the Department of Energy.

employed to build the landfill cells to current regulatory standards. All phases of landfill construction are reviewed, monitored, and approved by the Director. The design and construction of landfill cells provide reasonable assurance that wastes are contained. Other factors include the remote location of current facilities, the lack of a nearby population center, the location of the facilities in the Tooele County Hazardous Waste Industries Corridor, which prevents residential development in the area, the non-potable groundwater, the lack of precipitation, and the restricted access to the facilities.

- ✓ The Legislature should not divert funds from the Radioactive Waste Perpetual Care and Maintenance Account to other applications.

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1. OVERVIEW

1.1 LEGISLATIVE DIRECTIVE

The Utah Legislature stipulated by Utah Senate Bill 24, dated February 1, 2005 and signed February 25, 2005 that the Utah Solid and Hazardous Waste Control Board (USHWCB) and the Utah Radiation Control Board (URCB), now combined to form the Utah Waste Management and Radiation Control Board (UWMRCB), prepare and submit a report evaluating adequacy of funding and financial assurances provided for the closure, post-closure, and perpetual care and maintenance of hazardous waste and radioactive waste treatment, storage, and disposal facilities. The law was amended in 2010 and 2015 and is reproduced in this update as Appendix A.

For commercial hazardous waste management facilities and prior to July 2015, UCA §19-1-307 required the USHWCB, and as of July 2015 the UWMRCB, to address the following questions every five years:

- ✓ Are adequate financial assurances or funds required for closure and post-closure care of [commercial] hazardous waste treatment, storage, or disposal facilities under R315-264-140 through 151?
- ✓ Are adequate financial assurances or funds required for perpetual care and maintenance following the closure and post-closure period of a commercial hazardous waste treatment, storage, or disposal facility, if found necessary following the evaluation under Subsection (1)(c) of UCA §19-1-307?
- ✓ What costs (above minimal maintenance and monitoring) for reasonable risks that may occur during closure, post-closure, and perpetual care and maintenance of commercial hazardous waste treatment, storage, or disposal facilities including groundwater corrective action, differential settlement failure, or major maintenance of a cell or cells?

The provisions of UCA §19-1-307 required the USHWCB to evaluate in 2006 whether financial assurance or funds are necessary for perpetual care and maintenance following the closure and post-closure period of a commercial hazardous waste treatment, storage, or disposal facility to protect human health and the environment.

For commercial radioactive waste management facilities and prior to July 2015, UCA §19-1-307 required the URCB, and as of July 2015 the UWMRCB, to address the following questions every five years:

- ✓ Is the restricted account adequate to provide for perpetual care and maintenance of commercial radioactive waste treatment or disposal facilities?
- ✓ Is the amount of financial assurance required adequate to provide for closure and post-closure care of commercial radioactive waste treatment or disposal facilities?
- ✓ What costs (above minimal maintenance and monitoring) for reasonable risks that may occur during closure, post-closure, and perpetual care and maintenance of commercial radioactive waste treatment, storage, or disposal facilities including groundwater corrective action, differential settlement failure, or major maintenance of a cell or cells?

- ✓ What are the costs under UCA Subsection 19-3-106.2(5)(b) of using the Radioactive Waste Perpetual Care and Maintenance Fund during the period before the end of 100 years following final closure of the facility for maintenance, monitoring, or corrective action in the event that the owner or operator is unwilling or unable to carry out the duties of post-closure maintenance, monitoring, or corrective action?

UCA §19-1-307 requires the UWMRCB to submit a report on the evaluations to the Legislative Management Committee on or before October 1 of the year in which the report is due.

For purposes of this update it is important to note that as a result of legislation enacted during the 2015 General Session of the Utah Legislature (S.B. 244), beginning July 2015, the Division of Solid and Hazardous Waste (DSHW) and the Division of Radiation Control were consolidated into a single organization, the Division of Waste Management and Radiation Control (the Division). The legislation also eliminated both the Solid and Hazardous Waste Control Board and the Radiation Control Board and created the Utah Waste Management and Radiation Control Board. Accordingly, this update incorporates these important organizational changes.

This report has been prepared by URS Professional Solutions, LLC (URS-PS), an AECOM affiliate, acting as a contractor to the Utah Department of Environmental Quality, for the UWMRCB. The Board has reviewed and concurs with the results, conclusions, and recommendations expressed in this report.

1.2 COMMERCIAL HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL IN UTAH

The Director has permitted six commercial hazardous waste management facilities to treat, store, and/or dispose of hazardous waste. The six facilities and the activities each is permitted to conduct are listed in Table 1-1 on the following page.

After the operating life of any facility, the closure of each disposal facility is followed by a post-closure care period. The duration of this period is stated in Utah Administrative Code (UAC) as 30 years, contingent upon specified Division facility-specific determinations. During this time, the facility is actively maintained, custodial care is provided, and its performance is monitored. Once the closed facility is determined by the Director to satisfy applicable criteria, the post-closure permit is terminated.

The rules that govern the management of hazardous waste at facilities within Utah are found in Title R315 of the Utah Administrative Code. These rules require that each commercial hazardous waste land disposal facility's Permittee provide financial assurances sufficient for a third-party contractor to close the facility and to provide post-closure care of the facility following closure (in the event that the permittee is unable or unwilling to complete such activities).

Table 1-1. Commercial hazardous waste management facilities permitted in the State of Utah[6]	
Facility	**Permitted to:**
Clean Harbors Grassy Mountain	Treat, Store, and Dispose
Energy*Solutions* Mixed Waste Facility[7]	Treat, Store, and Dispose
Clean Harbors Aragonite	Treat and Store
Clean Harbors Clive	Store
Safety-Kleen Pioneer Road	Store
Nexeo Solutions	Store

The amount of funding for financial assurance is approved annually by the Director through review and revision of cost estimates updated and submitted by the Permittee. The financial assurances are intended to cover the costs of facility closure and post-closure care (in the event that the permittee is unable or unwilling to complete such activities). No financial assurances are provided for care of the facility following post-closure permit termination.

Only commercial hazardous waste land disposal facilities are required to provide funds for post-closure care. Currently, two commercial hazardous waste land disposal facilities exist in Utah that meet this requirement, Energy*Solutions*' Mixed Waste Facility and Clean Harbors' Grassy Mountain Facility. Energy*Solutions*' Mixed Waste Facility is covered beyond the post-closure care period under the Radioactive Waste Perpetual Care and Maintenance Fund. Thus, creation of a perpetual care fund for commercial hazardous waste land disposal facilities would affect only the Clean Harbors Grassy Mountain Facility.

1.3 COMMERCIAL RADIOACTIVE WASTE TREATMENT AND DISPOSAL IN UTAH

The Director has licensed three commercial radioactive waste management facilities to treat, store, and/or dispose of radioactive waste. The three facilities and the activities they are licensed to conduct are listed in Table 1-2 on the following page.

The closure of each facility is followed by up to 100 years of institutional controls (comparable to the 30-year post-closure period in the hazardous waste rules). During this time, the facility is actively maintained, custodial care is provided, and its performance is monitored. Following the 100-year institutional control period, monies of the Radioactive Waste Perpetual Care and Maintenance Fund cover all costs that might be incurred in maintaining, caring for, monitoring, and taking corrective actions required for the closed facility.

[6] Numerous non-commercial hazardous waste management facilities exist in Utah but are not addressed in this report.

[7] Permitted in connection with Utah Hazardous Waste Permit UTD982598898.

Table 1-2. Commercial radioactive waste management facilities licensed in the State of Utah	
Facility[8]	**Licensed to:**
Energy*Solutions*; LLRW Facility	Dispose
Energy*Solutions*; 11e.(2) Facility	Dispose
Energy*Solutions* Mixed Waste Facility	Treat[9], Store, and Dispose

The rules that govern the management of radioactive waste at facilities within Utah are found in Title R313 of the Utah Administrative Code. These rules require that each commercial radioactive waste management facility Owner/Licensee provide financial assurances sufficient for a third-party contractor to close the facility and to provide for institutional control of the facility following closure.

The amount of financial assurances required are approved annually by the Director through review and revision of cost estimates updated and submitted by the Owner/Licensee. The financial assurances are intended to cover the costs of closure and institutional control of the facilities.

1.4 OVERVIEW OF THE EVALUATION

As the Legislature has directed, the UWMRCB reviewed this report and concurs with its results and findings. The Board submits this report in fulfillment of the Legislature's charge.

Review of surety funds associated with commercial hazardous waste management facilities are discussed in Chapter 2, while Chapter 3 addresses review of surety and perpetual care funds associated with commercial radioactive waste management facilities. Recommendations are presented in Chapter 4 of this report. Appendices convey information that provides perspective on financial assurances provided for Utah facilities and those permitted or licensed in Utah and other states.

[8] All three facilities are located at Clive, Utah.

[9] Permitted Facility in connection with Utah Hazardous Waste Permit UTD982598898.

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2. COMMERCIAL HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

Treatment, storage, and disposal of hazardous waste in Utah are regulated under provisions of R315 of the Utah Administrative Code. Individual hazardous waste management facilities are required to submit applications for a permit to construct and operate such a facility. The Director reviews permit applications to ensure that all technical and regulatory issues are resolved in accordance with regulatory requirements and guidance.

The purpose of the Director's review is to develop reasonable assurance that applicable regulatory requirements will be satisfied during all phases of facility life, including construction, operation, closure, and for typically 30 years of post-closure care following facility closure. Given that applicable regulations are satisfied, confidence exists that human health and the environment will be properly protected during and after facility operation.

Once all regulatory issues are resolved to ensure compliance with regulatory provisions, the Director prepares a draft permit, notifies the public of its intention to issue a permit, receives and responds to public comments, and finally issues the permit. The regulations provide the outline for the more detailed facility-specific requirements given in the permit.

The Director maintains regulatory surveillance during all phases of facility life to ensure compliance with regulatory requirements and all permit conditions. The Director regularly conducts compliance inspections of all aspects of facility operations covered by regulations and permit conditions. Departures from required conditions and performance are addressed through a range of enforcement actions to ensure safe operation and that human health and the environment are properly protected.

The Permittee is required to provide financial assurances to protect against the possibility that it might not be able to meet all costs associated with facility closure and post-closure care.

No mechanism is presently required to cover possible costs associated with minor facility failures and maintenance that might occur after the post-closure care period, except for the Energy*Solutions* Mixed Waste Facility, which is covered by the Radioactive Waste Perpetual Care and Maintenance Fund. The Energy*Solutions* Mixed Waste Facility is covered because mixed waste contains both hazardous and radioactive contaminants.

In this section, the following are addressed:

- ✓ Commercial facilities permitted by the State of Utah to treat, store, and/or dispose of hazardous waste are identified
- ✓ Commercial facilities required to maintain financial assurances are identified and the nature of assurances they provide are briefly described
- ✓ Representative closure and post-closure activities are described
- ✓ Closure and post-closure financial assurances provided as required are identified and described
- ✓ Potential need for care and maintenance after the post-closure care period

- ✓ Adequacy of current requirements for providing financial assurances for commercial hazardous waste management facility closure and post-closure care
- ✓ Recommendations for revisions to current legal and regulatory requirements

Information regarding the financial assurance available for commercial hazardous waste disposal facilities is presented in a question and answer format below:

2.1 WHAT COMMERCIAL FACILITIES HAS THE STATE OF UTAH PERMITTED TO TREAT, STORE, AND/OR DISPOSE OF HAZARDOUS WASTE?

Table 2-1. Commercial hazardous waste management facilities permitted in the State of Utah

Facility	Permitted to:	Provides financial assurances for:
Clean Harbors Grassy Mountain	Treat, Store, and Dispose	Closure and Post-Closure
Energy*Solutions* Mixed Waste Facility[10]	Treat, Store, and Dispose	Closure and Post-Closure
Clean Harbors Aragonite	Treat and Store	Closure
Clean Harbors Clive	Store	Closure
Safety-Kleen Pioneer Road	Store	Closure
Nexeo Solutions	Store	Closure

The owner of any facility that will manage (that is treat, store, or dispose of) hazardous waste must ensure that funds are available for any costs associated with closing or maintaining the facility during the post-closure care of that facility. These facility owners provide legally enforceable financial assurances required under hazardous waste regulations. Financial assurances must be sufficient to cover all cost associated with facility closure and post-closure care.

Only two of the six commercial facilities permitted for hazardous waste management in Utah are required to provide financial assurances for care of the facility following closure because the wastes are disposed of at the site and are not removed after closure. Accordingly, these two, as shown in Table 2-1, provide financial assurances to cover not only closure costs, but also costs expected during post-closure care. As mentioned above, funds for perpetual care of the Energy*Solutions* Mixed Waste Facility are included in the Radioactive Waste Perpetual Care and Maintenance Fund.

[10] Permitted in connection with Utah Hazardous Waste Permit UTD982598898.

2.2 WHAT IS THE "LIFE CYCLE" OF A COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITY?

The life cycle of a commercial hazardous waste management facility consists of the phases or periods shown generally in Table 2-2.

Table 2-2. General phases of commercial hazardous waste management facility

Phase or Period	Typical Duration (years)	Applicability
Permitting and Initial Development	2 to 5 years	Treatment, Storage, and Disposal Facilities
Operating	15 to 40 years	Treatment, Storage, and Disposal Facilities
Closure	1 to 5 years	Treatment, Storage, and Disposal Facilities
Post-Closure Care	30 years	Disposal Facilities*
Following Permit Termination	Unlimited	Disposal Facilities*

*Because waste is not removed after closure.

2.3 WHAT IS FACILITY "CLOSURE?"

When the decision is made that the facility will no longer actively operate, it must go through a formal procedure known as facility closure. The purpose of facility closure is to remove all hazardous wastes associated with hazardous waste management operations, to the extent achievable. If waste is left in place, then post-closure financial assurances are required to cover costs of post-closure care. Such is the case for facilities permitted to dispose of hazardous waste.

Facility closure activities include:

- ✓ Disposing or shipment offsite of any waste received but not yet disposed of at the time closure commences
- ✓ Decontaminating of remaining support structures and operating equipment
- ✓ Dismantling and disposing of support structures, support systems, and equipment as required
- ✓ When required by the Permit, continuing the operational environmental monitoring program
- ✓ Closing and stabilizing all disposal units according to the design and permit requirements, once all waste has been disposed of

In general, facility closure activities do not include:

- ✓ Conducting environmental corrective actions
- ✓ Repairing facility components

2.4 WHO PERFORMS A FACILITY CLOSURE?

Under expected conditions, the Permittee will conduct facility closure at its own expense. Closure activities must be pursued until the Director determines that the facility has been successfully closed and that all hazardous wastes have been removed (or appropriately addressed where wastes remain in place). When the Permittee pays costs associated with facility closure, the terms and conditions for exercising the financial assurances are not fulfilled and no funds are disbursed from the financial assurance fund for closure. Once closure is completed by the facility and the funds for closure are no longer required, the financial assurance mechanism is returned to the control of the Permittee.

Under unusual conditions, the Permittee may be unable to close the facility. Under these conditions, and in accordance with applicable terms of the mechanism used to provide the required financial assurances, the Director may conduct the closure using an independent third-party contractor. To cover the costs of such closure, the Director would use the financial assurances provided for closure.

2.5 WHAT IS "POST-CLOSURE CARE?"

Following facility closure, the facility and the surrounding environment are monitored for a period of time long enough to develop confidence that the hazardous waste management units are performing as required and as expected. This period of time is referred to as the post-closure care period and its exact duration is determined by the Director. At the end of the post-closure care period, the permit is terminated.

The duration of the post-closure care period is not fixed under the Utah Administrative Code. The post-closure care period is typically expected to last for 30 years following facility closure. The Director may, however, shorten this duration if justification to do so is provided and approved. In contrast, however, the duration of post-closure care may also be extended beyond 30 years if environmental and physical monitoring data reveal that unstable or other unfavorable conditions exist or that residual risks are not or will not likely remain within acceptable limits.

Post-closure care activities typically include:

- ✓ Continuing the environmental monitoring program and reporting results
- ✓ Performing periodic surveillance
- ✓ Providing custodial care and maintenance
- ✓ Maintaining records
- ✓ Reporting periodically to the Regulatory Agency
- ✓ Carrying out other equivalent activities as determined by the Director
- ✓ Administering funds to cover the costs for these activities
- ✓ Conducting corrective actions for failed components or the failed facility

2.6 WHO PROVIDES POST-CLOSURE CARE?

Under expected conditions, the Permittee will provide post-closure care of the closed facility at its own expense. Post-closure activities must be pursued until the Director determines that the facility is performing acceptably and that the post-closure permit can be terminated. In this case, the conditions for using the post-closure care financial assurances are not fulfilled and no funds are disbursed for post-closure care. Once post-closure is completed by the facility and the funds for post-closure are no longer required, the financial assurance is returned to the control of the Permittee.

Under unusual conditions, the Permittee may be unable to provide post-closure care. Under these conditions, and in accordance with applicable terms of the financial mechanism used to provide the financial assurances, the Director may provide post-closure care using an independent third party contractor. To cover the costs of such post-closure care under these circumstances, the Director would use the financial assurances provided for post-closure care.

2.7 WHAT FORMS OF CLOSURE AND POST-CLOSURE CARE FINANCIAL ASSURANCES (FINANCIAL ASSURANCE MECHANISMS OR FINANCIAL SURETIES) ARE ALLOWED BY THE RULES?

A Permittee may satisfy the requirements for providing financial assurance for closure and post-closure care of a facility permitted to manage hazardous waste by using one or more of the following mechanisms. The reference in parentheses provides exact wording for each form of financial assurance.

- ✓ Trust fund (UAC R315-264-151(a)(1))
- ✓ Surety bond guaranteeing payment into a closure trust fund (UAC R315-264-151(b))
- ✓ Surety bond guaranteeing performance of closure and/or post-closure care (UAC R315-264-151(c))
- ✓ Letter of credit (UACR315-264-151(d))
- ✓ Insurance (UACR315-264-151(e))
- ✓ Financial test (UAC R315-264-151(f))
- ✓ Corporate guarantee that meets the certain specifications (UAC R315-264-151(h)(1))

Specific requirements are stated in the regulations for each form of financial assurance, as noted parenthetically above.

2.8 WHAT ARE THE ESTIMATED COSTS TO CLOSE UTAH'S PERMITTED COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES AND TO PROVIDE POST-CLOSURE CARE?

The costs estimated for the closure and post-closure care of commercial hazardous waste management facilities permitted by Utah are presented in Table 2-3. The Director reviews and

approves the proposed financial assurances once the proposed provisions are determined to satisfy applicable requirements.

Table 2-3. Summary of estimated facility closure and post-closure care costs for commercial hazardous waste management facilities permitted by the State of Utah

Facility	Estimated Facility Closure Cost	Estimated Post-Closure Care Cost
Clean Harbors Grassy Mountain	$21.3 million	$15.6 million
Energy*Solutions* Mixed Waste Facility	$12 million	$2 million
Clean Harbors Aragonite	$13.4 million	Not Applicable*
Clean Harbors Clive	$8.9 million	Not Applicable*
Safety-Kleen Pioneer Road	$0.2 million	Not Applicable*
Nexeo Solutions	$0.4 million	Not Applicable*

* Because waste does not remain in place after closure; therefore, post-closure care is not applicable.

Estimated costs can be influenced by such factors as:

- ✓ Closure and post-closure care plan specifications
- ✓ Changes in unit costs of items or activities required to close or provide post-closure care (such as the price of fuel, reduced availability of materials, and changes in qualified labor supply)
- ✓ Site-specific conditions (such as geotechnical and hydraulic characteristics of soils, meteorological conditions, and characteristics of waste managed at the facility) available at or near the facility
- ✓ Recent developments in technologies that could improve the conduct of any activity required during closure or post-closure care

Closure costs must address applicable requirements. For example:

- ✓ The Permittee must design, operate and close the facility so that the need for further maintenance is minimized.
- ✓ The Permittee must design, operate and close the facility so that the potential for post-closure release of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products is controlled, minimized, or eliminated.
- ✓ The estimated closure cost must be determined at the time in the facility's active life when the extent and manner of operation would make the closure most expensive.

- ✓ The cost estimate must assume that an independent third party will be hired to perform closure activities and post-closure care.
- ✓ The closure cost estimate may not take credit for salvage value of hazardous waste, non-hazardous waste, structures, equipment, land, or other assets associated with the hazardous waste management facility.

2.9 HOW MUCH FINANCIAL ASSURANCE MUST BE PROVIDED TO CLOSE A FACILITY AND PROVIDE POST-CLOSURE CARE?

Sufficient financial assurances must be provided in an amount equal to those estimated to be associated with closing a facility and providing post-closure care. The Permittee must estimate closure and post-closure costs and submit them for regulatory review as part of the initial permitting process. These cost estimates must account for all activities and costs that will be required to close the facility and to care for it during the post-closure care period.

After the permit is issued, the Permittee must update and submit annually the closure and post-closure care cost estimates for review by the Director. Having considered effects of any changes in closure plans, technological developments, and inflation, the Director will approve the amount of financial assurance for the coming year, until the next revised cost estimates is submitted and reviewed.

If the facility modifies its permit to bring new hazardous waste management units on line, increased financial assurance must be provided within 60 days of modification approval.

2.10 WHAT CLOSURE AND POST-CLOSURE FINANCIAL ASSURANCES ARE CURRENTLY BEING PROVIDED FOR UTAH'S PERMITTED FACILITIES?

As of 2015, financial assurances listed in Table 2-4 are currently being provided to cover the costs of closing and providing post-closure care at Utah's permitted commercial hazardous waste management facilities.

Table 2-4. Financial assurances presently provided by Permittees in Utah				
Facility	**Closure Financial Assurance Mechanism**	**Closure Financial Assurance Provided**	**Post-Closure Financial Assurance Mechanism**	**Post-Closure Financial Assurance Provided**
Clean Harbors Grassy Mountain	Insurance	$21.3 million	Insurance	$15.6 million
Energy*Solutions* Mixed Waste Facility	Surety Bond and Standby Trust	$12 million	Surety Bond and Standby Trust	$2 million
Clean Harbors Aragonite	Insurance	$13.4 million	Not Applicable	Not Applicable
Clean Harbors Clive	Insurance	$8.9 million	Not Applicable	Not Applicable
Safety-Kleen Pioneer Road	Insurance	$0.2 million	Not Applicable	Not Applicable
Nexeo Solutions	Funded Trust	$0.4 million	Not Applicable	Not Applicable

2.11 WHO IS RESPONSIBLE FOR OVERSEEING THE CLOSED FACILITY AFTER THE PERMIT IS TERMINATED?

Once the permit is terminated, the Division continues to monitor the performance of the closed facility. Although the State and Federal government could seek reimbursement from responsible parties, no financial assurances or other funds are provided for costs that might be incurred after permit termination.

2.12 WHAT FINANCIAL ASSURANCES OR FUNDS ARE PROVIDED TO COVER THE COSTS THAT MIGHT BE INCURRED AFTER THE PERMIT IS TERMINATED?

No financial assurance or other funds are explicitly provided for the perpetual care of, maintenance of, or corrective actions at commercial hazardous waste land disposal facilities should the need arise following the closure and post-closure care periods and termination of the post-closure permit.

2.13 WHAT IS "PERPETUAL CARE AND MAINTENANCE"?

The term "perpetual care and maintenance" is not defined in the Utah Administrative Code or US Environmental Protection requirements. For commercial hazardous waste land disposal facilities, perpetual care and maintenance activities that might be necessary following post-closure permit termination include:

- ✓ Maintaining appropriate levels of site security

- ✓ Providing minor repairs to components whose failure could compromise the stability and safety of the closed facility
- ✓ Performing routine maintenance of site and support structures and systems (such as landscaping, painting, maintaining fences, and repairing minor damage to cover systems
- ✓ Complying with applicable regulatory or legal requirements
- ✓ Pumping and treating groundwater contaminated beyond acceptable levels by the closed facility
- ✓ Restoring groundwater systems contaminated beyond acceptable levels by the closed facility
- ✓ Excavating and re-disposing of waste previously disposed of at the closed facility

2.14 DOES THE UTAH ADMINISTRATIVE CODE PROVIDE FOR PERPETUAL CARE AND MAINTENANCE OF CLOSED HAZARDOUS WASTE MANAGEMENT FACILITIES?

The Utah Administrative Code is based on rules developed and promulgated by the US Environmental Protection Agency (EPA). Neither EPA's rules nor the Utah Administrative Code provides for the perpetual care and maintenance of closed commercial hazardous waste management facilities following post-closure permit termination.

EPA's financial assurance requirements for hazardous waste management facilities have not explicitly addressed the need for maintenance, monitoring, or corrective actions following the facility's post-closure period and permit termination. EPA's rules assume that each facility's post-closure care period is not complete and the permit is not terminated until the facility has demonstrated that it is meeting and is likely to continue to meet applicable standards and requirements. Moreover, EPA's rules also implicitly assume that once the permit has been terminated, the disposal unit will continue to perform as designed so that no continuing attention is required.

Current estimates of the annual costs of monitoring and maintaining the closed Grassy Mountain facility total about $50,000[11] per year. Approximately $2.5 million invested at an assumed interest rate 2 percent per year would generate sufficient interest earnings to cover costs of this magnitude.

2.15 WHAT WILL BE THE VALUE OF A HAZARDOUS WASTE PERPETUAL CARE FUND IN THE FUTURE?

Monies deposited into a hazardous waste perpetual care fund would be invested according to Utah State Treasurer Rules. Investments must be made in secure financial instruments that have very small probability of failure or loss. Typically, such investments include US Treasury notes and bonds. Over the past century, these financial instruments have produced interest earnings of about 2 percent per year over and above prevailing inflation rates (RFF 2002, MSDW 1999).

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[11] This cost is based on sampling and analyzing groundwater once every five years, annual inspection of the facility, and annual minor maintenance of the landfill cover.

That is, they have a real interest rate of about 2 percent per year. Investments in such financial instruments grow faster than inflation by about 2 percent per year.

A review of the PTIF for FY 2012 through 2016, shows that the PTIF has generated a real rate of return of -0.9% (Statement of Account PTIF, Utah Public Treasurers' Investment Fund, FY 2012-2016).Given annual deposits of $54,000 plus interest earnings to a hazardous waste perpetual care fund, and an assumed real interest rate of 2 percent per year, Figure 2-1 and Table 2-5 present projected future values of the fund. Knowing the number of years from now that the facility closes and the time after that when the fund might be required, the value at the time of need can be determined. For example, if the facility terminates operations and is properly closed 20 years from now (shaded below) and the fund is required after 30 years of post-closure care (shaded below), its value is projected to be $2.5 million (shaded below), as shown in Table 2-5.

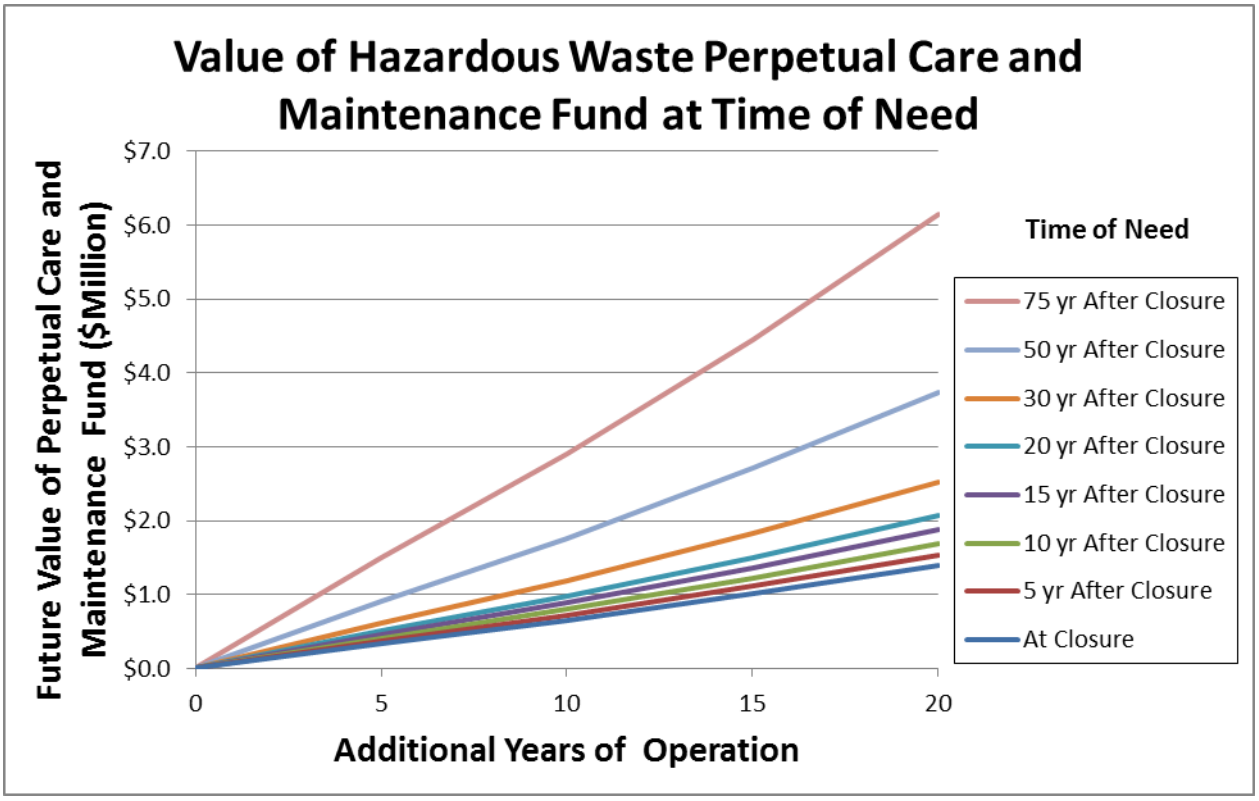

Figure 2-1. Projected Future Value; Hazardous Waste Perpetual Care and Maintenance Fund (assumes 2% average annual real return)

Table 2-5. Projected Future Value; Hazardous Waste Perpetual Care and Maintenance Fund (for 2% average annual real return)				
	Time of Facility Closure (years from today)			
	0 yr	**5 yr**	**10 yr**	**20 yr**
Collections Through Closure ($ million)	0.0	0.3	0.5	1.1
Future Value ($ million)	$0.0	$0.3	$0.7	$1.4
Time of Need (years after Closure)	**Value at Time of Need ($ million)**			
5 Years	$0.0	$0.4	$0.7	$1.5
10 Years	$0.0	$0.4	$0.8	$1.7
15 Years	$0.0	$0.5	$0.9	$1.9
20 Years	$0.0	$0.5	$1.0	$2.1
30 Years	**$0.0**	**$0.6**	**$1.2**	$2.5
50 Years	$0.0	$0.9	$1.8	$3.7
75 Years	$0.0	$1.5	$2.9	$6.1

As a general rule, the future value of a hazardous waste perpetual care fund grows:

- ✓ When the facility continues to operate so that deposits continue to be made into the fund
- ✓ When the need for the fund is delayed
- ✓ If annual deposits to the fund increase
- ✓ If the fund is invested in better-performing investment vehicles

2.16 WHAT MIGHT BE THE FUTURE VALUE OF A HAZARDOUS WASTE PERPETUAL CARE FUND IF GREATER ANNUAL FEES WERE IMPOSED?

If larger annual fees were required to be deposited into a hazardous waste perpetual care fund, more monies would be available after 20 additional years of operations and 30 years of post-closure care, as shown in Table 2-6, assuming no monies were prematurely withdrawn from the fund, and the fund were invested at an assumed real interest rate of 2 percent per year.

Table 2-6. Dependence of Perpetual Care Fund future value on annual fee (for 2% average annual real return)	
Annual Fee ($ per year)	**Future Value[12] ($ million)**
$15,000	$0.7
$25,000	$1.2
$35,000	$1.6
$45,000	$2.1
$75,000	$3.5
$100,000	$4.7

2.17 WHAT MIGHT BE THE CONSEQUENCES TO PERMITTEES OF IMPOSING GREATER ANNUAL FEES FOR A HAZARDOUS WASTE PERPETUAL CARE FUND?

At least two consequences might result from more aggressively accumulating monies within a hazardous waste perpetual care fund. These consequences are:

- ✓ Higher fees make competitive commercial activity less profitable
- ✓ Greater accumulations without current need might allow funds to be diverted for other purposes

Higher fees that would generate greater deposits to a hazardous waste perpetual care fund may have one of two commercial effects:

- ✓ Decrease the facility's profit margin because they do not or cannot raise the price of their services
- ✓ Decrease competitiveness with facilities offering similar service because the Utah facility has raised the price of their services

Both of these effects encumber the commercial viability of such facilities. Without raising prices, the facility's profitability is reduced and the company's ability to attract capital is diminished.

Increased prices mean the facility is less able to sell its service to those who require them, as long as alternative commercial facilities are available. Because hazardous waste treatment, storage, and disposal services are available at numerous facilities throughout the US, facilities permitted and offering such services in Utah are subject to significant competitive pressures.

[12] After 20 more years of deposits (disposal operations) and 30 years of post-closure care at an assumed real interest rate of 2 percent per year.

Thus, increasing its prices to cover any annual fees would probably weaken their commercial viability.

Another down side to accumulating funds in any publicly owned and administered fund is the susceptibility of the fund to political expediency. History has proven that publicly owned and administered funds established for one purpose relinquish their monies, upon appropriate legislative revision, to fund other purposes.

2.18 ARE SUFFICIENT FINANCIAL ASSURANCES PROVIDED TO COVER THE COSTS OF CLOSURE, POST-CLOSURE CARE, AND UNPLANNED AND UNANTICIPATED EVENTS?

The amount of financial assurance required and presently provided for closure and post-closure care of commercial hazardous waste treatment, storage, or disposal facilities is judged to be adequate.

The State currently does not require financial assurances nor has it established a fund to cover costs associated with closed hazardous waste management facilities following post-closure care.

As noted above, a minimum fund balance of about $2.5 million, when invested at an assumed 2 percent per year real interest rate, should provide sufficient interest earnings to cover the costs of routine monitoring and maintenance. With an annual fee of $54,000, the fund could amount to approximately $2.5 million, assuming 20 additional years of operations and 30 years of post-closure care, during which time no monies are withdrawn from the fund.

A hazardous waste perpetual care fund balance of $2.5 million invested at 2 percent real per year would produce interest earnings of more than $50,000 per year, without reducing the value of the fund. This would be sufficient to cover the costs of routine monitoring and maintenance. Additional funds would be required to cover the costs associated with unplanned and unanticipated events.

The financial and competitive effects of imposing fees on Clean Harbors to fund this account at the rate of $54,000 per year should be evaluated. If it causes the facility to terminate active operations, based on this estimate, no money will be available for any perpetual care, though the possibility of the need of such funds will persist.

Factors that could, at least in theory, contribute to potential deficiencies in closure and post-closure care cost estimates prepared for commercial hazardous waste treatment, storage, or disposal facilities, include the following:

- A drastic change in market price conditions (e.g., could impact labor rates, material costs, etc.) from those assumed when developing the cost estimates;
- Acceptance and disposal of unauthorized waste or an unauthorized volume of waste at the site;
- Occurrence/generation of unexpected contamination at the site;
- Cost associated with implementing measures necessary to address unanticipated technical/engineering issues (e.g., changes in designs and/or materials and construction methods required to address a change in a closure requirement, e.g., an alternative landfill cover, installation of an additional required secondary containment feature, etc.);

- Delays experienced in implementing closure activities at a site, which could affect closure costs; and/or
- Occurrence of a natural disaster (e.g., hurricane; flood, etc.) that could increase closure costs.

Section 3.13 below discusses this topic in additional detail.

2.19 WHAT OTHER COSTS MIGHT BE ANTICIPATED FOLLOWING POST-CLOSURE PERMIT TERMINATION?

Significant uncertainties are associated with determining costs associated with major maintenance of cells, differential settlement failure or groundwater corrective action at closed commercial hazardous waste land disposal facilities. However, an effort has been made to quantify a range of costs if one of these events occurred. These inexact estimated costs are summarized in Table 2-7.

Table 2-7. Summary of inexact costs of unplanned and unanticipated future events

Potential Future Event	Inexact Cost Range[13]
Major Maintenance of Cells	$1 to $50 million
Differential Settlement Failure	$10 to $70 million
Groundwater Corrective Action	$10 to $50 million
Aggregate Probability-Weighted Total	$5 to $30 million

The State of South Carolina has conducted a more detailed evaluation of costs associated with unexpected or unplanned events at the LLRW disposal facility located near Barnwell, SC (Baird 2008). In these evaluations, the following events were addressed:

[13] Rounded to the nearest $10 million or one figure of significance because of extreme uncertainty.

- ✓ Decreased Precipitation
- ✓ Adjacent Site Development
- ✓ Trench Collapse
- ✓ Burrowing Animals
- ✓ Increased Precipitation
- ✓ Worker Exposure
- ✓ Negative Media Coverage
- ✓ Regulatory Changes
- ✓ Mine/Quarry Activity at Site
- ✓ Spent Nuclear Fuel Rod
- ✓ Health Claims
- ✓ Invalid Geotechnical Model
- ✓ Property Values Depressed
- ✓ Extreme Weather

The analysis concluded with 65 percent confidence that the total chance occurrence cost of unplanned events, consequences, and responses would not exceed $28 million (the amount of funds available after meeting the costs of planned activities). With 80 percent confidence, these unplanned costs are estimated not to exceed about $53 million, and with 95 percent confidence, they are estimated not to exceed about $155 million.

2.20 SHOULD FUNDS BE REQUIRED FOR COSTS THAT MIGHT BE INCURRED FOR MAJOR EVENTS FOLLOWING POST-CLOSURE PERMIT TERMINATION?

Substantial regulatory effort has been, continues to be, and will in the future be committed to provide assurance that the hazardous waste disposal facilities permitted in Utah will perform as required and as planned (refer to Question 2-21). Furthermore, additional funds for the potential events and conditions identified above are not considered necessary at this time for the following reasons:

- ✓ Engineering controls employed to construct the landfill cells: When EPA developed the rules for landfill construction it took into consideration that landfill cells would need to be stable for many years. The landfill cells are required to have a compacted clay liner upon which multiple synthetic liners are placed to contain the waste and prevent ground water contamination. The waste is treated before it can be placed in a landfill cell to reduce its concentration and to stabilize it so that it minimizes the chance of migration. The waste is placed in the cell in compacted layers to minimize the chance of differential settlement after cell closure. The cell cap is designed to encompass the waste, shed precipitation, prevent erosion, and to withstand natural degradation.
- ✓ Design and monitoring prior to permit termination: The cap design and corresponding ground water monitoring ensure that no leachate is being generated and that the ground water contamination risk approaches zero. The leachate generation risk of zero is expected to be achieved in the first 10 years. Consequently, more than 20 years of cap performance are verified by the absence of leachate production and the ground water monitoring results.
- ✓ Remote location of the facility: The location of the facility is away from locations of interest. For example, the Grassy Mountain Facility is located approximately 80 miles west of Salt Lake City in a remote area of Tooele County.

- ✓ Lack of nearby population center: The location of the facility is away from population centers. For example, the nearest population center to the Grassy Mountain Facility is Grantsville, which is located approximately 40 miles away.
- ✓ Location of the facility is in the Tooele County Hazardous Waste Corridor: This area was created by the Tooele County Commission to provide a remote area for the location of commercial waste management facilities. Residential development is prohibited in this corridor. For example, this further prevents the possibility of any population center being located near Grassy Mountain Facility in the future.
- ✓ Non-potable groundwater: The quality of the groundwater at the facility is very poor (total dissolved solids concentration greater than 40,000 ppm) and is not suitable for human or animal consumption or for other agricultural uses without considerable treatment.
- ✓ Aridity: The amount of precipitation for a typical year is only about six to nine inches. This limits the amount of erosion and leachate creation for a closed landfill cell.
- ✓ Restricted access to the facility: Access to the facility is controlled. For example, the Grassy Mountain Facility is surrounded by a six-foot chain-link fence with warning signs and locking gate to discourage unauthorized access.

2.21 BEYOND FINANCIAL ASSURANCES, WHAT ELSE PROVIDES ASSURANCE THAT COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES WILL BE PROPERLY CLOSED AND WILL PERFORM AS REQUIRED?

The comprehensive system for regulating the management of hazardous waste includes numerous features that limit the probability that closure, post-closure, and other costs would exceed those covered through financial assurance. These features include:

- ✓ General Facility Standards
- ✓ Preparedness and Prevention
- ✓ Contingency Plan and Emergency Procedures
- ✓ Manifest System, Recordkeeping, and Reporting
- ✓ Groundwater Protection
- ✓ Use and Management of Containers
- ✓ Tanks
- ✓ Landfills
- ✓ Land Disposal Restrictions

These requirements are briefly and necessarily incompletely summarized below:

General Facility Standards (Utah Administrative Code (R315-264-10 through R315-264-19)

- ✓ Identification Number; Every facility owner or operator must obtain an EPA identification number.
- ✓ General Waste Analysis; The requirements of UAC R315-264-13 must be satisfied.
- ✓ Security; A facility owner or operator must prevent the unknowing entry, and minimize the possibility for the unauthorized entry, of persons or livestock onto the active portion of his facility.
- ✓ General Inspection Requirements; Facility owners or operators must inspect their facilities for malfunctions and deterioration, operator errors, and discharges, which may cause or lead to release of hazardous waste constituents to the environment or pose a threat to human health.
- ✓ Personnel Training; Facility personnel must successfully complete a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures the facility's compliance with applicable requirements.
- ✓ General Requirements for Ignitable, Reactive, or Incompatible Wastes; The owner or operator must take precautions to prevent accidental ignition or reaction of ignitable or reactive wastes.
- ✓ Location Standards; Sites at which hazardous waste management facilities will be developed must satisfy siting requirements that address seismic considerations and avoid floodplains.
- ✓ Construction Quality Assurance Program; A CQA program must be implemented for the construction of certain facility units to ensure that the constructed unit meets or exceeds all design criteria and specifications in the permit.

Preparedness and Prevention Utah Administrative Code (R315-264-30 through R315-264-37)

- ✓ Design and Operation of Facility; Facilities must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden discharge of hazardous waste or hazardous waste constituents to air, soil, groundwater, or surface water which could threaten the environment or human health.
- ✓ Required Equipment; All facilities must be equipped with the following:
  - Internal communications or alarm system.
  - Device capable of summoning external emergency assistance from local law enforcement agencies, fire departments, or State or local emergency response teams.
  - Portable fire extinguishers, fire control equipment, including special extinguishing equipment.

- Water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems.

✓ Testing and Maintenance of Equipment; all facility communications or alarm systems, fire protection equipment, safety equipment, discharge control equipment, and decontamination equipment must be tested and maintained to assure its proper operation in time of emergency.

✓ Access to Communications or Alarm System; whenever hazardous waste is being poured, mixed, spread, or otherwise handled, all employees involved in the operation must have immediate access to an internal alarm or emergency communication device.

✓ Required Aisle Space; the facility owner or operator must maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, discharge control equipment, and decontamination equipment to any area of facility operation in an emergency.

✓ Arrangements with Local Authorities; the owner or operator must attempt to make arrangements with law enforcement agencies, fire departments, and emergency response teams to enable them to provide emergency services appropriate to potential hazards at the facility.

Contingency Plan and Emergency Procedures Utah Administrative Code (R315-264-50 through R315-264-56)

✓ Purpose and Implementation of Contingency Plan; Each owner or operator must have a contingency plan for his facility to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden discharge of hazardous waste or hazardous waste constituents to air, soil, groundwater, or surface water.

✓ Content of Contingency Plan; The plan must describe the actions facility personnel must take in response to fires, explosions or any unplanned sudden or non-sudden discharge of hazardous waste or hazardous waste constituents to air, soil, or surface water at the facility.

✓ Emergency Coordinator; At all times at least one employee with the responsibility for coordinating all emergency response measures must either present on the facility premises or on call.

✓ Emergency Procedures; Whenever there is an imminent or actual emergency situation, the facility's emergency coordinator or his designee must immediately take certain actions to contain hazardous substances and minimize the effects of the situation on workers and the environment.

Manifest System, Recordkeeping, and Reporting Utah Administrative Code (R315-264-70 through R315-264-77)

✓ Use of Manifest System; A facility that receives hazardous waste must implement a manifest management system to ensure that all wastes received at the facility are documented.

- ✓ Operating Record; The record keeping requirements of UAC R315-264-73 must be satisfied.
- ✓ Manifest Discrepancies; The owner or operator must attempt to reconcile discrepancies between waste received and descriptions provided in manifests.
- ✓ Availability, Retention, and Disposition of Records; Records of waste disposal locations and quantities must be maintained in compliance with UAC R315-264-73(b).
- ✓ Biennial Report; Owners or operators of facilities that treat, store, or dispose of hazardous waste must prepare and submit a biennial report to the Director by March 1 of each even numbered year.
- ✓ Unmanifested Waste Report; If a facility accepts for treatment, storage, or disposal any hazardous waste from an off-site source without an accompanying manifest, the owner or operator must prepare and submit a report to the Director within 15 days of the receipt of the waste.
- ✓ Additional Reports; A facility owner operator must report discharges, fires, and explosions to the Director.

Groundwater Protection Utah Administrative Code (R315-264-90through R315-264-101)

- ✓ Required Programs; Owners and operators of land disposal facilities must conduct a monitoring and response program described in UAC R315-264-91).
- ✓ Groundwater Protection Standard; The owner or operator must comply with conditions specified in the facility permit to ensure that hazardous constituents detected in the groundwater from a regulated unit do not exceed applicable concentration limits in the uppermost aquifer underlying the waste management area beyond the point of compliance during the compliance period.
- ✓ Hazardous Constituents; The Director has specified in the facility permit the hazardous constituents to which the groundwater protection standard applies.
- ✓ Concentration Limits; The Director has specified in the facility permit concentration limits in the groundwater for hazardous constituents.
- ✓ Point of Compliance; The Director has specified in the facility permit the point of compliance at which the groundwater protection standard applies and at which monitoring must be conducted.
- ✓ Compliance Period; The Director has specified in the facility permit the compliance period during which the groundwater protection standard applies.
- ✓ General Groundwater Monitoring Requirements; The owner or operator must comply with the requirements stated in UAC R315-264-97 for any groundwater monitoring program
- ✓ Detection Monitoring Program; An owner or operator required to establish a detection monitoring program must, at a minimum, discharge the responsibilities stated in UAC R315-264-98.

- ✓ Compliance Monitoring Program; An owner or operator required to establish a compliance monitoring program must, at a minimum, discharge the responsibilities stated in UAC R315-264-99.
- ✓ Corrective Action Program; An owner or operator required to establish a corrective action program must, at a minimum, discharge the responsibilities started in UAC R315-264-100.
- ✓ Corrective Action for Solid Waste Management Units; The owner or operator of a facility seeking a permit for the treatment, storage or disposal of hazardous waste must institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste or constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in the unit.

Use and Management of Containers Utah Administrative Code (R315-264-170 through R315-264-179)

- ✓ Condition of Containers; If a container holding hazardous waste is not in good condition, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition or manage the waste in some other way.
- ✓ Compatibility of Waste with Containers; The owner or operator must use a container made of or lined with materials which will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired.
- ✓ Management of Containers; A container holding hazardous waste must always be closed during storage (except when it is necessary to add or remove waste) and must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.
- ✓ Inspections; At least weekly, the owner or operator must inspect areas where containers are stored, for leaks and container or containment system deterioration.
- ✓ Containment; Container storage areas must have a containment system designed and operated in accordance with UAC R315-264-175.
- ✓ Special Requirements for Ignitable or Reactive Waste; Containers holding ignitable or reactive waste must be located at least 50 feet from the facility's property line.
- ✓ Special Requirements for Incompatible Wastes; Incompatible wastes must satisfy requirements stated in UAC R315-264-177.
- ✓ Closure; At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.
- ✓ Air Emission Standards; The owner or operator must manage all hazardous waste placed in a container in accordance with the applicable requirements of UAC R315-264-179.

Tanks Utah Administrative Code (R315-264-190 through R315-264-200)

- ✓ In general, the requirements as of UAC-264-190 through R315-264-200, must be satisfied.

Landfills Utah Administrative Code (R315-264-300 through R315-264-317)

- ✓ Design and Operating Requirements; Any landfill that is not exempted must have a liner system for all portions of the landfill. The liner system must satisfy the requirements of UAC R315-264-301.
- ✓ Monitoring and Inspection; During construction or installation, liners and cover systems (e.g., membranes, sheets, or coatings) must be inspected for uniformity, damage, and imperfections (e.g., holes, cracks, thin spots, or foreign materials) in accordance with UAC R315-264-303.
- ✓ Surveying and Recordkeeping; The owner or operator of a landfill must maintain the items listed in UAC R315-264-309 in the operating record.
- ✓ Closure and Post-Closure Care; 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 satisfy requirements of UAC R315-264-310.
- ✓ Special Requirements for Ignitable or Reactive Waste; Ignitable or reactive waste must not be placed in a landfill, except under conditions stated in UAC R315-264-312.
- ✓ Special Requirements for Incompatible Wastes; Incompatible wastes, or incompatible wastes and materials must not be placed in the same landfill cell, except as required by UAC R315-264-313.
- ✓ Special Requirements for Liquid Waste; UAC R315-264-314, the placement of bulk or non-containerized liquid hazardous waste or hazardous waste containing free liquids, whether or not sorbents have been added, in any landfill is prohibited.
- ✓ Special Requirements for Containers; Unless they are very small, such as an ampoule, containers must either be at least 90 percent full when placed in the landfill; or be crushed, shredded, or similarly reduced in volume to the maximum practical extent before burial in the landfill in accordance with UAC R315-264-315.
- ✓ Disposal of Small Containers of Hazardous Waste in Overpacked Drums; Small containers of hazardous waste in overpacked drums may be placed in a landfill if the requirements stated in UAC R315-264-316 are met.
- ✓ Special Requirements for Hazardous Wastes F020, F021, F022, F023, F026, and F027; Hazardous Wastes F020, F021, F022, F023, F026, and F027 must not be placed in a landfill except as provided by UAC R315-264-317

Land Disposal Restrictions Utah Administrative Code (R315-268)

- ✓ In general the requirements regarding land disposal restrictions as found in UAC R315-268 must be satisfied. Wastes need to be treated to a specific level prior to land disposal.

Agency Inspections

- ✓ Division Facility Inspections
- ✓ EPA Off-site Rule Inspections
- ✓ EPA Oversight Inspections

2.22 HOW CAN THE STATE HELP ENSURE AGAINST UNANTICIPATED COSTS OF LONG-TERM CARE AND MAINTENANCE?

Ensuring against the unanticipated costs listed above could involve a range of possible actions. Each unanticipated cost might involve one or more actions such as:

- ✓ Increase financial assurance requirements
- ✓ Impose more stringent and costly siting, construction, operating, and closure requirements
- ✓ Require a perpetual care fund

2.23 ARE SUFFICIENT FINANCIAL ASSURANCES PROVIDED FOR ADEQUATE FUNDING FOR COSTS OF UNPLANNED AND UNANTICIPATED EVENTS?

In general, funds are available to cover the costs expected to close and provide post-closure care of commercial hazardous waste management facilities permitted in Utah. Funds are not provided to manage the costs of care at closed facilities after the permit has been terminated.

2.24 HOW DO THE FINANCIAL ASSURANCES REQUIRED FOR CLOSURE AND POST-CLOSURE CARE OF COMMERCIAL HAZARDOUS WASTE MANAGEMENT FACILITIES PERMITTED IN THE STATE OF UTAH COMPARE WITH THOSE REQUIRED IN OTHER STATES?

EPA Financial Assurance Requirements

The need for financial assurances for closure and post-closure care of hazardous waste management facilities was demonstrated historically by instances of abandonment or delayed closure, often occurring after the economic value of the facilities was diminished or nonexistent. The EPA recognized that post-closure care might be necessary for decades after the operating period, and that the facility owners or operators may lack funds for the required closure and/or care unless they provided for them during the operating period.

EPA first established financial responsibility standards for owners and operators of hazardous waste management facilities under the Resource Conservation and Recovery Act of 1976. The standards are contained in 40 CFR Parts 264 and 265 for facility permitting and interim status, respectively. EPA's original standards, proposed December 18, 1978 (43 FR 58995, 59006-7), provided (1) assurance that funds would be available when needed to properly close hazardous waste management facilities; (2) assurance that funds would be available when needed to monitor and maintain the facilities for a 20-year Post-Closure Period; and (3) liability coverage for injuries resulting from operation of the facilities. The initial closure and post-closure financial assurance required lump-sum deposits into trust funds in the amount of the closure and post-closure cost estimates multiplied by "present value factors" that accounted for growth of the fund during the operating life of the facility.

EPA revised its financial assurance rules on May 19, 1980 (45 FR 33260-33273) to (1) allow the closure trust fund to accumulate to its required value throughout the operating period (or for up to 20 years); (2) allow other financial assurance funding mechanisms besides the trust fund; and (3) extend the post-closure period from 20 years to 30 years. The stated purpose for extending the post-closure period to 30 years was to eliminate leachate monitoring requirements. Since it takes longer for contaminant migration to reach ground-water monitoring points than it would have taken to reach leachate detection monitoring points, it is necessary to monitor for a longer period.

EPA provides flexibility in the 30-year post-closure period via case-by-case reviews (45 FR 33197). If an owner or operator can demonstrate that there is no need to monitor and maintain his closed facility for the entire 30-year period, the period can be shortened. On the other hand, representatives of the public can petition to have the monitoring period extended for cause.

EPA believes that certain organic chemicals persist longer than 30 years and that heavy metals remain toxic forever, requiring careful management to limit mobilization. However, EPA deemed it impossible for many small single facilities to finance perpetual care after their revenues cease. While EPA advocated some form of national insurance to ensure perpetual monitoring of facilities with detected or imminent contamination, its near-term solution was to enable EPA's Regional Administrators to extend some or all of the post-closure care requirements for causes of detected or imminent groundwater contamination.

With respect to a possible perpetual care period, EPA appeared to seek a balance between perpetual monitoring and maintenance, where deemed necessary, and the financial burden imposed on the owner or operator of the individual facilities. EPA interpreted the RCRA statute to require measures to be taken, for as long as necessary, to ensure that land disposal facilities do not pose a threat to human health or the environment. However, they stopped short of imposing financial assurance requirements for the perpetual care period, citing the potential default of many facilities if faced with such a requirement.

As recently as 2001, an EPA Office of Inspector General (OIG) audit of RCRA financial assurance for closure and post-closure care found that there is insufficient assurance that funds will be available in all cases to adequately cover post-closure monitoring and maintenance (EPA 2001). The audit included nine of the ten EPA regions but excluded Region 8 (which includes Utah, Colorado, Wyoming, Montana, North Dakota and South Dakota). Although states may require more than 30 years of post-closure care, the audit found that (a) most state agencies had

not developed a policy or process to determine whether Post-Closure care should be extended beyond 30 years and (b) there is no EPA guidance on determining the appropriate length of post-closure care. The OIG recommended that EPA develop appropriate post-closure care time frames.

The OIG report (EPA 2001) summarized an audit survey of post-closure care needs among privately-owned hazardous waste landfills in nine states (AL, CA, CT, MO, NY, OH, TX, VA, and WA). State officials indicated that 20 percent of the 178 hazardous waste facilities then in post-closure will need care beyond the 30-year period; 6 percent of them will not; and the remaining 74 percent of them have yet to be evaluated for possibly needing to extend the post-closure care period. The audit survey identified only three facilities for which the post-closure period was extended beyond 30 years: two in New York and one in Ohio. However, officials in five of the nine states surveyed (AL, CA, CT, MO, and NY indicated that 30 years was insufficiently long for the post-closure care period and those in two of the other states (OH and TX) have not yet evaluated the adequacy of the 30-year period. The officials also expressed concern that if they extend the post-closure period beyond 30 years without supporting federal criteria, they may become involved in legal battles with facility owners and operators.

The OIG audit survey found that the projected annual monitoring and maintenance costs for the last (30th year) of the post-closure period ranged from $400 to more than $1 million, averaging more than $96,000 per facility. The drop from this level to zero funding in the 31st year could adversely affect state programs and the environment. Further projecting the post-closure costs past the 30th year, based on equivalence to the costs in the 30th year (assuming no unexpected cleanup), the un-funded liability that could fall to the nine states surveyed totals $2.8 million by the year 2017 and $19 million by 2030.

The OIG audit also addressed financial assurance funding mechanisms and found that captive insurance companies do not provide an adequate level of assurance for closure and post-closure care. Although some risks were also found with other mechanisms, many cases were also found where the other financial assurance mechanisms work as intended.

The accuracy of closure and post-closure cost estimates was found often to be inadequate in the nine-state OIG survey. Underestimated costs, leading to insufficient financial-assurance funding, are difficult to identify because reviewer judgments rely on different review criteria, reviewer experience, and differing levels of detail in the Closure and Post-Closure plans. An EPA Region IV study found that of 100 facilities in its eight states that submitted cost estimates, 89 had underestimated financial assurance costs by a total of $450 million. In one of the states, with 35 facility-submitted cost estimates, underestimated closure costs totaled $91 million and underestimated post-closure costs totaled $1.7 million.

EPA Region IV developed a software tool to improve state reviews of Subtitle C facility closure and post-closure cost estimates. Based on standard costing information such as published by the R.S. Means Company, the software expedites and standardizes the review process. Prior to its use, several very-similar fuel blender facilities submitted closure cost estimates ranging from $100,000 to $5,000,000. Because the estimates were documented so inconsistently, it was difficult for individual states even to challenge the wide discrepancies for like facilities. Several states reported in the OIG survey that they used the software while four of the nine states surveyed were unaware that it existed.

In 2007, EPA placed renewed emphasis on the financial assurance programs with issuance of three program memoranda regarding the importance of financial assurance requirements and oversight. (EPA 2007-a, b, c)

In 2009, EPA published a noticed of availability of RCRA Closure and Post-Closure Care Cost Estimating Software. The revised software is an update of the 2001 software and provides EPA and state permit writers with a consistent, accurate and rapid method of evaluating cost estimates for closure and post-closure care of hazardous waste management facilities. The software is made available to state regulators through EPA's software license. (EPA 2009)

State of Utah

The Utah financial assurance requirements for Hazardous Waste Landfills that correspond to regulations are contained in UAC R315-264-140 through 151.

Utah does not require financial assurance if the facility is owned or operated by the State of Utah or the Federal government [UAC R315-264-140(c);]. Utah requires that a financial assurance mechanism be put in place for closure [UAC R315-264-143] and post closure [UAC R315-264-145] for hazardous waste facilities. Assurances of financial responsibility for completion of corrective actions at solid waste management units must be provided [UAC R315-264-550 through 553].

Owners and operators of surface impoundments, landfills, land treatment units, and waste pile units that received waste after July 26, 1982, or that certified closure, according to UAC R315-265-115, which incorporates by reference 40 CFR 265.115, after January 26, 1983, must have post-closure permits, unless they demonstrate closure by removal or decontamination as provided under UAC R315-270-1(c)(5) and (6), or obtain an enforceable document in lieu of a post-closure permit, as provided under UAC R315-270-1(c)(7). If a post-closure permit is required, the permit must address applicable UAC R315-264 groundwater monitoring, unsaturated zone monitoring, corrective action, and post-closure care requirements of UAC R315. The denial of a permit for the active life of a hazardous waste management facility or unit does not affect the requirement to obtain a post-closure permit under UAC R315-270. Utah requires the same 30-year post-closure care period for hazardous waste disposal facilities [UAC R315-270-1 and UAC R315-264-110 through R315-264-120] but Utah explicitly requires monitoring of gases, water, and land during the period. Utah is more explicit than EPA in defining a stable site, for purposes of terminating post-closure care, as one with little or no settlement, gas production, or leachate generation. Also, the monitoring period may be as long as the Director deems necessary.

Utah's guidelines for closure and post-closure cost estimates follow UAC R315-142 and R315-264-143. The cost basis is also to include costs of obtaining, moving, and placing the cover material, final grading, moving and placing topsoil, fertilizing, seeding, and mulching, and removing any stored items, materials, buildings, equipment, or unnecessary items and materials [UAC R315-270-1(c)].

Utah's insurance requirements are identical to those of EPA and are found in UAC R315-264-140 through R315-264-151. Utah also requires that proof of insurance coverage be provided to

the Division [UAC R315-270-14(b)(17)]. Utah's notification requirements are found in UAC R315-264-148.

Since July 1, 2014, commercial hazardous waste disposal or treatment facilities are assessed an annual flat fee (UDWMRC 2016a). The annual fee is set each fiscal year via DEQ's fee schedule process (URL: http://www.deq.utah.gov/FeesGrants/fees/docs/2015/05May/DEQFEEDOC16.pdf) and approved by the Legislature. The fee amount assessed for FY16 for hazardous waste facilities was $2,414,500. This fee is a primary source of funding to support running certain Division programs, along with investment income generated by the fund.

State of California

California financial assurance regulations are contained in Title 22 (Social Security) of the California Code of Regulations, Division 4.5, Chapter 14, Article 6. The CA regulations are numbered identically to EPA regulations, with the prefix §66 (§66264.101 corresponds to 40 CFR 264.101). The California regulatory requirements correspond to those of EPA regulations in 40 CFR 264.101, 40 CFR 264.117, 40 CFR 264.142, 40 CFR 264.143, 40 CFR 264.144, 40 CFR 264.145, 40 CFR 264.147, and 40 CFR 264.148.

California requires post-closure permits for hazardous waste facilities in the post-closure phase. The post-closure permit is renewed every 10 years. The renewal re-sets the 30-year post-closure care period for the facility. California has several facilities with post-closure permits (URS 2011).

State of Nevada

Nevada hazardous waste and associated financial assurance regulations are identical to those of EPA because they incorporate the EPA hazardous waste land disposal regulations (namely, 40 CFR 264.101, 40 CFR 264.117, 40 CFR 264.142, 40 CFR 264.143, 40 CFR 264.144, 40 CFR 264.145, 40 CFR 264.147, and 40 CFR 264.148) by reference. Nevada Administrative Code (NAC) Chapter 444.8632(1) incorporates 40 CFR Parts 260 to 270, inclusive, except as modified by NAC 444.86325, 444.8633, and 444.8634.

NAC 444.86325(2)(h) modifies 40 CFR parts 264.143(g), 264.143(h), 264.145(g), and 264.145(h) to delete the sentence: "If the facilities covered by the mechanism are in more than one Region, identical evidence of financial assurance must be submitted to and maintained with the Regional Administrators of all such Regions." NAC 444.8633 modifies references in 40 CFR to refer to state-specific rules and organization.

NAC 444.8634 defines other meanings to certain terms referred to in 40 CFR, including references for payment and deposit of certain fees.

State of Oklahoma

Oklahoma hazardous waste and associated financial assurance regulations are identical to those of EPA because they incorporate the EPA hazardous waste land disposal regulations (namely, 40 CFR 264.101, 40 CFR 264.117, 40 CFR 264.142, 40 CFR 264.143, 40 CFR 264.144, 40 CFR 264.145, 40 CFR 264.147, and 40 CFR 264.148) by reference. Oklahoma Administrative Code

(OAC) Title 252, Chapter 205-3-2(f) incorporates all of the above-listed parts of 40 CFR Part 264.

State of Ohio

Ohio financial assurance regulations are contained in Ohio Administrative Code Chapters 3745-54 and 3745-55. The Ohio regulations are similar to EPA regulations, with the prefix OAC 3745-55-nn (e.g., nn is 17 in OAC-3745-55-17 that corresponds to 40 CFR 264.117). The Ohio regulations generally correspond to EPA regulations in 40 CFR 264.117, 40 CFR 264.142, 40 CFR 264.143, 40 CFR 264.144, 40 CFR 264.145, 40 CFR 264.147, and 40 CFR 264.148.

One significant difference occurs in financial assurance for remedy pathway (corrective action). While OAC-3745-54-100 and OAC-3745-54-101 prescribe the requirements for remedy pathway, they do not require that financial assurance for remedy pathway be set aside beforehand in trusts or other accounts. Financial assurance is required upon selection of remedy pathway.

Ohio is currently evaluating the adequacy of the 30-year period that it presently requires for post-closure care. (URS 2011) Ohio has extended its post-closure care requirement beyond the 30-year length for one hazardous waste landfill, as of the 2001 EPA OIG survey.

State of Texas

Texas financial assurance regulations for commercial hazardous waste landfills are contained in Title 30, Texas Administrative Code, Chapters 37 and 335. The Texas regulations generally correspond to EPA regulations in 40 CFR 264.101, 40 CFR 264.117, 40 CFR 264.142, 40 CFR 264.143, 40 CFR 264.144, 40 CFR 264.145, and 40 CFR 264.147. One significant difference is in the basis for the closure cost estimate, where Texas requires, in 30 TAC §335.178, that the closure cost estimate include removing, shipping, and handling all site wastes and costs for off-site disposal.

Texas is currently evaluating the adequacy of the 30-year period that it presently requires for post-closure care (URS 2011). However, Texas had not extended its post-closure care requirement beyond the 30-year length for any of its hazardous waste landfills as of the 2001 EPA OIG survey.

State of South Carolina

South Carolina financial assurance regulations for commercial hazardous waste landfills are contained in the South Carolina Code of Regulations (SCCR), Section 28-61-79. The South Carolina regulations generally correspond to EPA regulations in 40 CFR 264.101, 40 CFR 264.117, 40 CFR 264.142, 40 CFR 264.143, 40 CFR 264.144, 40 CFR 264.145, and 40 CFR 264.147. They explicitly call for financial assurance for corrective action [SCCR 28-61-79.264.101(b)], and allow for the closure cost estimate to include on-site disposal, as in the EPA regulation [SCCR 28-61-79.264.142].

Comparison of Utah Requirements with other States and EPA Requirements

Utah's requirement for financial assurance for corrective actions is equivalent to EPA's, which requires the financial assurance commitment to be contained in the operating permit with the closure financial assurance commitment. However, Utah adds qualifiers that the financial assurance for corrective action is only required in cases of known releases, and that it is not required for facilities operated by the federal or state (Utah) government. California, Nevada, Oklahoma, Texas, and South Carolina have similar requirements for corrective-action financial assurance to those of EPA. However, Ohio does not include financial assurance for corrective actions in their rules for corrective actions.

The 30-year post-closure period specified by EPA is adopted by all of the six other states reviewed here for maintenance, monitoring, and reporting. The states are virtually identical to the EPA rule, except in specifying the appropriate state administrator or department instead of the EPA administrator for either shortening or extending the 30-year post-closure period depending on site conditions. Through its renewal process every 10 years for hazardous waste management facilities with post-closure permits, the State of California effectively extends the term of the post-closure period. Utah's rule for the post-closure care period is more specific than the others in specifying criteria for altering the length of the post-closure period. The criteria require stability in landfill settlement, gas production and leachate generation.

Cost estimating for closure of hazardous waste management facilities has become more uniform throughout the US, since issuance of the cost estimating codes "CostPro" by EPA (EPA 2009). Cost estimates in Utah and the other six states correspond to EPA's basis: that the closure be done by a third party, that it is based on the worst-case time or condition for the site, and that the cost estimates be updated annually for inflation, changing site conditions, and changed operating and closure plans. Texas departs from the EPA and other state positions in requiring off-site disposal of all site wastes. Utah specifies more detail than most other states in requiring that the closure estimate include costs of cover material, grading, and topsoil stabilization.

The financial assurance mechanisms allowed by all seven states for site closure and for post-closure care are the same as those allowed by EPA. Similarly, the cost estimates for post-closure care, the liability insurance coverage, and the financial incapacity requirements of all seven states are also the same as those required by EPA.

2.25 DO ANY STATES HAVE FINANCIAL ASSURANCE FOR COSTS AND OTHER BURDENS THAT MIGHT DEVELOP OR EVOLVE AFTER THE PERMIT IS TERMINATED?

Although not the result of an exhaustive search in this evaluation, the Division has identified the following states that have protected themselves against financial and other burdens that might be realized following permit termination for any hazardous waste management facility:

State of Ohio

Envirosafe Services of Ohio operates a facility in Oregon, OH. The facility began operations in 1954 as a family-owned and -operated municipal and industrial solid waste landfill. The land area of the facility is 133 acres.

In 1988, the facility received a Federal RCRA permit, followed by issuance of a State permit in 1991. To comply with the financial assurance requirements, Envirosafe has established a trust fund for the closure and post-closure costs for the facility. In addition to the closure and post closure funding, the 1991 permit issued by the State of Ohio required Envirosafe to establish a perpetual care fund. This fund was designed to ensure funding for corrective measures for as long as waste remains on site. The ESIO trust fund combines all these and was fully funded to specified levels by 1995. The current estimated value of this trust fund is about $56 million.

State of New York

The owner of several hazardous waste landfills in western New York has voluntarily committed to a financial mechanism that effectively ensures the landfills will be protected against costs that might be incurred following permit termination. The CWM Model City hazardous waste management facility is located on the boundary between the towns of Lewiston and Porter in Niagara County. The facility uses fully permitted, state-of-the-art technologies to store, treat and dispose of a variety of liquid, solid and semisolid organic and inorganic hazardous waste and industrial non-hazardous waste.

The New York State Department of Environmental Conservation (DEC) has modified the operating permit of CWM Chemical Services, Inc. L.L.C. to incorporate an agreement that ensures that their Model City facility will always receive adequate long-term care without relying on state funds.

The possible presence of radioactive contaminants at this site may have had some influence in the decision to provide this additional financial protection. That is, it is unclear whether such financial protections would have been provided, were that waste constituents limited strictly to hazardous constituents.

The agreement provides perpetual monitoring and maintenance of all landfills at the site and perpetual operation and maintenance of the remedial systems that address releases from past waste management practices. The company also agreed to a financial mechanism that provides funds for perpetual stewardship of the site even if CWM were no longer financially viable.

Under current regulations, 30 years of care beyond facility closure is the standard financial requirement. By accepting responsibility for the long-term management of the Model City facility, CWM has accepted a higher standard for stewardship that generally expected within the hazardous waste land disposal industry.

As early as 1989, DEC took steps to ensure long-term management of wastes disposed at the site by including provisions for perpetual care of any new landfill developed at the site. The recent agreement expands that concept by including perpetual care for the closed landfills and for the remedial systems which have already been installed.

State of Kansas

Title 8 of the Kansas Administrative Regulations, Article 31 (Kansas Hazardous Waste Management Standards and Regulations) provides that each active hazardous waste land disposal facility must pay a monthly perpetual care trust fund fee, based on the number of pounds of hazardous waste disposed of at the facility.

The perpetual care trust fund fee is $0.005 per pound of hazardous waste disposed in landfills, $0.00000455 per for pound of hazardous waste disposed by deep well injection, and $0.001 per for pound of hazardous waste disposed by other methods.

State of Mississippi

Although it appears that its provisions were repealed after December 31, 1996, the Mississippi Code of 1972 as amended (revised through the 2003 legislature), Section 17-17-53(4)(a) provided that thirty-five percent (35 percent) of all monies received by the State Tax Commission under provisions of the named section would be appropriated to and utilized by the Department of Environmental Quality for the perpetual care and maintenance account of commercial facilities that manage hazardous or nonhazardous solid waste.

The amount paid by the Permittee to the State Tax Commission was determined as follows:

- ✓ Ten Dollars ($10.00) per ton for hazardous waste generated and disposed of in the state by landfilling or any other means of land disposal and for hazardous waste generated and stored for one year or more in the state;
- ✓ Two Dollars ($2.00) per ton for hazardous waste generated and treated in the state and for hazardous waste generated and stored for less than one year in the state; and
- ✓ One Dollar ($1.00) per ton for hazardous waste generated and recovered in the state.

2.26 WHAT LEGAL OR REGULATORY REVISIONS SHOULD BE MADE TO PROVIDE FOR THE COSTS ASSOCIATED WITH PERPETUAL CARE?

The Utah Waste Management and Radiation Control Board (UWMRCB) has identified the following areas in which improvements might be made to address the issue of perpetual care at closed commercial hazardous waste disposal facilities:

- ✓ The UWMRCB recommends that the Legislature consider requiring perpetual care for ongoing monitoring and maintenance of commercial hazardous waste land disposal facilities after termination of the post-closure permit, provided that the funds for perpetual care do not impose additional costs to the facilities, and do not reduce the Division's budget appropriations.
- ✓ The UWMRCB recommends that additional funds not be required at this time to cover potential catastrophic failure of the landfill cells, ground water corrective action or major maintenance at commercial hazardous waste land disposal facilities. This determination is based on the engineering controls employed to build the landfill cells to current regulatory standards. All phases of landfill construction are reviewed, monitored, and approved by the Director. The design and construction of landfill cells ensure containment of wastes as a means to prevent additional superfund sites. Other factors include the remote location of current facilities, the lack of a nearby population center, the location of the facilities in the Tooele County Hazardous Waste Corridor, which prevents residential development in the area, the non-potable groundwater, the lack of precipitation, and the restricted access to the facilities. (More details are provided in Section 2.20 under the heading "Should funds be

required for costs that might be incurred for major events following post-closure permit termination?”)

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3. LOW-LEVEL RADIOACTIVE WASTE TREATMENT AND DISPOSAL FACILITIES

The commercial management of LLRW in Utah is regulated under provisions of the Utah Administrative Code, Title R313. Individual commercial LLRW management facilities must submit applications to license, construct, operate and eventually close such facilities.

The Director reviews each license application to ensure that the facility will satisfy its regulatory performance objectives and comply with applicable technical and regulatory requirements. The Director relies on appropriate guidance to help make determinations. The purpose of the Director's review is to develop reasonable assurance that applicable regulatory requirements will be satisfied during all phases of facility life, including construction, operation, closure, and institutional control (100 years after facility closure). Given that applicable regulations are satisfied, confidence exists that the public health and the environment will be properly protected during facility operation and after its closure.

Once all regulatory issues are resolved to ensure compliance with regulatory provisions, the Director prepares a draft license, notifies the public of its intention to issue a license, receives and responds to public comment, and issues the license. The license contains requirements beyond those contained in regulations to ensure that commitments the applicant made during the application review process and assumed design conditions are achieved in practice.

The Director maintains regulatory surveillance during all phases of facility life to ensure compliance with regulatory requirements and all license conditions. The Director regularly conducts compliance inspections of all aspects of facility operations covered by regulations and license conditions. Departures from required conditions and performance are addressed through a range of enforcement actions to ensure safe operation and that the environment and human health are properly protected.

Regulatory requirements provide assurance that funds will be available to meet the costs of operating, decommissioning, maintaining, or monitoring the facility. The Licensee is required to provide financial assurances for completion of closure and institutional control in the event that they are unwilling or unable to complete such.

Utah Administrative Code R313 requires that the licensee must provide legally enforceable financial assurances (sureties) to cover all costs associated with facility closure and institutional control. These financial assurances are intended to cover anticipated costs through the facility operating life and a 100 year institutional control period following closure. These funds are available to the Director under stated conditions and ensure that the State will not fund closure, maintenance, and institutional control costs from public sources. While not required in US Nuclear Regulatory Commission rules or for hazardous waste permittees (addressed in Chapter 2), Utah has also established a Radioactive Waste Perpetual Care and Maintenance Fund (referred to in this report as the "Perpetual Care Fund") whose purpose is to provide for the care of closed disposal facilities following the institutional control period and to protect against the possibility of shortfall during the institutional control period.

Contributions to the Perpetual Care Fund have been made annually by each licensee (Energy*Solutions*) in the amount of $400,000 per year of active facility operation. The fund, including contributions and earnings, totaled about $6.18 million as of June 2016.

In this assessment, only those facilities currently licensed to manage LLRW are considered. No consideration is given to the possibility that existing facilities might be expanded to provide additional services and additional disposal capacity.

In this section, the following are addressed:

- ✓ Facilities licensed by the State of Utah to treat and/or dispose of LLRW are identified and generally described.
- ✓ Facilities required to maintain financial assurances are identified and the nature of assurances they provide are briefly described.
- ✓ Representative closure and institutional control activities are described.
- ✓ Closure and institutional control financial assurances provided as required are identified and described.
- ✓ Ways in which closed commercial LLRW management facilities might fail are identified and the orders of magnitude of their costs, their probabilities, and their financial risks bracketed.
- ✓ Changes to current legal and regulatory requirements recommended.

Answers to several questions are relevant and instructive. These questions and their answers follow in Section 3.1 below.

Legislation (Senate Bill 173) was enacted during the 2015 General Session of the Utah Legislature and signed into law March, 22, 2015, allowing a radioactive waste disposal facility to use a *third-party bid* to estimate required surety amounts. The bid would be in effect for five years with financial surety updates for the intervening years calculated using an approved cost-of-living (inflation) factor. The Bill also clarifies the area that the Director can ask for financial surety to the area specifically identified in the Radioactive Materials License (rather than all other property area that is under ownership/control by the licensee).

The U.S. Nuclear Regulatory Commission (NRC) has indicated that implementation of Senate Bill 173 (S.B. 173) would make Utah “incompatible” with the federal financial assurance regulations for radioactive waste disposal facilities. The Director is currently working to address the NRC’s concerns with S.B. 173. Further amendments to the statute were proposed during the 2016 General Session of the Utah Legislature (S.B. 231), but were not passed. New legislation is planned for the 2017 General Session to ensure compatibility with the NRC.

3.1 WHAT FACILITIES HAS THE STATE OF UTAH LICENSED TO TREAT AND/OR DISPOSE OF LLRW?

The owners of any facility that manage (that is, treat or dispose of) LLRW must ensure that funds are available to cover the costs associated with closing or maintaining the facility during the institutional control period of that facility. These facility owners provide legally enforceable

financial assurances required under the Utah Administrative Code. Financial assurances must be sufficient to cover all cost associated with facility closure and institutional control.

The facilities licensed for LLRW management in Utah involve hazards that will persist after successful closure and stabilization. Such hazards are associated with LLRW that remain at the facility following closure and stabilization (because they are disposed of at and not removed from the site). Accordingly, these facilities, as shown in Table 3-1, provide financial assurances to cover not only closure and stabilization costs, but also costs expected during institutional control.

Table 3-1. Commercial radioactive waste management facilities licensed in Utah

Facility[14]	Licensed to:	Provides financial assurances for:
Energy*Solutions*; LLRW Facility	Dispose	Closure and Institutional Control
Energy*Solutions*; 11e.(2) Facility	Dispose	Closure and Institutional Control[15]
Energy*Solutions* Mixed Waste Facility	Treat[16], Store, and Dispose	Closure and Post-Closure

3.2 WHAT IS THE "LIFE CYCLE" OF A COMMERCIAL LLRW MANAGEMENT FACILITY?

The life cycle of a LLRW facility consists of the phases or periods shown generally in Table 3-2.

Table 3-2. General phases of commercial LLRW facility

Phase or Period	Typical Duration (years)	Applicability
Licensing and Initial Development	2 to 5 years	Treatment, Storage, and Disposal Facilities
Operating	15 to 40 years	Treatment, Storage, and Disposal Facilities
Closure and Stabilization	1 to 5 years	Treatment, Storage, and Disposal Facilities
Institutional Control	Up to 100	Disposal Facilities

[14] All three facilities are located at Clive, Utah.

[15] Under provisions of the Nuclear Waste Policy Act of 1982, the US Department of Energy must by law provide long-term care of 11e.(2) facilities that have been closed and stabilized in compliance with US Nuclear Regulatory commission requirements. An additional condition of accepting such facilities is that funds sufficient to cover all long-term care costs must be transferred to the US DOE. One current facility will eventually be transferred to US DOE's care under these provisions: Energy*Solution's* 11e.(2) embankments at Clive, Utah. The Vitro embankment has already been transferred to US DOE.

[16] Permitted Facility in connection with Utah Hazardous Waste Permit UTD982598898.

	years	
Following Institutional Control	Unlimited	Disposal Facilities

3.3 WHAT IS FACILITY "CLOSURE AND STABILIZATION"?

When the decision is made that the facility will no longer actively operate, it must go through a formal procedure to close, decontaminate, dismantle, decommission, and stabilize the facility and any components that remain. The purpose of facility closure and stabilization is to eliminate the need for ongoing active maintenance to the extent practicable so that only minor custodial care, surveillance, and monitoring are required following closure and stabilization.

Facility closure and stabilization activities include:

- ✓ Disposing or shipment offsite of any waste received but not yet disposed of at the time closure commences.
- ✓ Decontaminating support structures and operating equipment.
- ✓ Dismantling and disposing of support structures, support systems, and equipment as required.
- ✓ When required by the license, continuing the operational environmental monitoring program.
- ✓ Closing and stabilizing all disposal units, once all waste has been disposed of.

Facility closure and stabilization activities do not include such activities as:

- ✓ Conducting environmental corrective actions.
- ✓ Providing major repair or replacement of facility components.

3.4 WHO PERFORMS A FACILITY CLOSURE AND STABILIZATION?

Under normal conditions, the Owner/Licensee will conduct facility closure and stabilization at its own expense. Closure activities must be pursued until the Director determines that the facility has been successfully closed and that all hazards have been eliminated (or appropriately addressed where residual hazards remain). In this case, the terms and conditions for exercising the financial assurances would not be fulfilled and no funds would be disbursed from the financial assurance for closure.

Under unusual conditions, the Licensee may be unable or unwilling to conduct the closure. Under these conditions, and in accordance with applicable terms of the mechanism used to provide the required financial assurance mechanism, the Director may conduct the closure using an independent third-party contractor. To cover the costs of such closure under these circumstances, the Director would use the financial assurance provided for closure. Thus, the State is protected from the financial liabilities that might otherwise be associated with facility closure.

3.5 WHAT IS "INSTITUTIONAL CONTROL"?

Following facility closure, the responsibilities for controlling the site and for monitoring and maintaining the facility lie with the landowner or a custodial entity. This period of time is referred to as the institutional control period. The duration of the institutional control period will be determined by the Director, but institutional controls may not be relied upon for more than 100 years following facility closure.

The landowner or custodial entity will conduct an institutional control program, including activities such as:

- ✓ Controlling physical access to the closed facility
- ✓ Conducting an environmental monitoring program at the disposal site
- ✓ Performing periodic surveillance
- ✓ Providing minor custodial care and maintenance
- ✓ Maintaining records
- ✓ Reporting periodically to the Regulatory Agency
- ✓ Carrying out other equivalent activities as determined by the Director
- ✓ Administering funds to cover the costs for these activities

Custodial care, as used above, includes such activities as:

- ✓ Repairing fencing
- ✓ Repairing or replacing monitoring equipment
- ✓ Reestablishing or controlling vegetation on stabilized disposal unit areas
- ✓ Performing minor repair of disposal unit covers
- ✓ Providing general disposal site upkeep

Active maintenance is also allowed during the institutional control period and may include:

- ✓ Pumping and treating water from a disposal unit
- ✓ Replacing a disposal unit cover
- ✓ Taking other episodic or continuous measures

Termination of the Institutional Control period before the Perpetual Care Fund grows to a future value of $40 to $60 million might jeopardize the adequacy of the Institutional Control financial assurances under assumptions of this evaluation. Specifically, monies in a Perpetual Care Fund could be assumed to be invested and to grow at rates that exceed the rate at which costs escalate by 2 percent per year or the real return on investment may be less. Under these conditions, the real value of Perpetual Care Fund grows faster than the costs of the potential demands grow. By the time the value of the Perpetual Care Fund would have grown to $35 to $60 million, it is judged to have sufficient capacity to cover the estimated costs of unplanned or unexpected events for which other financial assurances are not available (refer to Questions 3-14, 3-19, and 3-23).

3.6 WHO PROVIDES INSTITUTIONAL CONTROL AND WHO PAYS FOR IT?

Under expected conditions, the landowner or a custodial entity will provide care and maintenance of the closed facility during the institutional control period. In the case of the Energy*Solutions* facility at Clive, Utah, the facility Licensee (Energy*Solutions*) is the landowner. No custodial entity has been identified at this time and the State has not defined the process by which the custodial agency would be identified.

The costs of institutional control activities will be funded by financial assurances that the Licensee has provided for this purpose. The adequacy of these financial assurances are revised and submitted to the Director annually. In turn, the Director reviews and approves the proposed financial assurances once the proposed provisions are determined to satisfy applicable requirements.

3.7 WHO IS RESPONSIBLE FOR OVERSEEING THE CLOSED FACILITY AT THE END OF 100 YEARS OF INSTITUTIONAL CONTROL?

Under the current regulatory structure and license conditions for the currently licensed facilities, the responsibility for monitoring and maintenance continues with the licensee upon successful closure of the facility for the (100-year) institutional control period. Of course, laws and regulatory requirements might evolve over such a long period of time, not to mention the possibility that the licensee might cease to exist at any time.

For Information Concerning This Section, Please See The 2006 And 2011 Evaluation Of Closure, Post-Closure, And Perpetual Care And Maintenance For Commercial Hazardous Waste And Commercial Radioactive Waste Treatment, Storage, And Disposal Facilities Reports Found On The Division Of Waste Management And Radiation Control Website.

3.8 WHAT FORMS OF FINANCIAL ASSURANCES FOR CLOSURE AND INSTITUTIONAL CONTROL (FINANCIAL ASSURANCE MECHANISMS OR FINANCIAL SURETIES) ARE ALLOWED BY THE RULES?

An owner or operator may provide financial or surety arrangements that are generally acceptable to the Director, including:

- ✓ Surety bonds
- ✓ Cash deposits
- ✓ Certificates of deposit
- ✓ Deposits of government securities
- ✓ Irrevocable letters of credit

- ✓ Trust funds
- ✓ Combinations of the above or other types of arrangements, including commercial insurance, as may be approved by the Director.

elf-insurance, or an arrangement which essentially constitutes self-insurance, does not satisfy the surety requirement for private sector applicants under Utah Administrative Code.

The financial or surety arrangement must be written for a specified period of time. The surety arrangement must be automatically renewed unless the person who issues the surety notifies the Director; the beneficiary, the site owner; and the principal, the Licensee, not less than 90 days prior to the renewal date of its intention not to renew. In such a situation, the Licensee must submit a replacement surety within 30 days after notification of cancellation. If the Licensee fails to provide a replacement surety acceptable to the Director, the beneficiary may collect on the original surety.

Proof of forfeiture is not necessary to collect the surety. Thus, in the event that the Licensee is unable to provide an acceptable replacement surety within the required time, the beneficiary may automatically collect the surety before it expires. The conditions described above must be clearly stated on surety instruments.

3.8 WHAT ARE THE ESTIMATED COSTS TO CLOSE A FACILITY AND PROVIDE INSTITUTIONAL CONTROL?

The costs estimated for the closure and institutional control of commercial LLRW management facilities licensed by Utah are presented in Table 3-3. These estimated costs are the most recent costs revised and updated by Owners/Licensees and reviewed by the Director. Following the Director's independent review to ensure that applicable requirements were satisfied, the Director accepted them as an adequate basis for determining required financial assurances. Such costs are revised and independently reviewed by the Division annually and revisions made until applicable requirements are satisfied. Estimates of these costs were not further independently reviewed in the preparation of this report.

Table 3-3. Summary of estimated facility closure and institutional control costs for commercial radioactive waste management facilities licensed by the State of Utah

Facility	Estimated Facility Closure Cost	Estimated Institutional Control Cost
Energy*Solutions*; LLRW Facility	$58.5 million	$6.2 million[17]
Energy*Solutions* Mixed Waste Facility	$12 million	Covered Under Post-Closure
Energy*Solutions*; 11e.(2) Facility	$11.8 million	US DOE Long-Term Stewardship Program[18]

[17] Closure and Institutional Control Financial Assurances total $64,681,299 as of March 2015.

These cost estimates must account for all activities and costs that will be required to close the facility and to care for it during the post-closure care period. The costs estimates must also be based on the assumption that an independent third party contractor performs the required work.

The approach to estimating closure and institutional costs involves the following steps:

- ✓ Identify all necessary activities
- ✓ Estimate all required levels of effort, equipment, materials, supplies, and subcontractor support
- ✓ Determine unit costs for each cost item (labor, equipment, materials, and supplies)
- ✓ Calculate individual costs and aggregate
- ✓ Determine suitable contingency allowances
- ✓ Submit for Director review and revised to address their concerns
- ✓ Receive formal approval

Estimated costs can be influenced by such factors as:

- ✓ Closure and institutional control plan specifications.
- ✓ Current site-specific conditions (such as geotechnical and hydraulic characteristics of soils, meteorological conditions, and characteristics of waste managed at the facility) available at or near the facility.
- ✓ Recent developments in technologies that could improve the conduct of any activity required during closure or institutional control.
- ✓ Changes in unit costs of items or activities required to close or provide institutional control (such as the price of fuel, reduced availability of materials, and changes in qualified labor supply).

Closure and stabilization costs must address applicable requirements. For example:

- ✓ The Licensee must design, operate and close the facility so that the need for further maintenance is minimized.
- ✓ The cost estimate must assume that an independent third party will be hired to perform closure activities and institutional control care..

The closure financial assurance cost estimates provided in Table 3-3 reflect surety cost estimates that were approved by the Director in March 2015. Following the passage of senate bill (S. B. 173)

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[18] Under provisions of the Nuclear Waste Policy Act of 1982, the US Department of Energy must by law provide long-term care of 11e.(2) facilities that have been closed and stabilized in compliance with US Nuclear Regulatory commission requirements. An additional condition of accepting such facilities is that funds sufficient to cover all long-term care costs must be transferred to the US DOE. One facility will eventually be transferred to US DOE's care under these provisions: Energy*Solution's* 11e.(2) embankment at Clive, Utah. The Vitro embankment has already been transferred to US DOE

in 2015, Energy*Solutions* submitted two proposed alternative cost estimates for closure of the Energy*Solutions* facility prepared on their behalf by two separate third-party engineering firms. In these proposed alternative cost estimates, the surety estimates were developed by combining the sureties for LLRW, 11e.(2) and Mixed Waste facilities by assuming that all three facilities would close at the same time. It has not yet been determined whether the sureties can be combined given that the different disposal facilities at the Clive Complex are subject to different regulatory/legal requirements. If either or both of the proposed alternative closure cost estimates are approved, the total required surety amount for closing all three licensed disposal facilities could be reduced compared to the currently approved surety amounts that are shown in Table 3-3.

The initially proposed language in S.B. 173 also changed the area that the Director can require be covered by the financial surety to the area specifically licensed (area in Section 32). The two proposed alternative surety estimates are currently under review by the Director.

Subsequent to release of the initial proposed version of S.B. 173 for comment, the U.S. NRC indicated that the requirements contained in the new legislation regarding financial surety for LLRW licensees were not compatible with the NRC's financial surety requirements. Draft proposed revised financial assurance requirements for LLRW facilities in Utah were submitted to the NRC in February 2016 for review and comment (see Section 3.13).

3.9 WHAT FINANCIAL ASSURANCES ARE CURRENTLY BEING PROVIDED FOR CLOSURE AND INSTITUTIONAL CONTROL?

As of 2015, closure financial assurances listed in Table 3-4 for the costs of closing licensed commercial LLRW management facilities and maintaining institutional control.

Table 3-4. Financial assurances presently provided by Owners/Licensees in Utah

Facility	Closure Financial Assurance Mechanism	Closure Financial Assurance Provided	Institutional Control Financial Assurance Mechanism	Institutional Control Financial Assurance Provided
Energy*Solutions*; LLRW Facility	Surety Bond	$58.5 million[19]	Surety Bond	$6.2 million
Energy*Solutions* Mixed Waste Facility	Surety Bond and Standby Trust	$12 million	Not Applicable	Not Applicable
Energy*Solutions*; 11e.(2) Facility	Surety Bond	$11.8 million	US DOE Long-Term Stewardship Program[20]	$0.9 million

[19] Closure and Institutional Control Financial Assurances total $64,681,299 as of March 2015.

[20] Under provisions of the Nuclear Waste Policy Act of 1982, the US Department of Energy must by law provide long-term care of 11e.(2) facilities that have been closed and stabilized in compliance with US Nuclear Regulatory commission requirements. An additional condition of accepting such facilities is that funds sufficient to cover all

As required by Utah Administrative Code R313-25-31(3), these cost estimates and the resulting financial assurance arrangements are updated, critically reviewed, revised as necessary, and approved each year. Annually revised costs estimates account for changes in prevailing site conditions; the closure plan; institutional control plan; technologies available to accomplish closure and provide institutional control; and the effects of inflation.

3.10 WHAT IS "PERPETUAL CARE AND MAINTENANCE"?

The concept of providing for the perpetual care and maintenance of a facility is well established and accepted where the obligation to care for a facility is expected to persist beyond the lives of the individuals and entities involved in developing and operating the facility. In the context of commercial LLRW management facilities, the costs of providing perpetual care and maintenance at a closed commercial LLRW management facility are paid through legislative appropriations from the Perpetual Care Fund.

In general terms, perpetual care and maintenance would typically include activities that might be necessary following cessation of institutional control activities, such as:

- ✓ Maintaining appropriate levels of site security.
- ✓ Providing repairs to components whose failure has compromised or could compromise the stability and safety of the closed facility.
- ✓ Performing routine maintenance of site and support structures and systems (such as landscaping, painting, maintaining fences, and repairing minor damage to cover systems.
- ✓ Complying with applicable regulatory or legal requirements.
- ✓ Managing perpetual care and maintenance activities.
- ✓ Administering any perpetual care and maintenance fund, were they available.

3.11 WHAT IS THE RADIOACTIVE WASTE PERPETUAL CARE AND MAINTENANCE FUND?

The Radioactive Waste Perpetual Care and Maintenance Account (Perpetual Care Fund) was created by the Utah Legislature and is stated in UCA §19-3-106.2. Its purpose is to provide funding for the care of closed disposal facilities following the institutional control period and to protect against the possibility of funding shortfall during the institutional control period.

The sources of revenue for the Perpetual Care Fund include annual fees paid by the owner or operator of any active commercial radioactive waste treatment or disposal facility and investment earning produced by the fund. The fee paid by each such owner or operator is $400,000 per year. Monies in the fund are invested by the Utah State Treasurer. The balance of the Perpetual Care

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long-term care costs must be transferred to the US DOE. One facility will eventually be transferred to US DOE's care under these provisions Energy*Solution*'s 11e.(2) embankment at Clive, Utah. The Vitro embankment has already been transferred to US DOE.

Fund as of June 2016 was approximately $6.18 million, including accrued interest. Only the Legislature may authorize use of monies in the Perpetual Care Fund by appropriating funds for the stated purposes. The purposes and authorized uses of these funds under current law include the following.

- ✓ Perpetual care and maintenance of a commercial radioactive waste treatment or disposal facility, excluding sites within the facility used for the disposal of byproduct material (uranium mill tailings), beginning 100 years after the date of final closure of the facility (after the institutional control period).
- ✓ Maintenance, monitoring, or implementing corrective action at a commercial radioactive waste treatment or disposal facility, excluding sites within the facility used for the disposal of byproduct material, within the 100 years immediately following the date of final facility closure, provided that:
    - Owner or operator is unwilling or unable to carry out post-closure maintenance, monitoring, or corrective action; and
    - Financial surety arrangements made by the owner or operator, including any required under applicable law, are insufficient to cover the costs of post-closure maintenance, monitoring, or corrective action.

The statute (UCA §19-3-106.2) also provides that the "attorney general shall bring legal action against the owner or operator or take other steps to secure the recovery or reimbursement of the costs of maintenance, monitoring, or corrective action, including legal costs, incurred ...."

3.12 WHAT WILL BE THE COSTS OF MONITORING AND MAINTAINING THE CLOSED FACILITY FOLLOWING 100 YEARS OF INSTITUTIONAL CONTROL?

Previous estimates of the annual costs of monitoring and maintaining the closed Energy*Solutions* LLRW facilities ranged between $80,000 and $83,000 per year (Energy*Solutions* 2006). The Director reviews the licensee's estimates of Institutional Control period costs. These estimates adequately reflect the cost of continuing maintenance and monitoring following the end of Institutional Control period. Funds of about $4.2 million invested at an assumed 2 percent per year real interest rate[21] would generate sufficient interest earning to cover these costs.

Revisions to Utah Administrative Code R313-15-403, as issued for comment by the UWMRCB on December 10, 2015, (UDWMRC 2016) and approved by the Board on March 10, 2016, with an effective date of March 15, 2016, require, among other proposed changes, that, when terminating a license under restricted conditions, a licensee would need to have placed surety funds in a separate account and demonstrate the adequacy of the funds for institutional control activities (separate from those anticipated during perpetual care) based on an assumed 1 percent annual rate of return on investment.

[21] Real interest rate is the difference of the nominal (or current market) interest rate and the current inflation rate.

The U.S. NRC indicated that the proposed changes included in the initial S.B. 173 statute regarding financial surety for LLRW licensees were not compatible with the NRC's financial surety requirements. The Director submitted proposed draft revised financial surety requirements to the NRC for review in February 2016. The NRC provided a response in a letter dated March 9, 2016 identifying two suggested changes to the proposed legislation (S.B. 231) considered but not passed during the 2016 General Session (NRC 2016).

3.13 WHAT WILL BE THE VALUE OF THE RADIOACTIVE WASTE PERPETUAL CARE AND MAINTENANCE FUND IN THE FUTURE?

As noted above, the monies deposited into the Perpetual Care Fund are invested according to Utah State Treasurer rules. Investments must be made in secure financial instruments that have very small probability of failure or loss. Typically, such investments include US Treasury notes and bonds. Over the past century, these financial instruments have produced interest earnings of about 2 percent per year over and above prevailing inflation rates (RFF 2002, MSDW 1999)). Investments in such financial instruments grow faster than inflation by about 2 percent per year.

A review of the PTIF for FY 2012 through 2016, shows that the PTIF has generated a real rate of return of -0.9% (Statement of Account PTIF, Utah Public Treasurers' Investment Fund, FY 2012-2016).

Given the current value of the annual deposits to and earnings of the Perpetual Care Fund, and an assumed 2 percent real annual interest rate return, Figure 3-1 and Table 3-5 present projected future values of the fund. Knowing the number of years in the future when the facility closes and the time when the fund might be required, the value at the time of need can be determined. For example, if the facility terminates operations and is properly closed 20 years from now (shaded below) and the fund is required 100 years after facility closure (shaded below), its value is projected to be

$93 million (shaded below), as shown in Table 3-5.

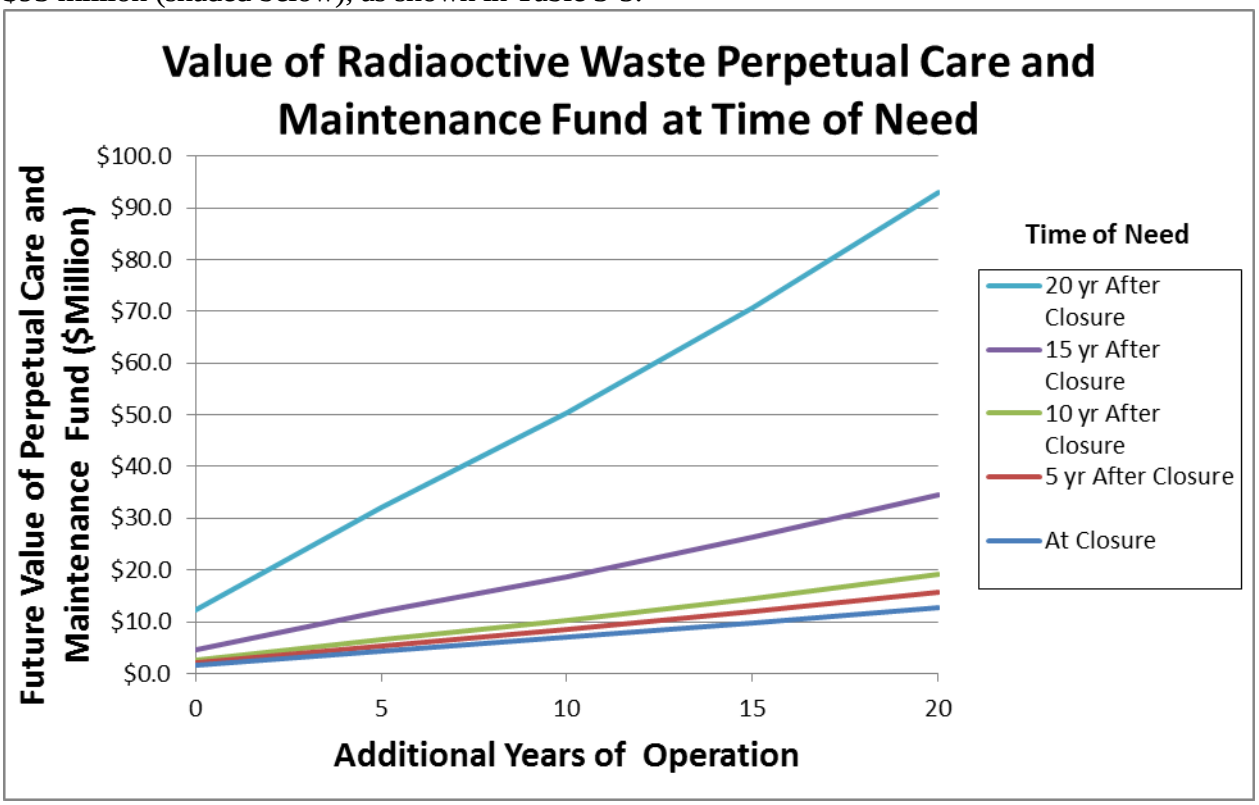

Figure 3-1. Projected Future Value of Radioactive Waste Perpetual Care and Maintenance Fund (2% average annual real return assumed)

Table 3-5. Projected Future Value of Radioactive Waste Perpetual Care and Maintenance Fund (2% average annual real return assumed)	
	At Facility Closure
Collections Through Closure ($ million)	$13
Future Value ($ million)	$13
Time of Need (years after Closure)	**Value at Time of Need ($ million)**
10 years	$16
20 years	$19

Table 3-5. Projected Future Value of Radioactive Waste Perpetual Care and Maintenance Fund (2% average annual real return assumed)	
	At Facility Closure
50 years	$35
100 years	$93
200 years	$675
300 years	$4,887
400 years	$35,402
500 years	$256,476

In general, the value of the fund grows faster than costs inflate. As a general rule, the future value of the Perpetual Care Fund grows:

- ✓ When the facility continues to operate so that deposits continue to be made into the fund
- ✓ When the need for the fund is delayed
- ✓ If annual deposits to the fund increase
- ✓ If the fund is invested in better-performing investment vehicles

If the Perpetual Care Fund balance were $93 million and invested at 2 percent real interest rate, it would produce interest earnings of nearly $1.9 million per year without diminishing the balance itself. Under these conditions, annual care costs could total as much as about $1.9 million per year without diminishing the potential of the Perpetual Care Fund to cover annual care costs of a closed LLRW disposal facility.

3.14 WHAT MIGHT BE THE FUTURE VALUE OF THE PERPETUAL CARE FUND IF GREATER ANNUAL FEES WERE IMPOSED?

If larger annual fees were required to be deposited into the Perpetual Care Fund, more monies would be available in the future, as shown in Table 3-6, assuming no monies were previously withdrawn from the fund, and assuming an average real interest rate of 2 percent per year.

Table 3-6. Dependence of Perpetual Care Fund future value on annual fee (2% average annual real return assumed)

Annual Fee ($ per year)	Future Value[22] ($ million)
$400,000*	$93
$500,000	$112
$600,000	$130
$700,000	$149
$800,000	$168
$900,000	$186
$1,000,000	$205

3.15 WHAT WOULD BE THE EFFECT OF FEWER YEARS OF FUTURE OPERATIONS OR NEED FOR FUNDS EARLIER THAN 100 YEARS AFTER FACILITY CLOSURE?

The financial assurances provided by the licensees for institutional control might be insufficient to cover all costs ultimately incurred following facility closure. It could occur if unplanned and unanticipated events were to occur earlier than the end of the 100 years of the institutional control period. Under this condition, the Perpetual Care Fund might be inadequate to cover all costs.

3.16 BEYOND FINANCIAL ASSURANCES, WHAT ELSE PROVIDES ASSURANCE THAT LICENSED COMMERCIAL LLRW MANAGEMENT FACILITIES WILL BE PROPERLY CLOSED AND WILL PERFORM AS REQUIRED

The comprehensive system for licensing and regulating commercial LLRW management facilities includes numerous requirements and features that limit the probability that closure and

[22] After 20 more years of deposits (disposal operations) and 100 years of institutional control at an assumed real interest rate of 2 percent per year.

institutional control costs would exceed those covered through financial assurance. These requirements and features are divided among:

- ✓ Performance objectives
- ✓ Waste characteristics requirements
- ✓ Siting requirements
- ✓ Design requirements
- ✓ Operating and closure requirements
- ✓ Environmental monitoring requirements

These requirements and features as summarized below:

Performance Objectives Utah Administrative Code (R313-25-19)

- ✓ Concentrations of radioactive material that may be released to the general environment in ground water, surface water, air, soil, plants or animals must not result in an annual dose exceeding an equivalent of 25 millirem (mrem) to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public.
- ✓ No greater than 4 mrem committed effective dose equivalent or total effective dose equivalent to any member of the public may come from groundwater.
- ✓ Reasonable efforts should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable (ALARA).
- ✓ Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in UAC R313-15, except for release of radioactivity in effluents from the land disposal facility, which are governed as stated immediately above.
- ✓ Every reasonable effort should be made to maintain radiation exposures ALARA.
- ✓ Design, operation, and closure of the land disposal facility must ensure protection of any individuals inadvertently intruding into the disposal site and occupying the site or contacting the waste after active institutional controls over the disposal site are removed.
- ✓ The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate, to the extent practicable, the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required.

Waste Characteristics Requirements Utah Administrative Code (R313-15-1008(2)(a))

- ✓ Wastes must be packaged in conformance with the conditions of the license issued to the site operator to which the waste will be shipped. Where the conditions of the site license are more restrictive than the provisions of UAC R313-15, the site license conditions are controlling.

- ✓ Wastes must not be packaged for disposal in cardboard or fiberboard boxes.
- ✓ Liquid waste must be packaged in sufficient absorbent material to absorb twice the volume of the liquid.
- ✓ Solid waste containing liquid must contain as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case may the liquid exceed one percent of the volume.
- ✓ Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.
- ✓ Waste must not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste.
- ✓ Waste must not be pyrophoric. Pyrophoric materials contained in wastes must be treated, prepared, and packaged to be nonflammable.
- ✓ Wastes in a gaseous form must be packaged at an absolute pressure that does not exceed 1.5 atmospheres at 68 degrees Fahrenheit. Total activity must not exceed 100 curies per container.
- ✓ Wastes containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practical the potential hazard from the non-radiological materials.

Technical Analyses Utah Administrative Code (R313-25-9)

- ✓ Under certain conditions, a site-specific performance assessment will be prepared.
- ✓ Site-specific performance assessments must include:
  - Analyses demonstrating that the general population will be protected from releases of radioactivity that consider the pathways of air, soil, ground water, surface water, plant uptake, and exhumation by burrowing animals.
  - Analyses of the protection of inadvertent intruders.
  - Analysis of the protection of individuals during operations that include assessments of expected exposures due to routine operations and likely accidents during handling, storage, and disposal of waste.
  - Analyses of the long-term stability of the disposal site that address active natural processes including erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over disposal areas and adjacent soils, surface drainage of the disposal site, and the effects of changing lake levels. *(Note: Although not explicitly listed in these requirements, analyses of long-term stability will necessarily address stability under seismic conditions.)*
- ✓ Any facility that proposes to land dispose of more than one metric ton in total accumulation of concentrated depleted uranium (DU) after June 1, 2010, must demonstrate by submitting a site-specific performance assessment that the performance standards specified in 10 CFR Part 61 and corresponding provisions of Utah rules will be

met for the total quantities of concentrated DU and other wastes. Any such performance assessment must be revised as needed to reflect ongoing guidance and rulemaking from NRC. For purposes of this performance assessment, the assessment must include an evaluation of a 10,000 year- performance period. As part of the DU Performance Assessment, the licensee has also completed modeling simulations extending beyond the 10,000-year modeling period to predict the future timing and magnitude of peak doses for selected (long-lived) radionuclides.

Siting Requirements Utah Administrative Code (R313-25-24)

- ✓ The primary emphasis in disposal site suitability is given to isolating wastes and to disposal site features that ensure that the long-term performance objectives are met.
- ✓ The disposal site must be capable of being characterized, modeled, analyzed, and monitored.
- ✓ Within the region where the facility is to be located, a disposal site should be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of UAC R313-25-20 through R313-25-23.
- ✓ Areas must be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of UAC R313-25-20 through R313-25-23.
- ✓ The disposal site must be generally well drained and free of areas of flooding or frequent ponding.
- ✓ Waste may not be disposed of in a 100-year flood plain, coastal high-hazard area or wetland, as defined in Executive Order 11988, "Floodplain Management Guidelines."
- ✓ Upstream drainage areas must be minimized to decrease the amount of runoff that could erode or inundate waste disposal units.
- ✓ The disposal site must provide sufficient depth to the water table that ground water intrusion, perennial or otherwise, into the waste will not occur.
- ✓ The hydrogeologic unit used for disposal must not discharge ground water to the surface within the disposal site.
- ✓ Areas must be avoided where tectonic processes such as faulting, folding, seismic activity, vulcanism, or similar phenomena may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of UAC R313-25 - 20 through R313-25-23 or may preclude defensible modeling and prediction of long-term impacts.
- ✓ Areas must be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with sufficient such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of UAC R313-25-20 through R313-25-23, or may preclude defensible modeling and prediction of long-term impacts.

- ✓ The disposal site must not be located where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives of UAC R313-25-20 through R313-25-23 or significantly mask the environmental monitoring program.

Design Requirements Utah Administrative Code (R313-25-25)

- ✓ Site design features must be directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure.
- ✓ The disposal site design and operation must be compatible with the disposal site closure and stabilization plan and lead to disposal site closure that provides reasonable assurance that the performance objectives of UAC R313-25-20 through R313-25-23 will be met.
- ✓ The disposal site must be designed to complement and improve, where appropriate, the ability of the disposal site's natural characteristics to assure that the performance objectives of UAC R313-25-20 through R313-25-23 will be met.
- ✓ Covers must be designed to minimize, to the extent practicable, water infiltration, to direct percolating or surface water away from the disposed waste, and to resist degradation by surface geologic processes and biotic activity.
- ✓ Surface features must direct surface water drainage away from disposal units at velocities and gradients that will not result in erosion that will require ongoing active maintenance in the future.
- ✓ The disposal site must be designed to minimize to the extent practicable the contact of water with waste during storage, the contact of standing water with waste during disposal, and the contact of percolating or standing water with wastes after disposal.

Operating and Closure Requirements Utah Administrative Code (R313-25-26)

- ✓ Disposal of only Class A LLRW is allowed in Utah.
- ✓ Wastes must be emplaced in a manner that maintains the package integrity during emplacement, minimizes the void spaces between packages, and allows the void spaces to be filled.
- ✓ Void spaces between waste packages must be filled with earth or other material to reduce future subsidence within the fill.
- ✓ Waste must be placed and covered in a manner that limits the radiation dose rate at the surface of the cover to levels that at a minimum will allow the Licensee to comply with all standards against radiation protection at the time the facility is closed and stabilized.
- ✓ The boundaries and locations of disposal units must be accurately located and mapped by means of a land survey.
- ✓ Near-surface disposal units must be marked in such a way that the boundaries of the units can be easily defined. Three permanent survey marker control points, referenced to United States Geological Survey or National Geodetic Survey control stations, must be established on the site to facilitate surveys.

- ✓ Horizontal and vertical controls must be provided by United States Geological Survey or National Geodetic Survey control stations as checked against United States Geological Survey or National Geodetic Survey record files.
- ✓ A buffer zone of land must be maintained between any buried waste and the disposal site boundary and beneath the disposed waste. The buffer zone must be of adequate dimensions to carry out environmental monitoring activities and take mitigative measures if needed.
- ✓ Closure and stabilization measures as set forth in the approved site closure plan must be carried out as the disposal units are filled and covered.
- ✓ Active waste disposal operations must not have an adverse effect on completed closure and stabilization measures.
- ✓ Only wastes containing or contaminated with radioactive material may be disposed of at the disposal site.

Environmental Monitoring Requirements Utah Administrative Code (R313-25-27)

- ✓ When a license application is first submitted (emphasis added), the applicant must have conducted a preoperational monitoring program to provide basic environmental data on the disposal site characteristics. The applicant must obtain information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site. For those characteristics that are subject to seasonal variation, data must cover at least a 12-month period.
- ✓ During the land disposal facility site construction and operation, the Licensee must maintain an environmental monitoring program. Measurements and observations must be made and recorded to provide data to:
    - Evaluate the potential health and environmental impacts during both the construction and the operation of the facility
    - Enable the evaluation of long-term effects and need for mitigative measures
    - Provide early warning of releases of waste from the disposal site before they leave the site boundary
- ✓ After the disposal site is closed, the Licensee responsible for post-operational surveillance of the disposal site must maintain a monitoring system based on the operating history and the closure and stabilization of the disposal site. The post-operational monitoring system must also be capable of providing early warning of releases of waste from the disposal site before they leave the site boundary.
- ✓ The Licensee must have plans for taking corrective measures if the environmental monitoring program detects migration of waste which would indicate that the performance objectives may not be met.

In addition to these universally applicable requirements, the Director is authorized and empowered to impose license conditions that must also be met to protect facility workers, the general public, and the environment. The Director maintains surveillance, monitors activities

related to the facility, and periodically performs inspections to determine compliance with regulatory requirements and license conditions.

The Owner/Licensee periodically prepares and submits environmental monitoring, operating, and other reports to the Director. The Director reviews and evaluates reports submitted by Owners/Licensees to assess whether the facility is being operated as required and as planned and whether changes should be made to provide greater assurance that the facility will perform as required and as planned.

The Owner/Licensee maintains records of all activities that indicate and document the performance of the commercial LLRW management facility. Each Owner/Licensee must also implement and maintain Quality Assurance and Quality Control programs to provide documentary evidence that required activities are performed properly.

All of these requirements and features help provide substantial assurance that LLRW disposed of in Utah will remain in a safe and secure condition that will not threaten or degrade public health or environmental media.

3.17 HOW MIGHT CLOSURE, INSTITUTIONAL CONTROL, AND OTHER COSTS BE GREATER THAN THE FUNDING PROVIDED BY FINANCIAL ASSURANCES AND THE PERPETUAL CARE FUND?

The requirements for estimating closure and institutional control costs have been determined to minimize the potential that actual closure or institutional control costs will exceed the value of financial assurances provided (NRC 1981). Moreover, the Utah Legislature created the Perpetual Care Fund to cover costs incurred later than 100 years after facility closure[23], whether they are associated with monitoring, maintaining, repairing, conducting corrective actions, or other conditions.

Notwithstanding the precautions taken to ensure safe operation, closure, and acceptable long-term maintenance, closure and institutional control cost estimates are merely projections of the costs of reasonably well-known but still uncertain future events, conditions, circumstances, and environment. To the extent that future conditions differ from those assumed and expected to exist, actual costs will likely vary from those estimated. Thus, actual costs could be either less than or greater than expected costs.

Uncertainties about the future might produce the following effects. These lists are limited only by human imagination and our collective judgment of what is “reasonable” to consider. Many of these effects are sufficiently ambiguous that no reasonable, warranted, or justifiable approach to dealing with them is possible.

Natural Conditions Worse Than Expected

- ✓ Climatic conditions change and produce excessive precipitation, run-on, or runoff

[23] Or during the first 100 years following closure under conditions limited by UCA 19-3-106.2(5)(b).

- ✓ Climatic conditions change and produce extreme aridity
- ✓ Earthquake ground motions are greater than projected
- ✓ Vegetation or burrowing animals intrude more aggressively than expected

Human Activities Not Anticipated

- ✓ Aircraft impacts the closed facility
- ✓ Waste constituents are dispersed by a terrorist attack or disgruntled employee
- ✓ Critical material, fuel, labor, or other prices are higher than projected
- ✓ Claims of health impacts attributable to the closed facility create new financial liabilities
- ✓ Laws and/or regulatory requirements change to create unanticipated financial liabilities
- ✓ Litigation delays or extends needed actions
- ✓ Incompetence, dereliction of duty, or ignorance within any entity involved with the licensed facility (Owner/Licensee, regulatory agency, financial institution, contractor, special interest groups, or members of the general public)

Facility Components Fail to Perform As Planned

- ✓ Water infiltration is greater than anticipated
- ✓ Water accumulates within disposal unit
- ✓ Water or wind erosion is greater than anticipated
- ✓ Excessive differential settlement damages the cover system
- ✓ Waste or constituents are exposed at the surface of the facility
- ✓ Wastes interact with unanticipated deleterious effects
- ✓ Construction flaws compromise facility performance

The probabilities of the outcomes listed above vary widely, as do their potential cost impacts. Both probabilities and financial (and other) impacts should be considered in identifying and evaluating any proposals to address them. For example, an event with a huge financial impact might appear to justify some effort. However, if its probability of occurrence is vanishingly small, the public interest might be better served instead by addressing events with smaller costs but a greater probability that it might occur. Without more detailed information about the possible events and outcomes listed above, any attempt to manage these risks would be based on simple speculation.

In recent evaluations of the impact of unplanned and unexpected events on costs of maintaining a closed LLRW disposal facility (Baird 2008), the State of South Carolina addressed the following events:

- ✓ Decreased Precipitation
- ✓ Adjacent Site Development

- ✓ Trench Collapse
- ✓ Burrowing Animals
- ✓ Increased Precipitation
- ✓ Worker Exposure
- ✓ Negative Media Coverage
- ✓ Regulatory Changes
- ✓ Mine/Quarry Activity at Site
- ✓ Spent Nuclear Fuel Rod
- ✓ Health Claims
- ✓ Invalid Geotechnical Model
- ✓ Property Values Depressed
- ✓ Extreme Weather

3.18 HOW LARGE COULD THE INCREASES OF CLOSURE, INSTITUTIONAL CONTROL, AND OTHER COSTS BE?

As noted above, many of the ways in which post-closure costs might be larger than expected can widely vary or have a significant level of uncertainty such that no effort to manage them is justified without further definition and information. In other cases that result in the facility failing to perform as required, reasonable estimates can be made of their costs and information developed in support of decision making. Even in these cases, however, substantial uncertainties exist about what might actually happen and what the resulting costs might be.

Notwithstanding the ambiguity and uncertainties associated with conditions that increase costs of monitoring and maintaining closed LLRW treatment and disposal facilities, an effort has been made to state the upper and lower bounds of the associated costs using a combination of realistic approximations and inference. These estimated costs are summarized in Table 3-7. A rigorous development of costs should be prepared as a basis for final decision making.

Table 3-7. Summary of inexact costs of unplanned and unanticipated future events

Potential Future Event	Inexact Cost[24] ($million)		
	Plausible Minimum	**As Estimated**	**Plausible Maximum**
Cover System Failures	$10	$20	$70
Excessive Water Enters Disposal Unit	$10	$30	$50
Surface Contamination Observed	$1	$3	$20
Wastes Interact with Unanticipated Deleterious Effects	$10	$30	$50
Aircraft Impacts the Closed Facility or Waste Constituents Are Dispersed by a Terrorist Attack	$5	$10	$30
Claims of Health Impacts Create New Financial Liabilities	$10	$40	$50
Laws/Regulations Create Unanticipated Financial Liabilities	Unknown	Unknown	Unknown

[24] Rounded to the nearest $10 million or one figure of significance because of extreme uncertainty.

Table 3-7. Summary of inexact costs of unplanned and unanticipated future events			
	Inexact Cost[24] ($million)		
Potential Future Event	Plausible Minimum	As Estimated	Plausible Maximum
Litigation Delays or Extends Needed Actions	Unknown	Unknown	Unknown

These costs were estimated using industry accepted practices and relying upon the judgment of professionals with extensive experience in the radioactive waste management industry. Where possible activities were identified; quantities (for example areas, volumes, and labor requirements) were calculated; unit costs determined (relying on such sources as Means 2015); and costs calculated and aggregated. Plausible minimum costs were estimated as one-quarter to one-half of the calculated cost. Plausible maximum costs were estimated as 5 to 7 times the calculated cost.

Again, these cost estimates are based on very poorly defined characteristics and conditions. They are, therefore, highly uncertain and great caution should be exercised in making any decisions based on information presented in Table 3-7.

3.19 WHAT ARE THE PROBABILITIES OF OCCURRENCE OF THE INCREASES OF CLOSURE, INSTITUTIONAL CONTROL, AND OTHER COSTS?

Quantifying the probability of any individual cause of excess closure and institutional control costs is beyond the scope of this report. Still, it is possible, for the purpose of placing these events and their impacts in relative perspective, to state realistic and upper bounds of probabilities. These probability bounds were developed as the combined judgment of professionals technically informed and experienced in the radioactive waste management industry. A rigorous development of both costs and probabilities would provide a better basis for final decision making. Such probabilities for unplanned and unanticipated future events are listed in Table 3-8.

Table 3-8. Order of magnitude probabilities for unplanned and unanticipated future events		
	Order of Magnitude Probability	
Potential Future Event	Realistic	Overstated
Cover System Failures	Less than 10 in 1,000	200 in 1,000
Excessive Water Enters Disposal Unit	Less than 10 in 1,000	200 in 1,000
Surface Contamination Observed	Less than 10 in 1,000	200 in 1,000
Wastes Interact with Unanticipated Deleterious Effects	Less than 1 in 1,000	50 in 1,000

Table 3-8. Order of magnitude probabilities for unplanned and unanticipated future events		
	Order of Magnitude Probability	
Potential Future Event	**Realistic**	**Overstated**
Aircraft Impacts the Closed Facility or Waste Constituents Are Dispersed by a Terrorist Attack	Less than 1 in 10,000	1 in 1,000
Claims of Health Impacts Create New Financial Liabilities	100 in 1,000	500 in 1,000
Laws/Regulations Create Unanticipated Financial Liabilities	100 in 1,000	500 in 1,000
Litigation Delays or Extends Needed Actions	500 in 1,000	1,000 in 1,000

Again, these order of magnitude probabilities are based on very poorly defined characteristics and conditions and are, therefore, highly uncertain. Great caution should be exercised in using the results presented in Table 3-8.

3.20 CONSIDERING BOTH THE PROBABILITY AND MAGNITUDE OF POSSIBLE COST INCREASES, WHICH POSSIBILITIES POSE THE GREATEST RISK FOR INCREASED COSTS?

Based on the descriptions of probability and the relative magnitude of possible cost increases stated above, the order of magnitude of expected costs or financial risks was scoped. A rigorous development of both costs and probabilities should be prepared as a basis for final decision making.

Financial risk is the product of the estimated cost and the probability that the cost would be incurred. The range of risks based on values presented in Table 3-7 and Table 3-8 are depicted in Table 3-9.

Table 3-9. Highly uncertain financial risks from unplanned and unanticipated future events				
	Financial Risk ($ million)			
Potential Future Event	**Minimum**[25]	**Realistic**[26]	**Overstated**[27]	**Maximum**[28]
Cover System Failures	$0.1	$0.2	$4	$14
Excessive Water Enters Disposal Unit	$0.1	$0.3	$6	$10

[25] Based on plausible minimum cost and realistic probabilities.

[26] Based on estimated cost and realistic probabilities.

[27] Based on estimated cost and overstated probabilities.

[28] Based on plausible maximum cost and overstated probabilities.

Table 3-9. Highly uncertain financial risks from unplanned and unanticipated future events				
	Financial Risk ($ million)			
Potential Future Event	**Minimum**[25]	**Realistic**[26]	**Overstated**[27]	**Maximum**[28]
Surface Contamination Observed	$0.01	$0	$1	$4
Wastes Interact with Unanticipated Deleterious Effects	$0.01	$0	$2	$3
Aircraft Impacts the Closed Facility or Waste Constituents Are Dispersed by a Terrorist Attack	$0	$0	$0	$0
Claims of Health Impacts Create New Financial Liabilities	$1	$4	$20	$25
Laws/Regulations Create Unanticipated Financial Liabilities	Unknown	Unknown	Unknown	Unknown
Litigation Delays or Extends Needed Actions	Unknown	Unknown	Unknown	Unknown
Total Financial Risk	**$1**	**$5**	**$32**	**$56**

Table 3-9 shows that, based on these highly uncertain analyses, the financial risk might likely range between $5 and $32 million. Based on these very uncertain estimated costs and probabilities, the total financial risk of unplanned or unanticipated events is unlikely to be less than about $1 million and unlikely to be more than about $60 million.

3.21 ARE SUFFICIENT FINANCIAL ASSURANCES PROVIDED TO PROTECT AGAINST INCREASED COSTS OF CLOSURE, INSTITUTIONAL CONTROL, AND UNPLANNED AND UNANTICIPATED EVENTS?

In general, funds are available to cover costs expected to close and provide institutional control of commercial LLRW management facilities licensed in Utah as shown in Table 3-7, Table 3-8, and Table 3-9.

As noted above, a minimum fund balance of about $4.2 million, when invested at 2 percent per year real interest rate, will provide sufficient interest earnings to cover the costs of routine monitoring and maintenance. This amount would produce interest earnings of about $84,000 per year, without depleting the principal balance of the fund.

Table 3-5 shows the value of the Perpetual Care Fund after 20 more years of operations (and deposits to the fund) and 100 years of institutional control following facility closure (without withdrawals from the fund) to be about $93 million. Maintaining a minimum balance of $4 million to cover the costs of routine monitoring and maintenance would leave about $89 million available at that time to cover other costs. Finally, Table 3-9 reveals that the most likely financial risks (probability-weighted costs) of unplanned and unanticipated events, with

substantial uncertainty, should range between $5 and $32 million following 100 years of institutional control. Moreover, under worst conditions, the financial risk should total no more than about $60 million following 100 years of institutional control and might be as small as $1 million. Thus, based on the very rough and inexact estimates of costs and probabilities presented in Table 3-7 through Table 3-9, it appears that sufficient monies would be available from the Perpetual Care Fund to cover the probable costs of expected events, as well as unplanned and unanticipated events.

If the value of the Perpetual Care Fund were $93 million and its funds were invested at 2 percent per year real interest rate, it would be capable of sustaining considerable maintenance and repair activities at the closed LLRW management facility. The Perpetual Care Fund would generate annual interest earnings of nearly $1.9 million per year, under stated conditions, without diminishing its principal balance.

The financial assurances provided by the licensees for institutional control might be insufficient to cover all costs ultimately incurred following facility closure. It could occur if unplanned and unanticipated events were to occur earlier than the end of the 100 years of the institutional control period. Under this condition, the Perpetual Care Fund might be inadequate to cover all costs.

3.22 HOW DO THE FINANCIAL ASSURANCES REQUIRED FOR CLOSURE AND POST-CLOSURE CARE OF COMMERCIAL LLRW MANAGEMENT FACILITIES LICENSED IN THE STATE OF UTAH COMPARE WITH THOSE REQUIRED IN OTHER STATES?

State of Utah

The State of Utah under UCA §19-3-106.2 defines the creation, funding, and use of the Perpetual Care Fund. The fund's overall purpose is to finance the perpetual care and maintenance of commercial LLRW disposal facilities following 100 years after final closure of the facility. The statute requires commercial LLRW disposal or treatment facilities to pay an annual fee of $400,000 to be deposited into the Perpetual Care Fund.

The legislature may release monies from this fund to conduct perpetual care and maintenance of the facility beginning 100 years after final closure. Appropriations from the Perpetual Care Fund may also be made to maintain, monitor or implement corrective action at a commercial radioactive waste disposal facility prior to 100 years after its final closure if the owner/operator is unable or unwilling to carry out post-closure maintenance, monitoring, or corrective action or if the financial surety arrangements made by the owner/operator are insufficient to cover such costs. If either condition occurs, the State will initiate legal action against the facility owner or operator to recover or reimburse the costs paid by this fund.

Utah Administrative Code for financial assurances for the closure, stabilization, and institutional control of radioactive waste disposal facilities are addressed in UAC R313-25 "License Requirements for Land Disposal of Radioactive Waste" as well as in UAC R313-22-35. These financial assurance requirements are virtually identical to the NRC requirements stated in 10 CFR 61 and 10 CFR 30.35, respectively.

Utah Administrative Code R313-25-11 requires the Licensee to be financially qualified to conduct the operations for which they are requesting a license. A similar requirement in included in UAC R313-25-30 which requires the facility have sufficient funds to carry out facility construction and operations.

Financial assurance requirements for the closure and post-closure periods are addressed under UAC R313-25-31. These assurances are required to be in place prior to commencement of operations. The applicant must submit cost estimates that are used to determine the adequacy of proposed financial sureties. The cost estimates must take into consideration the costs for an independent contractor to perform the required decontamination, closure, and stabilization work, and are revised annually. Using these cost estimates the Director determines whether the proposed financial surety mechanisms are sufficient. Acceptable financial assurance arrangements include surety bonds, cash deposits, certificates of deposit, deposits of government securities, escrow accounts, irrevocable letter or lines of credit, trust funds, and other arrangements with the approval of the Director. Self-insurance or comparable arrangements are not acceptable for these purposes.

Financial assurances for the Institutional Control period are addressed in the Utah Administrative Code R313-25-32. This requires that a binding arrangement be established between the applicant and disposal site owner before the license is issued. The Director reviews this agreement annually to ensure that changes in technology, facility operations, and inflation are addressed. Any changes to this agreement must be submitted to the Director for review and approval.

The owner of the only commercial LLRW disposal facility in Utah is Energy*Solutions*, LLC, who is also the Licensee and applicant referred to in the regulations. Energy*Solutions*' predecessor organizations were exempted from the ownership requirements of UAC R313-25-29. This exemption allowed site ownership to remain with the facility operator, whereas the regulations, as written, require ownership to rest with a public agency. Thus, the regulatory requirements, as stated in UAC R313-25-32 provide the State no assurance since the resulting binding arrangement would be between Energy*Solutions* and itself.

State of Washington

The State of Washington initially passed the Radioactive Waste Act in 1983. Under RCW 43.200.080(2) the State assumed the responsibilities for the perpetual care agreement between the State and the federal government that was executed in 1965. As part of this agreement and the sublease between the State and the operator of the Hanford LLRW disposal site, the Washington Department of Ecology was directed to assess and collect fees to ensure acceptable site closure. RCW 43.200.080 created a Site Closure Account (Fund 125) and a Perpetual Surveillance and Maintenance Account (Fund 500) within the State Treasury. The purposes of these funds were to finance perpetual surveillance and maintenance and to ensure site closure under the lease with the federal government.

The Site Closure Account is funded through the collection of fees to defray the estimated costs of closure. This fee is called the "perpetual care and maintenance fee" and amounts to $1.75 per cubic foot of waste disposed of (WAC 173-44-040). These funds are used to reimburse the site operator, the State Licensing agency, or contracted agencies for costs (and reasonable profit, as appropriate) associated with the final closure and decommissioning of the Hanford LLRW

disposal facility. Any funds remaining in the Site Closure Account after the final closure has been completed will be transferred to the Perpetual Surveillance and Maintenance Account.

The Perpetual Surveillance and Maintenance Account is funded through the collection of the same fees described in connection with the Site Closure Account. Funds in the Perpetual Surveillance and Maintenance Account are to be used exclusively to meet post-closure and maintenance costs or to otherwise satisfy surveillance and maintenance obligations.

Section 43.200.200 of the Radioactive Waste Act requires the Washington Department of Ecology periodically to review the potential for injury and property damaging resulting from the transportation and disposal of radioactive waste under state issued licenses. Financial assurance requirements maintained by licensees must be sufficient to protect the State from all claims, suits, legal fees, damages, or expenses resulting from these licensed activities. Acceptable financial assurances are identified. The appropriate level of financial assurances must consider the potential cost of decontamination, treatment, disposal, decommissioning and cleanup of facilities and equipment; federal cleanup and decommissioning requirements; and legal defense costs, if any (RCW 70.98.098).

Washington regulations pertaining to the licensing of commercial LLRW disposal facilities are found in WAC 246. The regulatory requirements pertaining to financial qualifications, financial assurances provided for site closure and stabilization, and financial assurances provided for institutional control correlate closely with the requirements of 10 CFR 61. A minor difference between the State of Washington and NRC regulations requires that surety have a specific time period and be automatically renewable.

State of South Carolina

The Atlantic Interstate LLRW Compact Implementation Act established South Carolina as a member of Atlantic LLRW Compact. This Act in Section 48-46 of the South Carolina Code defines the Decommissioning Trust Fund and the Extended Care Maintenance Fund.

The Decommissioning Trust Fund was established under a trust agreement between Chem-Nuclear Services, Inc., and the South Carolina Budget and Control Board, with the South Carolina State Treasurer as the trustee. This fund was created to ensure that adequate funding would be available for closure and decommissioning of the disposal site. The Decommissioning Trust Fund receives fees from the disposal of radioactive waste at the rate of $4.20 per cubic foot of waste disposed of.

The Extended Care Maintenance Fund is an escrow fund for perpetual care of the site. This fund provides custodial care, surveillance, and maintenance during the institutional control and post-closure observations periods. These activities are specified by the South Carolina Department of Health and may also include activities associated with site closure. Facility disposal fees include surcharges that are deposited into the Extended Care Maintenance Fund. The Extended Care Maintenance Fund receives fees from the disposal of radioactive waste at the rate of $2.80 per cubic foot of waste disposed of.

Similar to its meaning in 10 CFR 61, the term “maintenance” at the South Carolina LLRW disposal facility means active maintenance activities including pumping and treatment of groundwater and the repair and replacement of disposal unit covers. Consistent with NRC

regulations contained in 10 CFR 61, South Carolina regulations define the term “active maintenance” similarly not including custodial activities such as repair of fencing, repair or replacement of monitoring equipment, re-vegetation, minor additions to soil cover, minor repair of disposal unit covers, and general disposal site upkeep such as mowing grass.

If the revenues generated by current disposal fees are less than the allowable site operator reimbursement for care and maintenance activities conducted, the operator is reimbursed from the Extended Care Maintenance Fund. This condition might prompt the facility to suspend operations until the volume of waste is sufficient to generate revenues for operations. If facility operations were suspended, monies from the Extended Care Maintenance Fund could be used to reimburse the site operator for qualifying expenses and allowable profits. During such suspensions, funds may also be used to support the activities of the South Carolina Budget and Control Board (the Board), the Public Service Commission, and the Compact Commission as necessary based on revised budgets. The Board must also ensure that the fund remains adequate to defray costs for future maintenance or other obligations.

Once all funds in the Decommissioning Trust Fund have been exhausted, the Extended Care Maintenance Fund will be used for custodial care, surveillance, monitoring, and maintenance for the post-closure and institutional control periods.

South Carolina regulations for radioactive waste land disposal facilities are part of the Radiological Health Regulation 61-63, Part 7. These regulations mirror the NRC regulations with one notable difference. The requirement for open-ended surety mechanism has been removed but mechanisms with a specific term require automatic renewal.

State of Texas

The Texas Health and Safety Code (THSC), Section 401.003(11) identifies the Perpetual Care Account, also referred to as the Radiation and Perpetual Care Account. Securities provided by LLRW disposal license holders are deposited in the Perpetual Care Account. Funds in the Perpetual Care Account may be used to cover the costs of decontamination, decommissioning, stabilization, reclamation, surveillance, control, storage, and disposal of radioactive material reasonably required to protect the public health and safety and the environment and the costs of perpetual maintenance, surveillance, and corrective measures to remedy spills or contamination by radioactive materials. Funds in the Perpetual Care Account derive from securities (financial assurances) provided by license holders and the excess of fees collected by the Texas Commission on Environmental Quality (TCEQ, see THSC 401.303(g)). The TCEQ is required to seek reimbursement of security from the Radiation and Perpetual Care Account its uses to pay for actions permitted for the use of account funds.

The Texas regulations for licensing requirements for LLRW disposal are contained in Title 30 of the Texas Administrative Code, Part 1, Chapter 336, Subchapter H. Specific rules pertaining to liability and funding are addressed in R336.736. These rules are very similar to the corresponding NRC regulations with some exceptions but impose additional financial burdens on the license applicant.

Texas regulations require that the financial assurances for closure and stabilization be in place 60 days before the receipt of waste at the facility. Texas regulations require financial assurance not only for closure and stabilization of the facility, as required by 10 CFR 61, but also to provide

liability coverage for sudden and non-sudden accidental occurrence involving bodily injury and property damage. Texas rules also require that cost estimates and financial assurances be reviewed and evaluated annually in meeting open to the public. No fees are presently authorized to fund the closure and stabilization of the disposal facility.

Institutional control funding is addressed under 30 TAC 336.737; this section differs significantly from the NRC regulations. Under this rule the Licensee is required to pay into a perpetual care account. The required value of this account is determined by the TCEQ Executive Director and must include the funding necessary to provide perpetual surveillance, monitoring, required maintenance, and fund administration costs. The total amount of this assurance must be in place 60 days prior to the receipt of waste. As with the closure financial assurances, the annual review must be conducted in an open meeting. No fees are presently authorized to fund the institutional control of the disposal facility or protect against any liabilities that might accrue to the State.

Financial assurances must also be provided to cover the costs of possible corrective actions. Such corrective actions could result from unplanned events that might pose a risk to public health, safety, and the environment that might occur after the decommissioning and closure of the disposal facilities. The amount of financial assurance must be no less than $20 million at the time the disposal facility is decommissioned. TCEQ must annually review that basis for determining the amount of financial assurances required for corrective action.

Authorized financial assurance mechanisms for closure, stabilization, and institutional control, are defined in 30 TAC 37, Subchapter T. These mechanisms include a fully funded trust, surety bonds, irrevocable standby letter of credit, external sinking fund, or insurance. A combination of these mechanisms may also be used.

State of New York

LLRW disposal in the State of New York is not being pursued. However, in the 1980's LLRW disposal was a possibility, for which commercial LLRW disposal facility licensing rules were promulgated. These regulations are contained in 6 NYCRR Subchapter C, "Radiation". The financial assurance requirements differ extensively from those required by 10 CFR 61. The requirements of New York's LLRW disposal requirements are summarized below only to provide insight on the directions other states have taken in requiring financial assurances.

Financial assurance for closure, post-closure, and institutional control for land disposal facilities are addressed in 6 NYCRR, Part 383. The State financial assurance requirements corresponding to those contained in 10 CFR 61 are included in subpart 6 NYCRR 383-6. Under 6 NYCRR 383-6.4 a LLRW fund consisting of 3 separate trust funds must be established by the Licensee. These three funds are identified as:

- ✓ Closure, Post Closure, and Institutional Control Trust;
- ✓ Remedial Action/Third-Party Compensations Trust (Operation, Closure, Post-Closure periods); and
- ✓ Remedial Action/Third-Party Compensation Trust (Institutional Control Period).

These trusts must be established 60 days before the receipt of waste. The fund trustees will determine the pay-in amounts for each fund using the required costs, the number of years remaining before closure (not to exceed 30 years) and the number of payments required per year. These trust values and calculations must be reviewed annually.

The Closure, Post Closure, and Institutional Control Trust, is for reimbursement of costs that are in agreement with the approved closure, post-closure or institutional control plan. 6 NYCRR 383-6.8 requires that cost estimates for closure are based on the decontamination and dismantlement of disposal facilities, closure of the facility so that only minor custodial care is necessary, implementation of the closure plan by a third party, and implementation of the plan when closure would be most expensive. The cost estimate must not include salvage of equipment or other disposal facility assets. Also included in the estimate for closure, post-closure and institutional controls are considerations of the size, type and location of the facility, along with volume and nature of waste, any completed closure activates and the duration of health risks.

The Remedial Action/Third-Party Compensations Trust (Operation, Closure, Post-Closure Periods) is for remediating failures, and compensating third parties for injury or property damage that occur during the operations, closure, or post closure periods and that are caused by operation of the disposal facility. The Remedial Action/Third-Party Compensation Trust (Institutional Control period) covers the same failures and liabilities but only those that occur during the institutional control period.

Under 6 NYCRR 383-6.9 the applicant is required to submit proposed levels of coverage for the costs of remediation for each time period, as well as third party compensation. These cost estimates must take into considerations the following;

- ✓ Analysis of facility location including natural characteristics, geology, hydrology.
- ✓ Site demographics
- ✓ Disposal technology used at the site
- ✓ The type and concentration of radionuclides
- ✓ Probability analysis
- ✓ Major natural phenomenon
- ✓ Inadvertent intrusion
- ✓ Location specific and technology specific considerations
- ✓ Performance assessments
- ✓ Risk assessments
- ✓ Dose assessment modeling
- ✓ Expected radiation exposures
- ✓ Potential (stochastic and non-stochastic) health effects

In addition to the established trust funds, alternative financial assurance mechanisms must be provided to address the difference between actual value of the trusts and the current cost

estimates. These alternative mechanisms may include alternate trusts, surety bonds, letter of credit, liability insurance, written guarantee or a combination of these mechanisms.

State of Illinois

No commercial LLRW disposal facility is being developed in the State of Illinois. However, in the 1980's LLRW disposal was a possibility, for which commercial LLRW disposal facility licensing rules were promulgated. These regulations are contained in Title 32 of the Illinois Administrative code (IAC), Part 601. The financial assurance portions of Illinois regulation for licensing requirements for land disposal of radioactive waste 32 IAC Part 601 are the same as those contained 10 CFR 61. The requirements of Illinois' LLRW disposal requirements are summarized below only to provide insight on the directions other states have taken in requiring financial assurances.

The Illinois Low-Level Radioactive Waste Management Act defines policy for developing and operating a commercial LLRW disposal facility within the State of Illinois. This act created the Low-Level Radioactive Waste Facility Closure, Post-Closure Care, and Compensation Fund. This fund provided for decommissioning, closing, monitoring, inspecting, caring for, taking remedial actions, purchasing facility and third party liability insurance during the institutional control period, mitigating the impacts of suspended or interrupted disposal operations, compensating persons suffering damages or losses caused by a release from the proposed commercial LLRW disposal facility, and fulfilling obligations under a [host] community agreement.

The Low-Level Radioactive Waste Facility Closure, Post-Closure Care, and Compensation Fund was to be funded with waste fees imposed on all waste received for disposal. The waste fee was projected to grow to $3.00 per cubic foot of waste disposed of by 1985. Additional fees were charged owners of nuclear power plants. Twenty percent of fees collected were to be transferred to the Low-Level Radioactive Waste Facility Closure, Post-Closure Care, and Compensation Fund and used for purposed identified above.

State of Nevada

Since the Beatty LLRW disposal facility was closed in the 1980's, only surveillance and maintenance activities are presently conducted at this site. No revenues, except interest income, accrue to the Fund for Care of Sites for Disposal of Radioactive Wastes.

The Nevada Revised Statutes (NRS) 459.231 creates special revenue fund in the State treasury a Fund for Care of Sites for Disposal of Radioactive Wastes. The fund is administered by the Director of Health and Human Services. The Director may use annual income for the purpose for which the fund was created, although no purpose is mentioned (except as inferred from the name of the fund) in NRS 459.231 which created the fund.

Nevada regulations for the disposal of radioactive waste are contained in NAC 459.800 through 459.826. Nevada regulatory requirements for financial assurances are generally comparable to those of 10 CFR 61. Provisions of NAC 459 are essentially the same as those of 10 CFR 61, but consist of different language owing to the fact that these regulations have not been revised since 1984.

Commonwealth of Pennsylvania

No commercial LLRW disposal facility is expected to be developed in Pennsylvania. The requirements of Pennsylvania's LLRW disposal requirements are summarized below only to provide insight on the directions other states have taken in requiring financial assurances.

Requirements governing the disposal of LLRW in the Commonwealth of Pennsylvania are contained in Title 25 of the Pennsylvania Code, Chapter 236, with financial assurance and liability requirements stated in Section 236.601 through 236.607. Pennsylvania's financial assurance requirements address:

- ✓ Onsite cleanup during operations
- ✓ Liability for bodily injury and property damage during operations
- ✓ Site closure and decommissioning
- ✓ Long-term care
- ✓ Liability for bodily injury and property damage following site closure

3.23 DO ANY STATES HAVE FINANCIAL ASSURANCE FOR COSTS THAT MIGHT DEVELOP OR EVOLVE AFTER FACILITY CLOSURE?

State of Texas

The State of Texas requires financial assurances for closure and institutional control of the facility. In addition, Texas rules require that financial assurances be provided to protect against the possibility that the commercial LLRW disposal facility might be found at some future time to have failed to perform as planned and required (30 TAC 336.738). As presently being implemented, the following costs are being considered in determining what financial assurances should be provided for these worst case corrective action costs:

- ✓ Determining the nature of the failure
- ✓ Designing a response to the failure
- ✓ Implementing the planned response including:
    - Excavating cover system over affects areas
    - Removing waste (contained in reinforced concrete canisters)
    - Transferring retrieved waste and contaminated materials to another commercial LLRW disposal facility for final disposal
    - Backfilling the hole from which waste was retrieved and cover system was excavated
    - Restoring surface conditions and reestablishing cover system

- Monitoring the newly closed and stabilized disposal facility to ensure acceptable performance

One company has estimated the cost of this worst-case corrective action scenario to total about $20 million for its proposed facility design.

Texas rules also provide that the Licensee of a commercial LLRW disposal facility must provide financial assurance for bodily injury and property damage to third parties caused by sudden and non-sudden accidental occurrences arising from operations of the disposal facility (30 TAC 336.736). One company proposing to develop a commercial LLRW disposal facility in the State of Texas has provided an insurance policy with coverage limits of $5 million per occurrence and $10 million in the aggregate to protect against claims of bodily injury and property damage.

State of Washington

As noted above, Washington rules require that the Licensee maintain financial assurances sufficient to protect the State from all claims, suits, legal fees, damages, or expenses resulting from these licensed activities.

3.24 WHAT LEGAL OR REGULATORY REVISIONS SHOULD BE MADE TO BETTER ASSURE AGAINST UNFUNDED COSTS?

The UWMRCB concludes that the existing financial assurances provided for closure and institutional control of the closed LLRW disposal facilities are adequate at current levels and with current, rules, controls and practices.

The UWMRCB recognizes the following:

- ✓ The Radioactive Waste Perpetual Care and Maintenance Account was established by the Legislature to finance the perpetual care and maintenance of commercial LLRW disposal facilities at the conclusion of the institutional care period and to protect against the possibility of funding shortfall during the institutional control period. Annual payments of $400,000 are required by state law to be paid into this fund.
- ✓ Based on information provided in this report, a minimum amount of $13 million has been established in order for the fund to meet the intended obligations for perpetual care and maintenance.
- ✓ Since 2008, Energy*Solutions* has set aside the balance of $13 million utilizing the surety required for financial assurance for closure and institutional care. As the annual payment of $400,000 is made to the perpetual care fund, an equivalent reduction is made to the overall obligation of the liability for closure, institutional care, and perpetual care.

Therefore, the UWMRCB recommends the following:

- ✓ The Legislature should not divert funds from the Radioactive Waste Perpetual Care and Maintenance Account to other applications.
- ✓ The Legislature should consider additional investment options for the State Treasurer in order to achieve a greater rate of return for the Radioactive Waste Perpetual Care and Maintenance Account.

- ✓ Additional funds not be required at this time to cover potential catastrophic failure of the landfill cells, ground water corrective action or major maintenance at commercial radioactive waste land disposal facilities. This determination is based on the engineering controls employed to build the landfill cells to current regulatory standards. All phases of landfill construction are reviewed, monitored, and approved by the Director. The design and construction of landfill cells provide reasonable assurance that wastes are contained. Other factors include the remote location of current facilities, the lack of a nearby population center, the location of the facilities in the Tooele County Hazardous Waste Industries Corridor, which prevents residential development in the area, the non-potable groundwater, the lack of precipitation, and the restricted access to the facilities.

4. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

The UWMRCB concludes that the amount of financial assurance required and provided for closure and post-closure care of commercial hazardous waste treatment, storage, or disposal facilities under Section 19-6-108 is judged to be adequate at current levels and with current rules, controls and practices.

The UWMRCB recommends the following changes to address the issue of perpetual care at closed commercial hazardous waste land disposal facilities:

- ✓ The UWMRCB recommends that the Legislature consider requiring perpetual care for ongoing monitoring and maintenance of commercial hazardous waste land disposal facilities after termination of the post-closure permit, provided that the funds for perpetual care do not impose additional costs to the facilities, and do not reduce the Division's budget appropriations.
- ✓ The UWMRCB recommends that no additional funds be required at this time to cover potential catastrophic failure of the landfill cells, ground water corrective action or major maintenance at commercial hazardous waste land disposal facilities. This determination is based on the engineering controls employed to build the landfill cells, the remote location of current facilities, the lack of a nearby population center, the location of the facilities in the Tooele County Hazardous Waste Industries Corridor which prevents residential development in the area, the non-potable groundwater, the lack of precipitation, and the restricted access to the facilities.

4.2 RADIOACTIVE WASTE DISPOSAL FACILITIES

The UWMRCB concludes that the financial assurances provided and currently approved for closure and institutional control of the closed LLRW disposal facilities are adequate at current levels and with current, rules, controls and practices.

The UWMRCB recognizes the following:

- ✓ The Radioactive Waste Perpetual Care and Maintenance Account was established by the Legislature to finance the perpetual care and maintenance of commercial LLRW disposal facilities at the conclusion of the institutional care period and to protect against the possibility of funding shortfall during the institutional control period. Annual payments of $400,000 are required by state law to be paid into this fund;
- ✓ Based on information provided in this report, a minimum amount of $13 million has been established in order for the fund to meet the intended obligations for perpetual care and maintenance; and
- ✓ Since 2008, Energy*Solutions* has set aside the balance of the targeted minimum amount of $13 million utilizing the surety required for financial assurance for closure and institutional care. As the annual payment of $400,000 is made to the perpetual care fund,

an equivalent reduction is made to the overall obligation of the liability for closure, institutional care, and perpetual care.

- ✓ Therefore, the UWMRCB recommends the following:
  - ✓ The Legislature should consider additional investment options for the State Treasurer in order to achieve a greater rate of return for the Radioactive Waste Perpetual Care and Maintenance Account.
  - ✓ Additional funds not be required at this time to cover potential catastrophic failure of the landfill cells, ground water corrective action or major maintenance at commercial radioactive waste land disposal facilities. This determination is based on the engineering controls employed to build the landfill cells to current regulatory standards. All phases of landfill construction are reviewed, monitored, and approved by the Director. The design and construction of landfill cells provide reasonable assurance that wastes are contained. Other factors include the remote location of current facilities, the lack of a nearby population center, the location of the facilities in the Tooele County Hazardous Waste Industries Corridor, which prevents residential development in the area, the non-potable groundwater, the lack of precipitation, and the restricted access to the facilities.
  - ✓ The Legislature should not divert funds from the Radioactive Waste Perpetual Care and Maintenance Account to other applications.

Based on a review of selected information that available after September 2011 related to licensed/unlicensed LLRW facilities in Utah, the following recommendations are also provided:

- ✓ It is recommended that the Director: (1) continue to work with the NRC and other stakeholders as appropriate to resolve any potential incompatibility issues between the State's proposed amendments to financial surety requirements for LLRW licensees in Utah and NRC's financial surety requirements; and (2) Further evaluate the economic impacts of the proposed final changes in financial surety requirements on financial assurance estimates for closure and post-closure of affected licensed LLRW facilities in Utah.

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NRC 2016	U.S. Nuclear Regulatory Commission, Letter dated March 9, 2016 to Scott Anderson, Utah Division of Waste Management and Radiation Control, RE Comments on S.B. 231.

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APPENDIX A:
UCA 19-1-307: EVALUATION OF CLOSURE, POST-CLOSURE, AND PERPETUAL CARE AND MAINTENANCE FOR HAZARDOUS WASTE AND RADIOACTIVE WASTE TREATMENT AND DISPOSAL FACILITIES – REPORT

APPENDIX A:
UCA 19-1-307: EVALUATION OF CLOSURE, POST-CLOSURE, AND PERPETUAL CARE AND MAINTENANCE FOR HAZARDOUS WASTE AND RADIOACTIVE WASTE TREATMENT AND DISPOSAL FACILITIES – REPORT

19-1-307. Evaluation of closure, postclosure, and perpetual care and maintenance for hazardous waste and radioactive waste treatment and disposal facilities -- Report.

(1)(a) Beginning in 2006, the Waste Management and Radiation Control Board created in Section 19-1-106 shall direct an evaluation every five years of:

(i) the adequacy of the amount of financial assurance required for closure and postclosure care under 40 C.F.R. subpart H, Sections 264.140 through 264.151 submitted pursuant to a hazardous waste operation plan for a commercial hazardous waste treatment, storage, or disposal facility under Section 19-6-108; and

(ii) the adequacy of the amount of financial assurance or funds required for perpetual care and maintenance following the closure and postclosure period of a commercial hazardous waste treatment, storage, or disposal facility, if found necessary following the evaluation under Subsection(1)(c).

(b) The evaluation shall determine:

(i) whether the amount of financial assurance required is adequate for closure and postclosure care of hazardous waste treatment, storage, or disposal facilities;

(ii) whether the amount of financial assurance or funds required is adequate for perpetual care and maintenance following the closure and postclosure period of a commercial hazardous waste treatment, storage, or disposal facility, if found necessary following the evaluation under Subsection(1)(c); and

(iii) the costs above the minimal maintenance and monitoring for reasonable risks that may occur during closure, postclosure, and perpetual care and maintenance of commercial hazardous waste treatment, storage, or disposal facilities including:

(A) groundwater corrective action;
(B) differential settlement failure; or
(C) major maintenance of a cell or cells.

(c) The Waste Management and Radiation Control Board shall evaluate in 2006 whether financial assurance or funds are necessary for perpetual care and maintenance following the

closure and postclosure period of a commercial hazardous waste treatment, storage, or disposal facility to protect human health and the environment.

(2)(a) Beginning in 2006, the Waste Management and Radiation Control Board created in Section 19-1-106 shall direct an evaluation every five years of:

(i) the adequacy of the Radioactive Waste Perpetual Care and Maintenance Account created by Section 19-3-106.2; and

(ii) the adequacy of the amount of financial assurance required for closure and postclosure care of commercial radioactive waste treatment or disposal facilities under Subsection 19-3-104(11).

(b) The evaluation shall determine:

(i) whether the restricted account is adequate to provide for perpetual care and maintenance of commercial radioactive waste treatment or disposal facilities;

(ii) whether the amount of financial assurance required is adequate to provide for closure and postclosure care of commercial radioactive waste treatment or disposal facilities;

(iii) the costs under Subsection 19-3-106.2(5)(b) of using the Radioactive Waste Perpetual Care and Maintenance Account during the period before the end of 100 years following final closure of the facility for maintenance, monitoring, or corrective action in the event that the owner or operator is unwilling or unable to carry out the duties of postclosure maintenance, monitoring, or corrective action; and

(iv) the costs above the minimal maintenance and monitoring for reasonable risks that may occur during closure, postclosure, and perpetual care and maintenance of commercial radioactive waste treatment or disposal facilities including:

(A) groundwater corrective action;
(B) differential settlement failure; or
(C) major maintenance of a cell or cells.

(3) The boards under Subsections(1) and(2) shall submit a report on the evaluations to the Legislative Management Committee on or before October 1 of the year in which the report is due.

Enacted by Chapter 10, 2005 General Session

Amended by Chapter 278, 2010 General Session, and Chapter 441, 2015 General Session
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APPENDIX B:
DESCRIPTIONS OF SELECTED HAZARDOUS WASTE LANDFILLS PERMITTED AND OPERATING IN OTHER STATES

Prepared by URS Professional Solutions, LLC
(an AECOM Affiliate)

This appendix summarizes information pertaining to 11 commercial hazardous waste management facilities, including hazardous waste landfills that are operated in the United States. Ten such facilities examined are located in states other than Utah. The review compares the site-specific conditions and requirements to the conditions and requirements of the Grassy Mountain facility in Utah.

The following commercial hazardous waste landfills are reviewed and characterized in this appendix:

- ✓ Clean Harbors Grassy Mountain Facility at Tooele, Utah
- ✓ Chemical Waste Management at Kettleman City, California
- ✓ Clean Harbors Buttonwillow, LLC at Buttonwillow, California
- ✓ Clean Harbors Westmorland at Westmorland, California
- ✓ Envirosafe Services of Ohio at Oregon, Ohio
- ✓ Clean Harbors Lone Mountain at Waynoka, Oklahoma
- ✓ U.S. Ecology, at Beatty, Nevada
- ✓ Waste Control Specialists LLC at Andrews, Texas
- ✓ U.S Ecology Texas Facility at Robstown, Texas
- ✓ Clean Harbors Deer Park at Deer Park, Texas
- ✓ Pinewood Facility at Pinewood, South Carolina.

Information reviewed and compiled for the 11 hazardous waste management facilities is presented in the following sections and includes:

- Facility name and location
- U.S. Environmental Protection Agency (EPA) ID Number
- Land area (footprint size)
- Year operations began and projected remaining life
- Post-closure period duration
- Estimates closure and post-closure costs
- Type of closure/post-closure financial surety mechanism
- Corrective action program in place (yes or no?)
- Average annual precipitation
- Number of monitoring wells; and
- Approximate depth to groundwater

Table B-1 at the end of this Appendix provides a summary of the above information for the 11 hazardous waste management facilities that were examined.

4.3 CLEAN HARBORS GRASSY MOUNTAIN FACILITY AT TOOELE, UTAH

Clean Harbors operates the facility at Grassy Mountain near Tooele, Utah. Located in the Great Salt Lake Desert 80 miles west of Salt Lake City, facility operations began in 1982. Clean Harbors acquired this facility from Safety-Kleen Service Inc. in September 2002. The fenced portion of the facility occupies approximately 640 acres, surrounded by a half-mile buffer area. Geologically the facility is located on the remnants of ancient Lake Bonneville, consisting of a thick layer of silty clay (Utah Department of Environmental Quality [UDEQ] 2016). No potable water exists in aquifers under the site and no rivers, streams, or lakes lie within 20 miles of the facility. Annual precipitation averages 7.8 inches, with an evaporation rate of 40 inches a year.

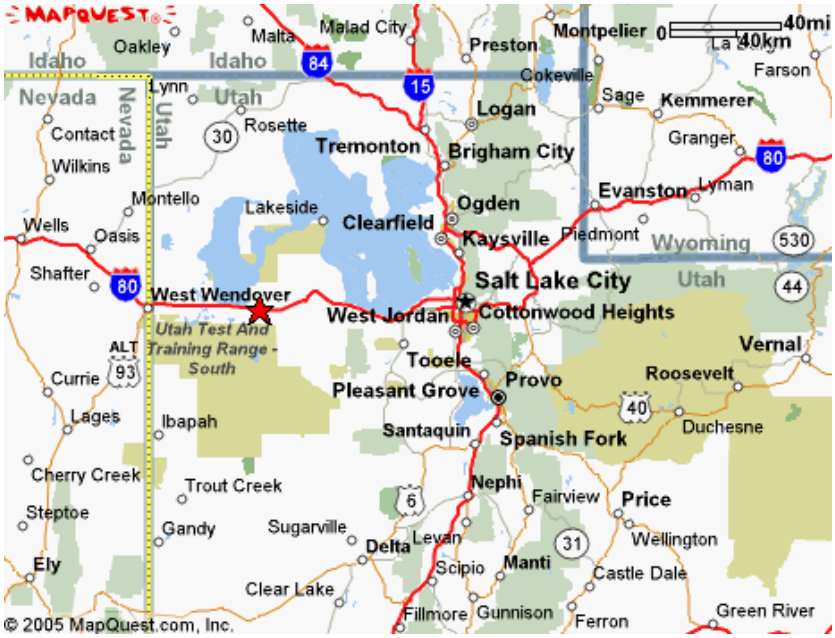

Figure B-1. Location of Grassy Mountain, UT Facility

Facility operations include drum storage, polychlorinated biphenyl (PCB) storage, solidification, stabilization, repackaging, waste water treatment, surface impoundments, Toxic Substances Control Act of 1976 (TSCA), and Resource Conservation and Recovery Act of 1976 (RCRA) landfills. Wastes accepted at the facility include PCBs, non-hazardous waste, asbestos, hazardous wastes for treatment of metals, acidic waste, caustic waste, and hazardous debris (Clean Harbors [Undated]). A total of eight landfill cells regulated under the RCRA permit exist at the site. Of these cells, five have been closed. The three active cells have a remaining capacity of 761,000 cubic yards, with a possible additional 1,366,000 cubic yards of space that is not currently permitted. The facility is expected to operate for an additional 20 years (Clean Harbors [Undated]; USSEC 2004).

Figure B-2. Grassy Mountain, UT Disposal Cell Configuration

There are a total of 55 monitoring wells on the facility, of which 37 are used to monitor the RCRA portion of the facility. There is a shallow, non-potable aquifer at a depth of approximately 12 feet.

The latest Certificate of Insurance for Clean Harbors Grassy Mountain, approved effective July 2015, provides a total closure cost estimate of $36,923,981 with a breakdown of $21,308,525 for closure and $15,615,456 for post-closure care (UDWMRC 2016). The facility will undergo partial closure with operations undergoing closure as necessary. Five landfill cells have undergone closure at this time. Hazardous Waste Cells 1 and 2 were closed in August 1991. Hazardous Waste Cell 3 was closed in March 1996. Cells 4 and 5 are currently being closed. Although Industrial Waste Cells 1 and 2 were closed in January 1998, a small amount of hazardous waste was placed in these cells and they are now regulated under the RCRA permit.

The post-closure period is a minimum of 30 years. Required post-closure activities include maintaining the final cover, the groundwater monitoring system, and the survey benchmarks. Operational tasks include groundwater sampling, leachate collection, control of run-on and run-off water to prevent erosion, and routine inspections. Administrative tasks include required annual reporting.

4.4 CHEMICAL WASTE MANAGEMENT AT KETTLEMAN CITY, CALIFORNIA

The Chemical Waste Management (CWM) Kettleman Hills Facility is located in western California. The facility, which began operations in 1979, is located 3.5 miles from Kettleman City. The hazardous waste permitted area occupies 555 acres, with another 1,045-acre buffer owned by CWM. Precipitation in the area averages 8 inches a year.

Figure B-3. Location of Kettleman City, CA Facility

Waste operations include chemical oxidation, chemical precipitation, fuel blending, neutralization, cyanide destruction, and PCB services. The facility is permitted to accept acids/corrosives, metals, cyanides, solvents, PCB, and halogenated organics. Facility operations include a drum storage, drum decant, PCB flushing /storage, bulk storage, final stabilization, surface impoundments, above-ground evaporation tanks, and landfill disposal (California Department of Toxic Substances and Control [DTSC] 2003).

Landfill operations currently include one active hazardous waste cell, one inactive hazardous waste cell, and one cell that was converted to accept municipal waste. There are 18 landfill cells that have undergone closure; the first two closed in 1988 and the remaining 16 cells were closed between 1996 and 1997. The active Cell B-18 is permitted for a capacity of 10,700,000 cubic yards of which 7,300,000 are still unused. Cell B-18 and Cell B-19, which are currently used for municipal waste, were designed with a double liner, leachate detection, collection, and recovery system. The older landfill cells on the facility were constructed prior to the current requirements of RCRA. These units have been closed with covers equivalent to current RCRA standards. The facility has submitted an alternative cover system as the standard for landfills at this facility because of the drying and cracking of cover soils resulting from the arid climate. The alternative cover has the following components: 2.5 feet of vegetative soil cover, geotextile drainage layer, 40-mil thick, textured, high-density polyethylene geomembrane, 1 foot of compacted foundation layer, and a 1-foot intermediate soil cover over the last lift of waste (DTSC 2003). All closed units will be maintained as partial closures until the final facility closure, in accordance with the Post-Closure Plan submitted by CWM, which has been approved, after which time the post closure period of 30 years will begin (DTSC 2003). The site is currently undergoing corrective action for groundwater contamination. Two extraction/treatment systems operate on site to contain the groundwater contamination. The groundwater at the site is poor quality and has been designated as non-potable, with a flow rate of approximately 10 ft/year (U.S. EPA 2000a). The site is required to comply with a mitigation plan to limit disturbances of two identified endangered species in the area.

The DTSC finalized a permit modification for the Chemical Waste Management, Inc., Kettleman Hills hazardous waste facility in May 2014. This modification increased the hazardous waste landfill's capacity by about five million cubic yards (DTSC 2014). A Phase IIIA expansion, 3.5

acres in area, was constructed in Landfill B-18 in early 2015. A second expansion (Phase IIIB) has an area of approximately 10.5 acres, construction of which also was just recently completed (DTSC 2015; Gathungu 2016). CWM submitted financial surety documentation to the DTSC in February 2015 proposing the following closure and post-closure care surety amounts:

- Closure Cost Estimate - $23,186,481 (2015 dollars)
- Post-Closure Cost Estimate - $32,646,905 (2015 dollars)

Both sureties provided are in the form of a Certificate of Insurance. These proposed closure and post-closure surety cost estimates are currently under review by the DTSC (Feroug 2016).

4.5 CLEAN HARBORS BUTTONWILLOW, LLC AT BUTTONWILLOW, CALIFORNIA

The Clean Harbors Buttonwillow, LLC facility is located in Buttonwillow, California (Facility No. CAD980675276). Clean Harbors acquired this facility in 2002 from Safety-Kleen Services, Inc. Operations at the facility began in 1982. The site occupies 320 acres and has an annual average precipitation of 6.5 inches per year.

Figure B-4. Aerial Photo Kettleman City, CA Facility

Figure B-5. Location of Buttonwillow, CA Facility

Waste operations consist of a stabilization treatment unit, a drum handling and storage area, one active non-hazardous waste surface impoundment (WMU 31), and two operating hazardous waste (Class 1) landfills (WMU 34 and WMU 35). . Two former hazardous waste landfills (WMU 28 and WMU 33) were certified closed with an evapotranspiration cap in 2001. Sludge in nonhazardous surface impoundments 22, 23, and 27 was undergoing solidification in 2014 for final closure as Class II landfills (CIWMB 2014).

The facility accepts a variety of RCRA waste codes, as well as California hazardous wastes, hazardous and non-hazardous soils, hazardous and non-hazardous liquid, Naturally Occurring Radioactive Material (NORM), and Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) wastes containing radionuclides in the decay series of U-238, U-235 and Th-232), and debris for macroencapsulation but does not accept infectious materials, forbidden explosives, compressed gasses, or municipal garbage (Clean Harbors Environmental Services, Undated-a)). The active operational area at the facility is approximately 270 acres; co-disposal of nonhazardous, nonputrescible, industrial solid waste wastes occurs or will occur within approximately 97 acres of the permitted hazardous waste disposal footprint (Clean Harbors, LLC 2014; CIWMB 2014). Total site capacity is approximately 13, 250,000 cubic yards and the total permitted landfill capacity is in excess of 10,000,000 cubic yards. The facility's currently constructed landfill capacity is approximately 9,500,000 cubic yards and has an estimated closure date of 2040 (Clean Harbors Buttonwillow, LLC 2014; CIWMB 2014). Between 1998 and 1999 Formerly Utilized Sites Remedial Action Program (FUSRAP) construction and demolition debris was accepted and disposed of at the Buttonwillow facility. This debris from New York exhibited low-activity residual radioactivity. The State of California submitted a letter to the facility in 1999 stating the previous owner had unlawfully accepted the waste. During the previous owners' bankruptcy preceding the State also filed proof of a claim possibly seeking removal of the waste. There has been no further action on this from the State of California (USSEC 2004).

The California Department of Toxic Substances and Control (DTSC) approved a Closure and Post-Closure Maintenance Plan submitted by Clean Harbors Buttonwillow LLC, which covers the permitted landfills and is included in the DTSC Hazardous Waste Facility Permit. There is no

evidence that any releases have occurred at the facility. Financial assurance for closure and post-closure care is funded via a Certificate of Insurance for the Buttonwillow Facility. As of the December 2015 financial surety update, the DTSC's approved 2015 financial assurance amounts are $8,303,931 for Closure and $13,415,839 for Post-Closure care (Ward 2016).

4.6 CLEAN HARBORS WESTMORLAND AT WESTMORLAND, CALIFORNIA

The Clean Harbors Westmorland facility, located in Imperial County, California, was acquired in 2002 from Safety-Kleen Services, Inc.. Occupying 640 acres, the facility began operations in 1980. Located in the Imperial Valley near the Superstition Mountains and the Salton Sea National Wildlife Refuge, the site is approximately 50 miles from the U.S.-Mexico border. Precipitation in the area averages less than 3 inches per year.

Figure B-6. Location of Westmorland, CA Facility

Waste operations consist of a drum storage facility, bulk storage, treatment facility for stabilization, solidification and microencapsulating, physical and chemical treatment, and a hazardous waste landfill. The facility accepts a variety of waste codes from the U.S. and Mexico, but does not accept infectious materials, forbidden explosives, compressed gasses, municipal garbage, or radioactive materials. However, it is permitted to accept naturally occurring radioactive material (NORM) waste from geothermal operations (Clean Harbors Environmental Services, Undated -b). One open landfill cell exists at the site. This cell has a remaining capacity of 2,732,000 cubic yards, with a remaining life of 68 years. Two cells exist that are closed and administered under a post-closure permit.

The groundwater monitoring system on site has been in operation for 10 to 12 years. There are 58 operational groundwater monitoring wells that are not contaminated with hazardous constituents. There are elevated levels barium, boron and iron. There are no maximum contaminant levels (MCLs) for boron or iron, and barium levels were below MCLs (U.S. EPA 2000b; Center for Land Use Interpretation, Undated).

The California Department of Toxic Substances and Control (DTSC) is currently reviewing a Part B Permit Renewal application for this facility. There is no evidence that any releases have occurred at the facility (Ward 2016). Preliminarily-approved financial assurance cost estimates for completing closure and 30 years of post-closure care activities at the facility are $12,493,163 (2015 dollars) (Closure) and $24,041,533 (Post-Closure). The new Draft Permit is expected to be issued for public review in mid-2016. The financial assurance for closure and post-closure care activities will be funded via a Certificate of Insurance (Ward 2016).

4.7 ENVIROSAFE SERVICES OF OHIO AT OREGON, OHIO

Envirosafe Services of Ohio, Inc. operates a facility in Oregon, OH. The facility began operations in 1954 as a family owned and operated municipal and industrial solid waste landfill. In 1983 the facility was sold to Envirosafe, who stopped accepting municipal waste. In 1988 the facility received a Federal RCRA permit, with a State permit issued in 1991. The land area of the facility is 133 acres, which is divided into northern and southern sections by a public road. The geology of the site is characterized by sediments deposited by glacier and non-glacier activity. These sediments include thick layers of dense clays with low permeability. The facility is two miles south of Lake Erie (www.envirosafeservices.com). The annual average precipitation is approximately 33.8 inches.

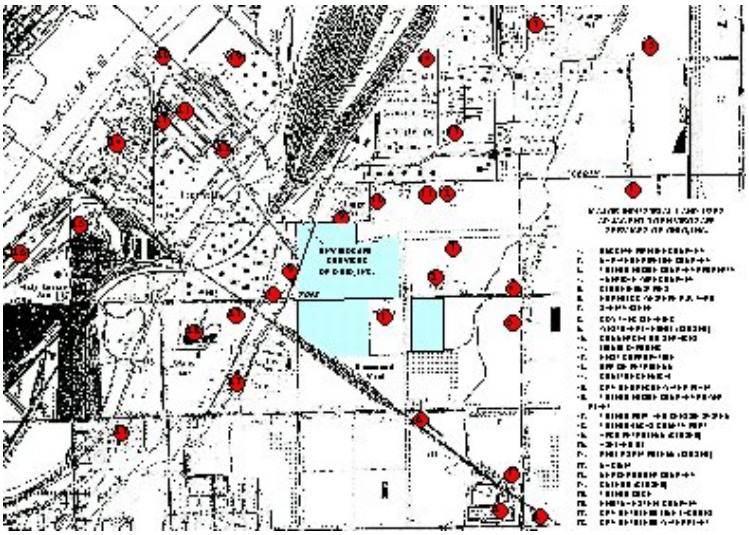

Figure B-7. Location of Envirosafe of Ohio Facility

Facility operations include waste treatment, container storage, waste transportation, and long-term waste disposal in landfills. The facility specializes in managing electric arc furnace dust. The northern portion of the site contains the four closed landfills as well as the closed sanitary landfills. The southern part of the site contains the active hazardous waste landfill identified as Cell M. Cell M's disposal capacity is approximately 2.3 million cubic yards (Envirosafe Services of Ohio, Inc. 2015).

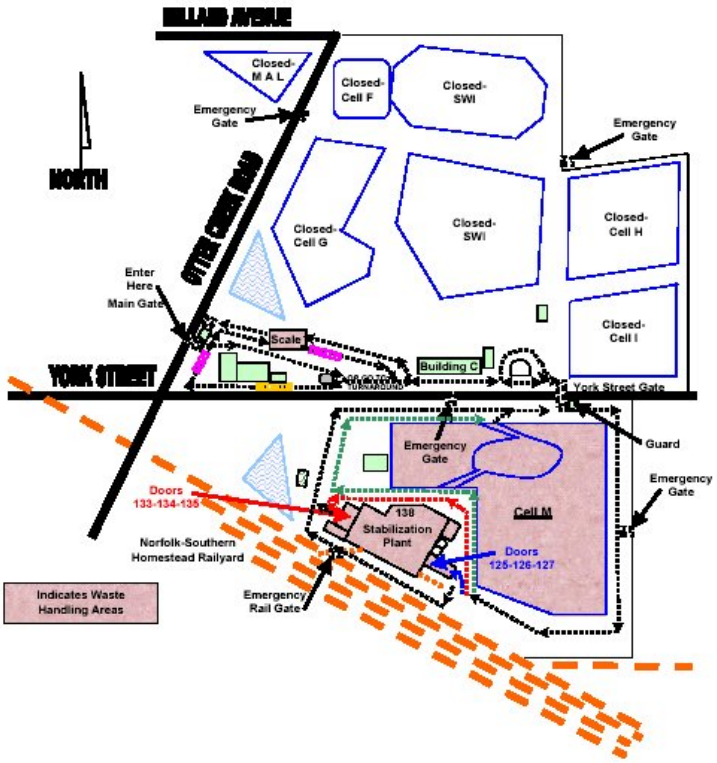

Figure B-8. Envirosafe of Ohio Disposal Cell Configuration

A total of 119 monitoring wells exist at the facility (www.envirosafeservices.com). These wells monitor three hydraulic zones on the facility, including the bedrock aquifer, the only unit below the site capable of producing a useable amount of water. Of the wells on site, 22 are located in the bedrock aquifer. The flow rates for all the areas under the site are very low, with the upper layers ranging from $2.0x10^{-7}$ to 3.8x10-8 and $1.0x10^{-9}$ in the bedrock aquifer (www.envirosafeservices.com). Leachate has migrated to the shallow groundwater on the site. This facility is currently undergoing a Corrective Action Investigation of all solid waste management units to assess the contamination at the facility from the pre-RCRA disposal activities. Contamination has been found outside the landfill cells, and contamination has been detected in groundwater in two of the hydraulic zones. The contamination found on the site as part of the corrective action investigations appear to be a result of past site disposal activities.

To comply with the financial assurance requirements of RCRA, Envirosafe has established a trust fund for the closure and post-closure costs for the facility. In addition to the closure and post-closure funding, the 1991 permit issued by the State of Ohio required Envirosafe to establish a perpetual care fund. This fund was designed to ensure funding for corrective measures for as long as waste remains on site. The Earth Sciences Information Office **(**ESIO) trust fund, which combines all these, was fully funded in 1995. The estimated value of this trust fund was $56 million in 2006 (www.envirosafeservices.com). According to the Envirosafe Services of Ohio's website, the current value of the combined closure, post-closure and perpetual care fund is $54 Million (Envirosafe Services of Ohio, Inc. 2015).

4.8 CLEAN HARBORS LONE MOUNTAIN AT WAYNOKA, OKLAHOMA

Clean Harbors Environmental Services, LLC operates a hazardous waste treatment, storage, and disposal facility located in Woods County Waynoka, Oklahoma. This facility was acquired from Safety-Kleen Services in 2002. Operations began in 1978, with a total site area of 560 acres. Average rainfall is 27.1 inches per year. The facility site was chosen for its isolated location, impermeable soils, and lack of potable groundwater.

Figure B-9. Location of Lone Mountain, OK Facility

The Oklahoma Department of Environmental Quality (ODEQ) renewed the RCRA/HSWA Operations Permit in April 2011 for a term of 10 years. The facility includes a drum storage facility, hazardous waste tank storage, waste water treatment, and a landfill. The facility accepts Mega Rule PCB, hazardous and non-hazardous soil, debris, plating, acidic, caustic, cyanide, and sulfide waste. The facility also operates a waste water treatment facility for processing leachate as well as customer wastewater (Clean Harbors Environmental Services, Undated-c). The facility exceeds the minimum technological requirements for landfill construction by using one clay liner, three synthetic liners, and constructing all disposal cells above the natural ground surface (ODEQ 2004).

The ODEQ has issued an operating permit for existing operations at the facility and a Post-Closure Permit governing the performance of post-closure monitoring and maintenance of disposal cells that have been closed. There is ongoing groundwater remediation at one disposal cell (Cell 5) in response to a confirmed release from that cell and they are monitoring conditions in a groundwater monitoring well adjacent to another disposal cell that sporadically exhibits apparent evidence of a possible release of volatile organic compounds; however, confirmed evidence of a release from that other cell has not been determined (ODEQ 2016a).

On July 29, 2014, Clean Harbors Lone Mountain Facility submitted to the ODEQ's Land Protection Division a RCRA/HSWA Class 3, Tier II Operations Permit Modification Application to allow for expansion of operations, specifically to add landfill capacity in Cell 15. This

modification request was subsequently approved. The permitted total disposal capacity in this cell after the approved increase was 8,065,000 cubic yards (ODEQ 2014).

The Oklahoma DEQ is currently reviewing the following proposed financial assurance amounts for the facility which were submitted to them in December 2015 (ODEQ 2016a):

- Closure Cost Estimate for Ongoing Operations - $18,033,529 (2015 dollars)
- Post-Closure Cost Estimate for Closed Landfill Cells- $14,411,251 (2015 dollars)
- Corrective Action Cost Estimate (Cell 5) - $2,070,930 (2015 dollars)

The Corrective Action surety fund was established by the ODEQ following preparation of a Corrective Measures Study by the permittee and development of a cost estimate for implementing the preferred remedy.

A surety bond serves as the financial assurance mechanism. The surety bond covers three different permitted Clean Harbors facilities in Oklahoma. A zero-balance Standby Trust Agreement is also maintained so that if the permittee were to default on the surety bond, available financial assurance funds could be directed by the State to that trust account to fund required closure, post-closure, and corrective action activities (ODEQ 2016b).

Figure B-10. Clean Harbors Lone Mountain, OK Facility

4.9 U.S. ECOLOGY AT BEATTY, NEVADA

The U.S. Ecology Beatty facility is located in Nye County, Nevada. This facility occupies 80 acres of land leased from the State of Nevada. Disposal operations began in 1970, with a portion of the site used for disposal of low-level radioactive waste (LLRW). The closed LLRW disposal area is separate from the RCRA disposal area. The facility is located approximately 12 miles from Beatty. The Amargosa River is located approximately one mile from the facility, but is mostly dry. The Lake Ash Meadows Wildlife Refuge, Crystal Lake is located approximately 30 miles from the facility. The general hydrogeologic characteristics of the area include alluvial gravel and clay interbedded with silty clay playa deposits (American Ecology Corporation 2004). Average annual precipitation is approximately 4 inches.

Figure B-11. Location of Beatty, NV Facility

Waste operations at the U.S. Ecology Beatty Facility include hazardous waste storage, treatment (solidification, oxidation, neutralization and stabilization) and disposal; as well as, TSCA (PCB) waste storage, consolidation and disposal. Accepted wastes include RCRA and state-regulated hazardous wastes, non-regulated industrial waste and TSCA-regulated wastes. The facility is authorized to accept hazardous waste from outside the United States with prior notification to both US EPA and the Nevada Division of Environmental Management (NDEP).

Permitted waste management units include a PCB draining/flushing and storage area, a truck wash pad, a waste consolidation area, outdoor and indoor waste treatment tanks, container storage areas, one closed hazardous waste landfill (Trench 11) and one active hazardous waste landfill (Trench 12), with one recently proposed new hazardous waste landfill (Trench 13) under consideration. All of the RCRA-permitted hazardous waste disposal trenches incorporate a double composite liner design with leachate removal and leak detection systems. Trench 11 had a permitted capacity of 2.36 million cubic yards and it was closed and final cover placed in 2013. The leachate collection and removal system for Trench 11 is active and still being monitored. The active Trench 12 has a footprint of 11 acres and a total landfill capacity of 1.66 million cubic yards. Several older chemical waste landfills, formerly referred to as cells, were active prior to the establishment of RCRA regulations; and as such, did not include synthetically-lined construction. These pre-RCRA disposal units have all been closed and capped.

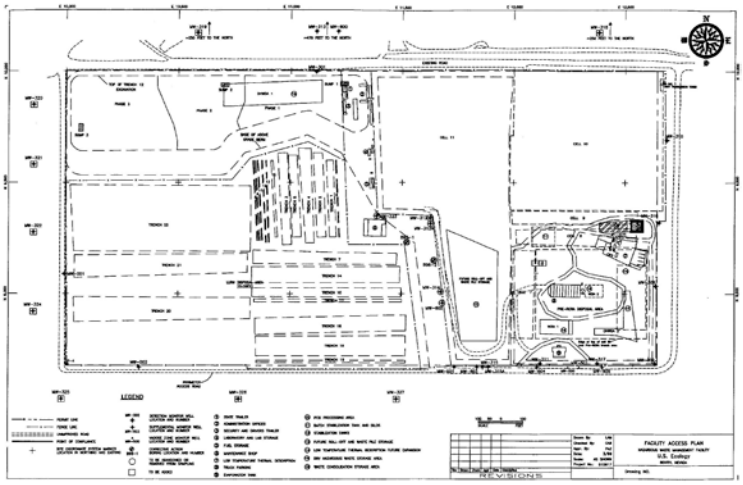

Figure B-12. Beatty, NV Disposal Cell Configurations

Figure B-13. Disposal in Cell 11, Beatty, NV

There are a total of 23 monitoring wells, 12 of which are in the upper aquifer (~280 ft), with the remainder in the lower aquifer (~380 ft to 480 ft). The groundwater monitoring wells indicate contamination in the immediate vicinity of the site from pre-RCRA activities. This is being addressed with the installation of soil vapor extraction wells to remove the gasses that are the source of the contamination. Groundwater indications have been sporadic and inconsistent and there is no evidence of an organized plume or patterned movement offsite (U.S. EPA 1999).

Closure and Post-Closure Plans are maintained in accordance with US Ecology Nevada‘s (USEN’s) RCRA and TSCA permits. Closure activities include removal, decontamination and disposal of tanks and equipment, removal and disposal of container management areas, appropriate capping of the landfills, and monitoring and maintenance throughout the post-closure period.

A Closure Plan prepared by USEN complies with the requirements of 40 CFR §§264.111, 264.112 (a) - (c) and 40 CFR §270.14 (b)(13), as adopted by the NDEP. Final closure is expected to take place as part of normal operation after all the disposal trenches are full. The post-closure care period for the USEN facility will begin upon closure of the final land disposal unit, will continue for 30 years after completion of closure, and will include maintenance, as needed, groundwater monitoring, and leachate management.

Financial assurance for the US Ecology hazardous waste management facility is established by the RCRA and ISCA permits. The state-issued RCRA Permit requires US Ecology to maintain one or more funding mechanisms for closure, post-closure and corrective action measures. The current funding mechanism includes a State account which covers the closure and post-closure cost estimates. Pursuant to permit requirements, the closure cost estimates are updated annually for inflation factors and changes made to the facility. The 2015 estimate for closure and post-closure is $9,039,242.62 ($3,903,150.69 – Closure; $5,136,091.93 – Post-Closure) (Leigh 2016). U.S .Ecology pays various fees based upon the tonnage and type of waste received at the facility each quarter. Currently, the Closure/Post-Closure Fund is fully funded in amount of the approved closure cost estimate.

RCRA Permit HW0025 also establishes liability requirements for sudden and non-sudden accidental occurrences at the Beatty facility consistent with the federal regulations (40 CFR 264.147.b). The current Certificate of Liability Insurance provides coverage for multiple US Ecology sites in the amount of $20,000,000 (Leigh 2016).

4.10 WASTE CONTROL SPECIALISTS LLC AT ANDREWS, TEXAS

Waste Control Specialists, LLC (WCS) in Andrews County, Texas operates several facilities which include an Industrial Solid Waste and Hazardous Waste Storage, Processing and Land disposal facility in West Texas. The facility is permitted under Texas RCRA Permit # HW-50358, and TSCA EPA ID No. TXD988088464 granted by EPA for treatment, storage and land disposal of TSCA wastes, including PCBs and asbestos. Initially permitted in 1994, the facility began operations in 1997, and the permit was renewed in 2005, with a current permit modification date of 7/22/2015. Other facilities (LLRW) currently licensed and operated on the site by WCS are detailed in Appendix C. The facility sits near the border of Texas and New Mexico and the closest population center is Eunice, New Mexico, 6 miles away. There are no rivers or streams within 5 miles. Annual average precipitation for the area is 15 inches.

Figure B-14. Location of Waste Control Specialists, TX Facility

The facility is authorized to accept hazardous and non-hazardous solid industrial wastes. The facility is permitted to receive and treat the following waste streams, including acids, bases, and metals, organic waste, water reactive inorganic materials, PCBs, and exempt radioactive waste, including NORM and depleted uranium. The site covers approximately 41.3 acres, and the current permit allows for disposal of 5,423,000 cubic yards of Land Disposal Restriction (LDR) - compliant hazardous waste. The East and West Landfill current have a disposal capacity of 2,310,000 cubic yards and include Cells A through K, with final cover installed on Cells A-D. The processing and storage facility includes a negative pressure process building, a stabilization building, covered container storage area, and a bin storage area. They are authorized to store up to 1.5 million ft^3 of waste.

All landfill cells have double liner and leachate collection systems, and were built after land disposal restrictions were adopted so that no liquids or unstable wastes were placed in the landfill. The depth to the water table is 230 feet and there are 88 groundwater monitoring wells that are sampled twice a year. No potable water exists under the site.

The permittee provides financial for closure of all existing permitted units in an amount not less than $14,815,041 (2012 dollars). The permittee provides financial assurance for unconstructed proposed units in an amount of $1,185,280 (2012 dollars). Additionally, the cost estimate for performing 30 years of post- closure activities for the landfills is $1,696,500 (2013 dollars) WCS, Undated).

The permittee provides financial assurance for closure of all existing permitted units in an amount not less than $14,815,041 (2012 dollars). The permittee provides financial assurance for unconstructed proposed units in an amount of $1,185,280 (2012 dollars). Additionally, the post closure cost estimate for the landfills is $1,696,500 (2013 dollars) (WCS, Undated). Post-closure requirements for the 30-year post-closure period include maintenance of storm water conveyances, cover, benchmarks, site perimeter fence, and integrity of groundwater monitoring wells; establishing a self-sustaining, vegetative cover, inspecting the leachate collection system; preparing an annual report, as well as another report.

TCEQ uses an annual percentage change (annual inflation factor) system to increase required financial assurances. The inflation factor used to inflate 2012 dollars to 2013 dollars is 1.5% and 2013 to 2014 dollars is also is 1.5% (TCEQ 2016). Applying these inflation factors the total cost estimate for closure of all existing and proposed facilities and closure and post closure financial assurance in 2014 dollars is $18,205,878, distributed as follows:

- Closure Cost Estimate for Existing Permitted Units - $15,262,826 (2014 dollars)
- Closure Cost Estimate for Proposed Units- $1,221,105 (2014 dollars)
- Post-Closure Cost Estimate (all units) - $1,721,948 (2014 dollars)

The financial surety amounts are provided through a Trust.

4.11 U.S. ECOLOGY TEXAS FACILITY AT ROBSTOWN, TEXAS

U.S. Ecology Texas (USET) s operates a hazardous waste management facility near Robstown, Texas. The facility (Hazardous Waste Permit No. 50052), which began operations in 1973, comprises a total of 440 acres, which is divided into an eastern portion (159 acres), a northwest portion (200 acres), and a western portion (81 acres). The eastern portion contains active and inactive waste management operations, the northwest portion is a buffer zone, and the western portion contains treatment tanks, a container storage building and active disposal cells (U.S. Ecology 2014).

Facility features include treatment tanks, recycling operations, landfill cells, container storage buildings, an onsite laboratory, an office, shop buildings, truck parking garage, groundwater treatment facility, and non-commercial deep well injection (U.S. Ecology 2014).

The facility is located 15 miles from the Nueces River and 40 miles from Lake Corpus Christi. The annual average precipitation is 29.7 inches. The general hydrogeologic description of the area includes fluvial and deltaic sands and clays. The first saturated zone beneath the ground surface is a confined, saline aquifer underlain by a cohesive clay layer (American Ecology Corporation 2005).

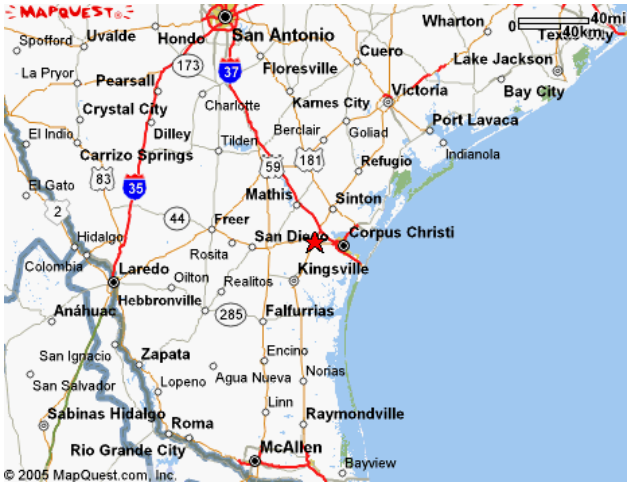

Figure B-15. Location of Robstown, TX Facility

This facility specializes in serving the petrochemical industry on the Gulf coast. There are 31 closed cells, three active hazardous waste cells and one active non-hazardous waste cell. . As of December 31, 2014, the total permitted airspace at the facility was 1,387,421 cubic yards (USSEC 2015). Wastes accepted include acids, corrosives, metacyanides, solvents, halogenated organics, PCBs, as well as some NORM materials (TCEQ 2013). Disposal cells have multiple liners and a double-leachate collection system. The first two liners are a minimum of 3 ft thick,

and consist of compacted clay and an 80-mil high-density polyethylene (HDPE) synthetic liner on the floor and side walls. This provides a 5-ft minimum buffer between the cell floor and the historic high groundwater table. A 40-mil high-density polystyrene (HDPS) liner is installed on cell sidewalls (American Ecology Corporation 2005).

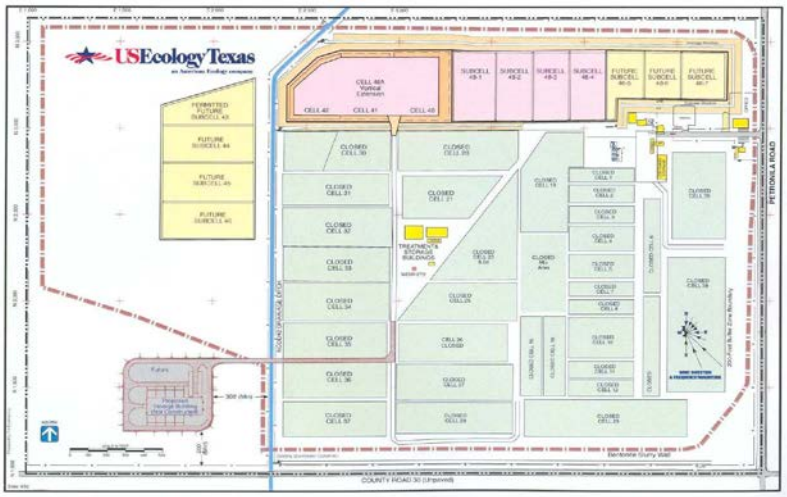

Figure B-16. Robstown, TX Disposal Cell Configuration

Figure B-17. Disposal at Robstown, TX Facility

In 1977, during installation of monitoring wells contamination was found in samples from the shallow sand aquifer that underlies this facility. This aquifer is non-potable due to salinity. Because of the contamination, which resulted from disposal activities prior to 1977, the facility has implemented a groundwater compliance plan. This plan includes a system to contain, pump, and treat the contaminated groundwater. This system includes a groundwater slurry wall encompassing the facility, a groundwater recovery system, above-ground storage tanks, and a deep injection well. The groundwater recovery system creates an inward groundwater gradient

that has prevented contaminated groundwater from leaving the site. There are a total of 60 monitoring wells (American Ecology Corporation 2005). The cost estimate for site closure was $3,837,900 in 2006. The 30-year post-closure period requires maintenance, inspections, and access controls. Site maintenance includes storm water conveyances, cover, sustaining vegetative cover, site benchmarks, and perimeter fencing. Regular inspection of the site and the leachate collection system, maintenance of leachate collection records and calculations, and site access control are also required. The post-closure cost estimate was $3,158,753 in 2006.

U.S. Ecology established, and will maintain throughout the life of the facility, financial assurance for the calculated cost of closure and post-closure of all facility units. US Ecology Texas meets financial assurance requirements for closure and post closure at its Robstown Facility, in accordance with 40 CFR264.143(e)(9) and 40 CFR264.145(e)(9), adopted by reference in 30 TAC 335.512(a)(6). The existing mechanism for insuring financial assurance requirements for closure and post closure activities has been approved by the Texas Commission on Environmental Quality (TCEQ) (American Ecology Corporation 2005).

For the Hazardous Waste Permit re-issued in 2013, the permittee provided financial assurance for closure of all existing permitted units covered by the permit in the amount of $ 7,879,700 (2009 dollars) and financial assurance for completing post-closure monitoring and maintenance activities in the amount of $ 1,203,100 (2009 dollars). In addition, the permittee agreed to provide financial assurance for operation of the Groundwater Monitoring and Corrective Action Programs, as applicable, in accordance with a Compliance Plan (TCEQ 2013).

ESET issued a Certificate of Insurance policy from Indian Harbor Insurance on June 27, 2012 covering up to the following maximum amounts for completing closure and post-closure and corrective actions at the site (U.S Ecology Texas 2012):

- Closure: $9,957,559 (2012 dollars)
- Post-closure: $ 5,677,483 (2012 dollars)
- Corrective Action: $4,886,727 (2012 dollars)

Applying the TCEQ-prescribed annual inflation factors (1.5% inflation factor to inflate 2012 dollars to 2013 dollars and 1.5% to inflate 2013 dollars to 2014 dollars) equates to the following financial assurance cost estimates in 2014 dollars:

- Closure: $10,258,526 (2014 dollars)
- Post-closure: $ 5,849,085 (2014 dollars)
- Corrective Action: $5,034,428 (2014 dollars)

In addition, ESET issued a certificate of insurance policy from Indian Harbor Insurance on March 7, 2013 for an amount of $178,723 (2012 dollars) to cover the cost of completing well plugging and abandonment at the site (U.S. Ecology Texas 2013).

4.12 CLEAN HARBORS DEER PARK AT DEER PARK, TEXAS

Clean Harbors Deer Park is a hazardous waste facility operated on 145 acres near Deer Park, Texas (Texas Industrial Solid Waste Management Facility I.D. No. HW-50089-01). Facility

operations began in 1971, and the facility was acquired by Clean Harbors in 2002 from Safety-Kleen Services Inc.

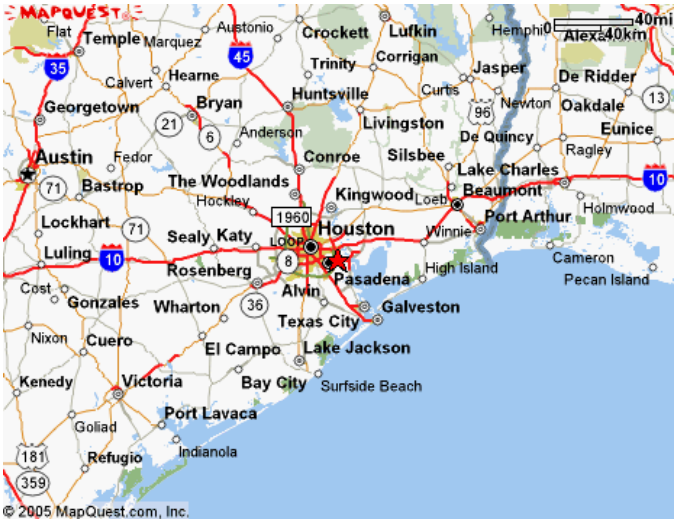

Figure B-18. Location of Deer Park, TX Facility

Clean Harbors Deer Park operates two (2) commercial hazardous waste incinerator trains at its Deer Park, Texas facility. Incineration Train I consists of a 3.6-meter rotary kiln, a Loddby Liquids injection burner, a horizontal afterburner, a wet scrubber system, and associated waste feed and emission control systems. Incineration Train II consists of a 4.4-meter rotary kiln, a mechanical fluidized bed reactor (Rotary Reactor), a common vertical afterburner, a wet scrubber system, and associated waste feed and emission control systems (Clean Harbors 2011).

Incineration residues generated from the Train I and II incinerators is analyzed to ensure compliance with all applicable Land Disposal Restrictions. Incineration residues are established and encapsulated as necessary to meet these rules. All residues are land-disposed in on-site landfill units (Clean Harbors 2011).

The Deer Park landfill units are permitted to accept commercial landfill waste and residuals associated with on-site operations. Materials met or currently meet all applicable land disposal restrictions and Deer Park permit requirements prior to placement in one of three on-site landfill units. The three landfill units include the South Landfill (closed; 20 acres), the North Landfill (operating; 20 acres), and the East Landfill (proposed; approximately 45 acres) (Clean Harbors 2011).

Groundwater contamination exists at the site but groundwater is prevented from moving offsite with an extensive groundwater recovery program. This program includes a pump-and-treat system to maintain an inward gradient to ensure contamination does not move offsite. All leachate collected from the on-site landfills is treated using a PACT (activated carbon) system. This includes groundwater collected per the Compliance Plan that addresses on-site groundwater contamination (Clean Harbors 2011).

A facility closure plan has been developed and submitted to the Texas Council on Environmental Quality (TCEQ) in accordance with RCRA requirements and is available at the site for inspection upon request. A Certificate of Insurance guarantees financial assurance for closure.

Clean Harbors and its subsidiaries purchases an insurance program for Closure (Post-Closure and Corrective Action where so required) in amounts that meet regulatory requirements (Clean Harbors 2011).

The TCEQ is currently reviewing the following proposed financial assurance amounts for the facility. These proposed financial surety amounts were submitted to them in August 2015 (Stoebner 2016):

- Closure Cost Estimate - $17,464, 621 (2014 dollars)
- Post-Closure Cost Estimate - $7,080,649 (2014 dollars)
- Corrective Action Cost Estimate - $4,323,472 (2014 dollars)

The financial surety is provided through a Certificate of Insurance (Stoebner 2016).

4.13 PINEWOOD FACILITY AT PINEWOOD, SOUTH CAROLINA

The Pinewood Facility is located in a rural area of Sumter County between Summerton and Pinewood and comprises a total area of approximately 534 acres. Within that area landfill disposal cells were formerly used to dispose of commercially-generated RCRA regulated wastes but these disposal cells are now closed. . The disposal cells are collectively referred to as the former Pinewood Landfill.

The site is located approximately ¼ mile from Lake Marion, and 1¼ miles from the Manchester State Forest. Annual precipitation averages approximately 48.6 inches.

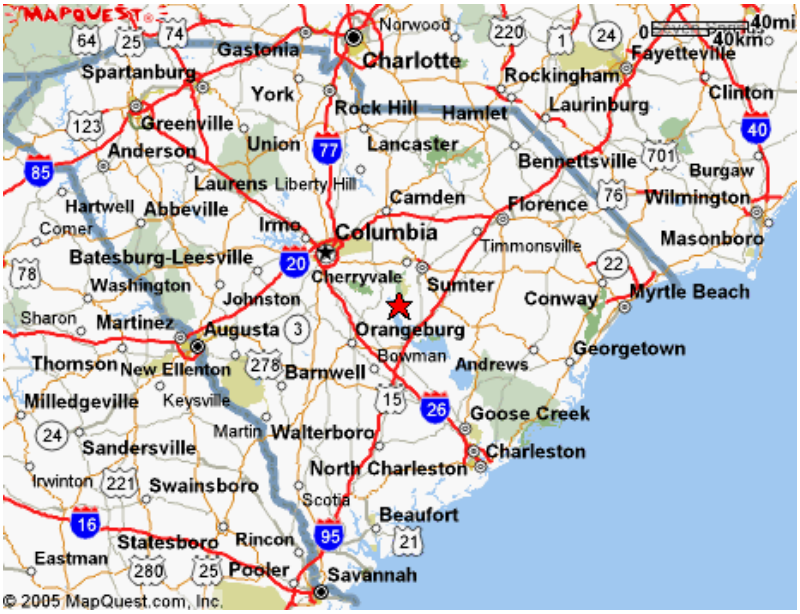

Figure B-19. Location of Pinewood, SC Facility

The Pinewood Facility site was originally a mine for opaline claystone, commonly used for kitty litter. In 1977 the mine operator applied for a permit to disposal of industrial waste. This waste was deposited in unlined cells. Waste activities on-site included stabilization, solidification, and landfill activates. Wastes accepted included acidic /corrosive wastes, halogenated organics,

solvents, and metals. In 1979, the waste that had been buried in unlined cells was excavated and reburied in lined cells. Beginning their use in 1984, the landfill cells were designed with double liners and leachate collection systems. The landfill cells were developed in three separate areas on the property. The Facility is now a closed hazardous waste landfill cells site and is no longer considered an active treatment, storage, and disposal facility. Closure activities at the site began in 2000 and were completed in 2006. The landfill cells are currently closed and are being monitored and maintained (South Carolina Division of Health Assessment and Consultation 1997; Pinewood Site Custodial Trust 2011a;b). The South Carolina Department of Health and Environmental Control (SCDHEC) has regulatory oversight of the day-to-day post-closure operations at the Site. SCDHEC is the lead agency for oversight of the Pinewood Site post-closure care.

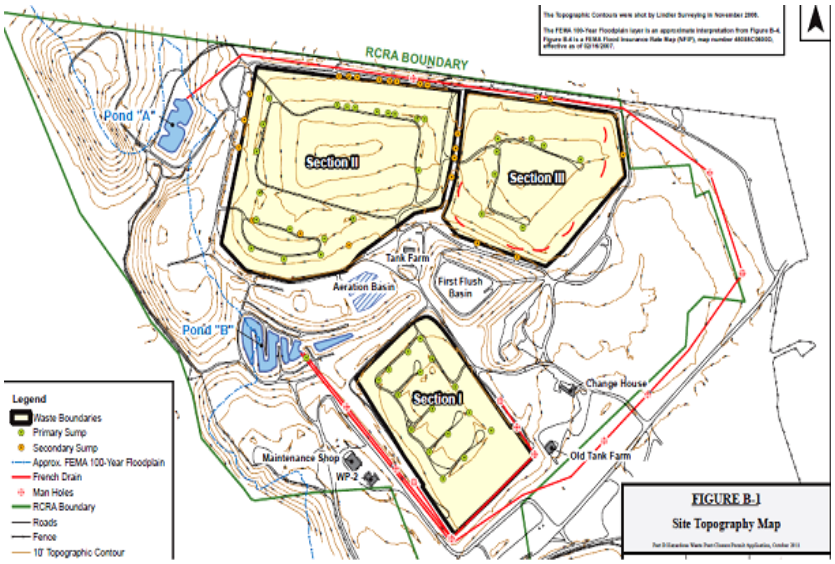

Figure B-20. Pinewood, SC Facility (2011)

Ongoing operations include collection and management of leachate from the closed cells, remediation of water table contamination from Solid Waste Management Units (SWMUs) resulting from operation of the claystone mine, monitoring of groundwater and surface water, and maintenance of landfill cover, ditches and sedimentation ponds (Pinewood Site Custodial Trust 2011a).

There are 167 groundwater monitoring wells on the site, 50 of which are sampled quarterly. The other wells are sampled annually. Groundwater is located at a depth of approximately 20 feet. Groundwater contamination was detected in 1983; the contamination has not spread beyond the facility boundaries and has been contained. The contamination is considered a result of early site activities and not the result of problems from waste buried in the lined cells. Corrective action to extract and treat this groundwater has been ongoing since 1987. As of 1997, regulators saw no evidence that the contamination was the result of ongoing waste operations or waste disposed of

in lined cells, and existing contamination is contained (South Carolina Division of Health Assessment and Consultation 1997).

The agreement pertaining to closure and post-closure was worked out following Safety-Kleen's bankruptcy filing. This agreement between the State of South Caroline and Safety-Kleen was approved by the U.S. bankruptcy court. The facility is now owned by the Pinewood Site Custodial Trust, with Kestrel Horizons Inc. currently serving as the trustee. The bankruptcy settlement established a trust fund to finance closure of the Site, and an annual annuity for the post-closure operation and maintenance of the Site for a 100 - year post-closure period, which runs from 2005 to 2104 (Pinewood Site Custodial Trust 2011c). The annual annuity is supplemented by the trust fund when necessary to finance post-closure care of the site.

The annual operations and maintenance budget for the former Pinewood Landfill, excluding the Trustee costs, was estimated by the former Trustee in 2014 to be $3,227,200. This annual budget has been divided into three categories; $2,106,800 associated with leachate collection, treatment, and solids disposal; $794,600 in general site operations and maintenance; and $325,800 in routine groundwater monitoring (Haley & Aldrich 2015).

In addition to the funds for closure and post-closure, there is also a New Environmental Impairment Fund. This separate contingency fund was established to fund activities that may be needed beyond the scope of the custodial trust fund to ensure protection of the environment. This fund received a total contribution of $39 million (www.pinewoodsite.net).

Table B-1. Summary of hazardous waste management facility characteristics and information[29]

Facility Name	State	City	EPA ID	Land Area (acres)	Began Operations	Remaining Life (years)	Post closure period	Closure cost Estimate	Post closure cost Estimate	Closure/ Post Closure Mechanism	Corrective Action ?	Average Precipitation (in/yr)	Number of Monitoring wells	Depth to water table (ft)
Clean Harbors Grassy Mountain	UT	Grassy Mountain	UTD991301748	640	1982	24	30	$21.3 million (2015 dollars)	$15.6 million (2015 dollars)	Certificate of Insurance	No	7.8	34	12
Chemical Waste Management	CA	Kettleman City	CAT000646117	499	1975	5	30	$23,2 million (2015 dollars)	$32.6 million (2015 dollars)	Certificate of Insurance	Yes	8		
Clean Harbors, LLC Buttonwillow	CA	Buttonwillow	CAD980675276	320	1982	44	30	$8.3 million (2015 dollars)	$13.4 million (2015 dollars)	Certificate of Insurance	No	6.5		
Clean Harbors Westmorland	CA	Westmorland	CAD000633164	640	1980	68	30	$12.5 million (2015 dollars)	$24 million (2015 dollars)	Certificate of Insurance	Yes	3	58	
Envirosafe Services of Ohio	OH	Oregon	OHD045243706	133	1954		perpetual care	$54 million (2015 dollars)	Combined with closure	Trust	Yes	33.8	117	
Clean Harbors Lone Mountain	OK	Waynoka	OKD065438376	560	1978	18	30	$18.0 million	$14.4 million	Surety Bond	Yes	27		

[29] Information effective as of December 1, 2015 to February 29, 2016

Table B-1. Summary of hazardous waste management facility characteristics and information[29]

Facility Name	State	City	EPA ID	Land Area (acres)	Began Operations	Remaining Life (years)	Post closure period	Closure cost Estimate	Post closure cost Estimate	Closure/ Post Closure Mechanism	Corrective Action ?	Average Precipitation (in/yr)	Number of Monitoring wells	Depth to water table (ft)
U.S. Ecology	NV	Beatty	NVT330010000	93	1970		30	$3.9 million (2015 $)	$5.1 million (2015 $)	State account	Yes	4"/yr	23	280
Pinewood (Custodial Trust) Facility	SC	Pinewood	SCD070375985	534	1977	0	100	N.A. (Closed)	$3.2 million /year (total $ 323 million for 100 yrs)	Trust and Post-closure annuity	Yes	49	167	20
Clean Harbors Deer Park	TX	Deer Park	TXD055141378	145	1971	23	30	$17.5 million (proposed)	$7.1 million (proposed)	Certificate of Insurance	Yes	54.4	144	8 - 25
U.E. Ecology Texas	TX	Robstown	TXD069452340	240	1973		30	$10,3 million (2014 $)	$5.8 million (2014 $)	Certificate of Insurance	Yes	29.7	60	
Waste Control Specialists (Hazardous Waste Permit No. 50358)	TX	Andrews	TXD988088464	1340	1997		30	$15.3 million /$1.2 million (existing units/proposed units) (2014 $)	$1.72 million (2014 $)	Trust	No	15	88	230

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Clean Harbors Environmental Services, Undated -b. Westmorland, California Facility Fact Sheet. Transportation and Disposal. www.cleanharbors.com .

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FINAL REPORT
September 2016

APPENDIX C:
DESCRIPTIONS OF SELECTED LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITIES LICENSED AND OPERATING IN OTHER STATES

Prepared by URS Professional Solutions, LLC (an AECOM Affiliate)

C.1 *OPERATING COMMERCIAL LLRW DISPOSAL FACILITIES*

The following currently operating commercial LLRW disposal facilities are reviewed and characterized:

- ✓ Energy*Solutions* LLC at Clive, UT
- ✓ US Ecology Inc. at Hanford, WA
- ✓ Chem-Nuclear Systems, LLC at Barnwell, SC
- ✓ Waste Control Specialists, LLC at Andrews, TX

For each facility, information about the following topics is summarized:

- ✓ History
- ✓ Site Characteristics
- ✓ Facility Characteristics
- ✓ Waste Characteristics
- ✓ Method Used for Funding Post-Closure Activities
- ✓ Current and Projected Physical Status
- ✓ Status of Financial Assurances Provided

*C.1.1 Energy*Solutions *LLC LLRW and NARM Disposal Facilities at Clive, UT*

The Energy*Solutions* LLC (Energy*Solutions*) Complex is located in Clive, Utah (Tooele County) approximately 65 miles west of Salt Lake City on Highway I-80 and 45 miles east of Wendover, Utah (the Nevada-Utah border). Most of the land within a 10-mile radius of the site is publicly owned and administered by the Bureau of Land Management (BLM). Prior use of the land consisted of grazing of sheep and cattle and occasional off-road recreational driving.

Figure C-17. Location of the Operating Energy*Solutions* facility at Clive, UT

C.1.1.1 History

Envirocare of Utah, Inc. obtained a radioactive materials license in 1988 for NORM disposal. Prior to Envirocare conducting activities at the site, the U.S. Department of Energy (DOE) and the State of Utah used a portion of the site to place 11e.(2) material from the Vitro mill site located in central Salt Lake City. Energy*Solutions* acquired Envirocare's interest in the Clive Complex and the license was transferred to Energy*Solutions* in 2005.

Envirocare's initial Radioactive Materials License (RML) has been amended several times to include man-made isotopes and receive RCRA Part B Permitted waste from the Utah Division of Solid Waste and Hazardous Waste. On May 2, 2011, Energy*Solutions* submitted a request to amend the LLRW license and permit to create a proposed Class A West (CAW) disposal embankment and to formally retract a previous request for a Combined Class A disposal cell. On October 25, 2012, Energy*Solutions* submitted a request to renew RML No. UT 2300249. The application proposed the use of an evapotranspiration (ET) cover on the CAW cell. On May 12, 2014, The Utah Division of Radiation Control issued a Low-Level Radioactive Waste (LLRW) License Amendment, No. 16, approving the May 2, 2011, Energy*Solutions* request for redesign of the CAW Embankment. This design included a rock armor/radon barrier multi-layered cover system. A total of twenty License amendments have been approved for RML UT2300249, the most recent (RML Amendment 20) being approved on June 30, 2015 (UDEQ 2015a). A currently active 11e.(2) disposal unit for disposal of 11e.(2) waste is also operated in accordance with Utah Department of Environmental Quality (UDEQ) RML No. UT2300478, for which a total of eleven amendments have been approved (UDEQ 2015b).

As of 2013, the Clive facility was estimated to have sufficient capacity for approximately 30 years of operations based on Energy*Solutions*'s estimate of future disposal volumes Energy*Solutions*'ability to optimize disposal capacity utilization, and the license amendment to convert volume capacity originally intended for 11e(2) waste to Class A LLRW that was

approved in November 2012 (USSEC 2013). In accordance with RML UT 2300249, Energy*Solutions* may dispose of a volume of Class A LLRW and Naturally Occurring and Accelerator Produced Radioactive Materials (NARM) in the CAW disposal embankment described in License Condition 40 not exceeding 8,724,097 cubic yards, and in the Mixed Waste Cell not exceeding 1,354,092 cubic yards. Together, the total aggregate volume of waste disposed of in the CAW disposal embankment and the Mixed Waste Landfill Cell shall not exceed 10.08 million cubic yards (UDEQ 2015a).

C.1.1.2 Site Characteristics

The site is on the eastern edge of the Great Salt Lake Desert, 3 miles west of the Cedar Mountains, 2.5 miles south of Interstate 80, and 1 mile south of a switch point on the Union Pacific Railroad system named Clive. It is located in the semi-arid desert of western Utah. Precipitation at the site is estimated to average about 7.8 inches per year. Pan evaporation at Clive was averaged at 49.5 inches over the last ten years, which makes the evapotranspiration potential significantly higher than the average precipitation at the site.

The nearest resident (single) is about 7 miles from the site and the nearest populated area is about 30 miles from the site at Tooele, Utah.

The facility is located in part of the Basin and Range Province of North America. Basin and Range topography is typified by block-faulted mountain ranges that generally trend north to south. This predominant geologic structural feature, with its alluvial filled basins, is discontinuous and was created by extensional normal faulting. The basins consist mainly of sediments originating from Quaternary lacustrine Lake Bonneville deposits and Quaternary and Tertiary colluvial and alluvial materials derived from adjacent mountains. The unconsolidated to semi-consolidated valley fill is about 800 to 1000 feet thick throughout the central portions of the valleys in the Great Salt Lake Desert.

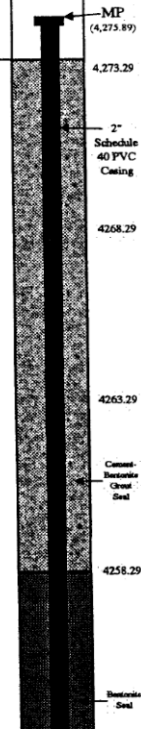
The site aquifer system consists of a shallow, unconfined aquifer that extends through the upper 30 to 40 feet of lacustrine deposits. A confined aquifer begins around 40 to 45 feet below the ground surface and continues through the valley fill. Due to the low precipitation and relatively high evapotranspiration, little or no precipitation reaches the upper unconfined aquifer as direct vertical infiltration. The groundwater quality in the unconfined aquifer at the facility is considered saline with concentrations of several chemical species (sulfate, chloride, and total dissolved solids) significantly exceeding the EPA secondary drinking water standards. The shallow, unconfined aquifer shows TDS in the range of 14,151 to 69,600 mg/l.

The average horizontal groundwater velocity is on the order of 1.18 feet/year, calculated from exiting monitor wells on site. The average linear vertical velocity was calculated to average 3.45 feet/year based on vertical hydraulic gradients, average vertical hydraulic conductivity, and a porosity of 0.30.

Envirocare of Utah, Inc.
Groundwater Monitoring Well Boring Log

Project: B & C Waste Area
Date Drilled: 4-5-00 Date Completed: 4-5-00
Boring Number: GW-108
Northing: 7,425,717.51 Easting: 1,190,239.29
Logged By: Brian Duggan
Groundwater Elevation (ft): 4,249.63
Date Measured: 4/12/2000
Ground Surface Elevation (ft): 4,273.29
Measuring Point (MP) Elevation (ft): 4,275.89
MP is top of Protective Casing
Total Depth (ft): 39.0
Diameter (in): 8.0
Drilling Contractor: RC Exploration
Drilling Method: Hollow Stem Auger
Well Screen: Diameter 2-inch I.D. Length 39.0 to 24.0 feet Slot Size 0.010-inch
Casing: Diameter 2-inch I.D. Length 24.0 to 0.0 feet Type PVC Sch. 40
Sand 39.0 to 21.5 feet Bentonite Seal 21.5 to 14.8 feet Cement Grout Seal 14.8 to 0.0 feet

Depth (feet)	Grain Size % Gravel	% Sand	% Fines	Blows (6 in.)	Sample Type	Sample Recovery	Graphic Log	Stratigraphic Log	Elevation (feet)
0	0	25	75	NA	CC	3.5	ML	Clayey silt, brown, very stiff, dry.	4,273.29
1									
2									
3	0	20	80				CL	Silty clay, light brown with iron oxide staining, moderately stiff, slightly moist.	
4	0	15	85	NA	CC	5.0			4268.29
5									
6									
7								Silty clay, light gray with light brown layers, moderately stiff, moist, salt crystals.	
8									
9	0	75	25	NA	CC	4.5	SM	Silty sand, brown, medium dense, slightly moist, fine-subrounded sand grains.	4263.29
10									
11	0	75	25					Silty sand, light brown, fine to medium grained sand, loose, dry.	
12									
13									
14	0	70	30	NA	CC	4.0		Silty sand, light brown, fine, subrounded sand grains, medium dense, moist	4258.29
15									
16									
17									
18									
19	0	70	30	NA	CC	4.5			



Envirocare of Utah, Inc.
Groundwater Monitoring Well Boring Log

Project: B & C Waste Area
Date Drilled: 4-5-00 Date Completed: 4-5-00
Boring Number: GW-108
Northing: 7,425,717.51 Easting: 1,190,239.29
Logged By: Brian Duggan
Groundwater Elevation (ft): 4,249.63
Date Measured: 4/12/2000
Ground Surface Elevation (ft): 4,273.29
Measuring Point (MP) Elevation (ft): 4,275.89
MP is top of Protective Casing
Total Depth (ft): 39.0
Diameter (in): 8.0
Drilling Contractor: RC Exploration
Drilling Method: Hollow Stem Auger
Well Screen: Diameter 2-inch I.D. Length 39.0 to 24.0 feet Slot Size 0.010-inch
Casing: Diameter 2-inch I.D. Length 24.0 to 0.0 feet Type PVC Sch. 40
Sand 39.0 to 21.5 feet Bentonite Seal 21.5 to 14.8 feet Cement Grout Seal 14.8 to 0.0 feet

Depth (feet)	Grain Size % Gravel	% Sand	% Fines	Blows (6 in.)	Sample Type	Sample Recovery	Graphic Log	Stratigraphic Log	Elevation (feet)
20							SM	Silty sand, fine grained, light brown, dense, moist. Very thin black sand layers	4253.29
21									
22									
23									
24	0	30	70	NA	CC	5.0	ML	Clayey silt, brown, stiff, moist, fine sands, no plasticity.	
25									4248.29
26	0	60	40				SM	Silty sand, light brown, dense, moist, fine sand, high silt fraction.	
27									
28								thin white sand layer, fine grained, sub-rounded, approximately 1.5 centimeters thick.	16/30 Sand
29				NA	CC	5.0		Silty sand, light brown, wet, loose.	
30									4243.29
31	0	35	65					Silty sand, greenish gray, medium dense, very moist to wet.	
32									
33							CL	Silty clay, greenish gray, stiff, very moist.	
34	0	15	85	12 8 8	SS/ CC	4.5			4238.29
35	0	65	35	13			SM	Silty sand, greenish gray, loose, wet	2" Schedule 40 PVC 0.010-inch Screen
36							CL	Silty clay, greenish gray, stiff, very moist	
37	0	20	80						
38								Thin, wet, silty sand lenses.	
39									

TD of boring - 39.0 feet bgs

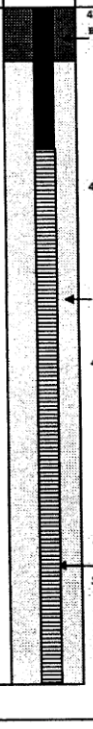


Figure C-18. Clive, UT Geology - Well GW-108

C.1.1.3 Facility Characteristics

Energy*Solutions* is a privately held corporation, which currently owns approximately 1,600 acres of land in two and a half sections. The facility is constructed mainly in Section 32, Township 1 South, Range 11 West, SLBM, Tooele County, Utah. BLM manages adjacent lands to the east and south and Clean Harbors owns lands on the north and west.

Energy*Solutions* currently operates four disposal embankments. In addition, the DOE constructed and owns the Vitro disposal embankment located adjacent to Energy*Solutions*' facilities. The disposal facility design is a primarily above grade landfill embankment constructed using materials native to the site or found in close proximity to the site. Synthetic materials are also used in the construction of the mixed waste embankment.

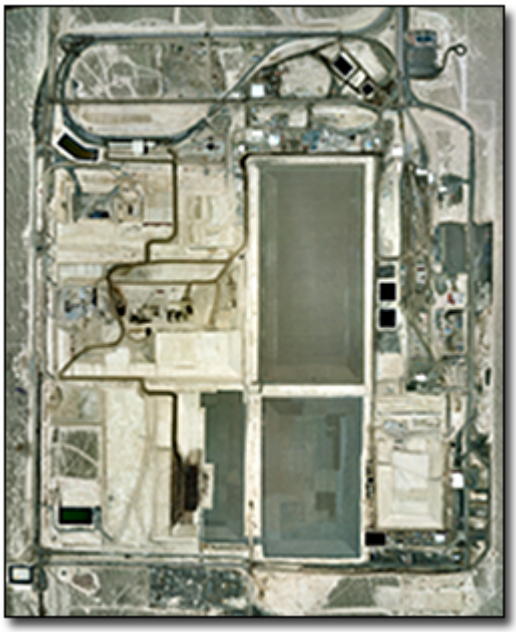


Figure C-19. Aerial View of Energy*Solutions*' LLRW/NARM Disposal Facilities at Clive, UT

The principal design features of the embankments include a clay liner, waste placement, final cover, drainage systems, and a buffer zone. The liner system consists of a prepared foundation overlain by a two-foot thick layer of $1x10^{-6}$ cm/sec permeability clay. The liner is placed in the embankment at a depth of approximately 7–10 feet below native grade. The waste disposed in the embankments may take a variety of physical forms, including soil or soil-like material, compressible debris, incompressible debris, oversized debris and containerized Class A LLRW. Liquid waste may not be disposed in the embankments. The embankment cover is a multi-layer system consisting of a radon barrier, lower filter zone, sacrificial soil, upper filter zone, and erosion barrier with strict specifications on materials and construction.

Based on the historic minimum depth to groundwater, the levels would need to rise some 18 feet below the LLRW embankment to begin to threaten contact with disposed waste.

A buffer zone of 94 feet is created between a closed embankment and the fence that is installed to maintain the boundary of the closed embankment. In addition, during construction a 300-foot buffer zone exists between the closest edge of any embankment and the site perimeter fence.

Figure C-20. Clive, UT Railcar Rollover

Figure C-21. Clive, UT Mixed Waste Liner Placement

C.1.1.4 Waste Characteristics

RML UT2300249 authorizes Energy*Solutions* to dispose of Class A LLRW and NARM in the Class A West Embankment and the Mixed Waste Disposal Cell. Table C-11 provides the design volumes, the actual waste volumes disposed as of August 25, 2010, and the remaining capacity of the embankments. As of December 31, 2010, a total of about 84 million curies had been disposed of at Energy*Solutions*' LLRW disposal embankments (that is, including neither mixed waste nor 11e.(2) waste).

Table C-11. Approximate volumes of Energy*Solutions*' embankments, August 27, 2015

Embankment	Design Volume (cy)	Volume Disposed (cy)	Capacity Remaining (cy)
11e.(2)	5,048,965	1,600,289	3,345,734
LARW	2,200,000	2,200,000	0
Class A West	8,724,097	4,124,015	4,282,187
Class A North (CAN)	Combined in Class A West		
Mixed Waste	1,353,004	936,584	354,110
TOTALS	17,326,066	8,860,888	8,072,031

Prohibited wastes include waste that contains or is capable of generating toxic gases, vapors or fumes; wastes containing pyrophoric, hazardous, dangerous, or chemically explosive materials; materials that could react violently with water or moisture or when subjected to agitation; wastes containing unprocessed liquids; and wastes containing amounts of uranium, plutonium, and uranium-233 that would cause the waste to be classified as Special Nuclear Material.

On June 1, 2011, Energy*Solutions* submitted an initial Performance Assessment addressing the disposal of depleted uranium (DU) at the Clive facility. Several additional documents and updates to the initial DU Performance Assessment have been issued to the Utah Division of Waste Management and Radiation Control (UDWMRC), which is currently reviewing.

C.1.1.5 Current and Projected Physical Status

Energy*Solutions* anticipates the facility to be operational for about an additional 20 years. Energy*Solutions*' environmental monitoring program addresses all potentially affected environmental media. Reports submitted to date to the State of Utah reveal no releases to the environment that are out of the ordinary or of unacceptable magnitude or character.

Recently approved or proposed changes to facilities at the Energy*Solutions* complex in Clive include the following (UDWMRC 2016a):

- The CAW Embankment was approved by the UDWMRC in November 2012.
- Energy*Solutions* has requested changes to the final cover design – to include an Evapotranspiration (ET) Cover (Not approved)
- Performance Assessment (PA) for blended waste (ET Cover) (Not approved)
- Performance Assessment (PA) for (DU) (ET Cover) (Not approved)

C.1.1.6 Method Used for Providing Financial Assurances

Energy*Solutions* has provided financial surety for the closure of its disposal facility and all disposal embankments in accordance with regulatory requirements. The amount of financial surety is calculated as the maximum amount estimated for the proper placement of all contaminated material into an embankment, for decommissioning and decontamination of the site, for completion of the embankment construction to the required standards, and to provide financial assurance for all required post-closure monitoring and maintenance activities.

The cost estimates are reviewed on a yearly basis and the financial surety updated to assure that the amount remains sufficient to account for inflation, construction of new facilities, and other cost adjustments. The financial assurances were provided in the form of commercial insurance, though an irrevocable letter of credit until 2013 when Energy*Solutions* changed their financial assurance mechanism to a surety bond

C.1.1.7 Status of Financial Assurances Provided

Currently approved closure cost estimate surety amounts for licensed facilities at the Energy*Solutions* site are as follows (UDWMRC 2016a; UDWMRC 2016b):

Facility/ Surety	Closure Cost Estimate
LLRW Disposal Facility Surety	$ 58,497,276.78 (2015 dollars) (Approx. $58.5 M)
11e.(2) Facility Surety	$ 11,834,232.96 (2015 dollars) (Approx. $11.8 M)
Mixed Waste Facility Surety	$12,020,500.88 (2015 dollars) (Approx. $12 M)

Currently approved surety amounts for performing post-closure activities at these licensed facilities are as follows (UDWMRC 2016b; UDWMRC 2016c):

Facility/ Surety	Post-Closure Cost Estimate
LLRW Disposal Facility Surety (2015)	$ 6,184,022.31 (2015 dollars) (Approx. $6.2 M)
11e.(2) Facility Surety (2015)	$ 872,999.27 (2015 dollars) (Approx. $0.9 M)
Mixed Waste Facility Surety	$1,970,938.72 (2015 dollars) (Approx. $2 M)

The combined estimated cost to provide long-term surveillance and maintenance at all three facilities during the institutional control period is about $9.42 million. Financial assurances are maintained as described in Section C.1.6 of this appendix. The balance of the State's Radioactive Waste Perpetual Care and Maintenance Fund to be used for costs incurred 100 years after final facility closure following was about $4.02 million as of July 31, 2011.

C.1.2 US Ecology Inc. at Hanford, WA

The site is located in Benton County and is approximately 23 miles northwest of Richland, WA. It is the only LLRW in this study that is on Federal land. It is situated near the center of the 560-square mile DOE Hanford facility. Access to the site is restricted and there are no permanent residences on or adjacent to the site. The Columbia River, located approximately 12 miles east, is the nearest significant surface water body, as shown in Figure C-22.

The Richland disposal site is regulated by the Washington Department of Health and has a full-time onsite inspector. Additionally, the Department performs two to four compliance audits a year. US Ecology has had no license violations during the last ten years.

C.1.2.1 History

This desert site has successfully operated since first receiving waste in 1965. The State of Washington leases the land from the federal government and the Company subleases the land from the State. The lease between the State and the Federal government terminates in 2061. US Ecology's Lease with the State of Washington expires July 29, 2015, but includes options to renew for up to four additional 10-year periods.

Figure C-22. Location of the Operating US Ecology Facility at Richland, WA

C.1.2.2 <u>Site Characteristics</u>

The site in a semi-arid environment and has not exhibited water management problems in the wastes.

The Hanford Reservation is located in the Pasco Basin on the semiarid alluvial plain of the Columbia River. The disposal site is situated on glacier-fed river sediments of the ancestral Columbia River that consist of sand, silt, and gravel in various combinations. These deposits are up to about 200 feet deep and overlay the Reingold Formation, which is a layer of sedimentary material up to 1,200 feet thick. Below this formation, the bedrock consists of Yakima Basalt. The land is generally flat with intermittent dunes, except where grading has occurred. The surface dunes consist of fine silt and sand and are subject to migration in areas where the fragile vegetative cover has been destroyed. The depth of the water table beneath the disposal site is about 245 feet, with the bottom of this unconfined aquifer being coincidental with the lowest layers of the Reingold Formation.

The vadose zone consists of sediments with variable hydraulic properties and generally is composed of poorly sorted sand with local admixtures of gravel, silt and clay. The vadose zone beneath the trenches is about 265 feet thick, or extends to about 315 feet below the ground surface. Because of the low infiltration rates and low soil moisture content, water movement through the vadose zone is slow. The water table at the facility is encountered at a depth of

approximately 315 feet below the ground surface, or at elevations arranging from about 403 to 410 feet above mean sea level. This is about 265 feet below the trench bottoms. The unconfined aquifer beneath the facility is about 100 feet thick, with a ground water flow in an easterly to northeasterly direction.

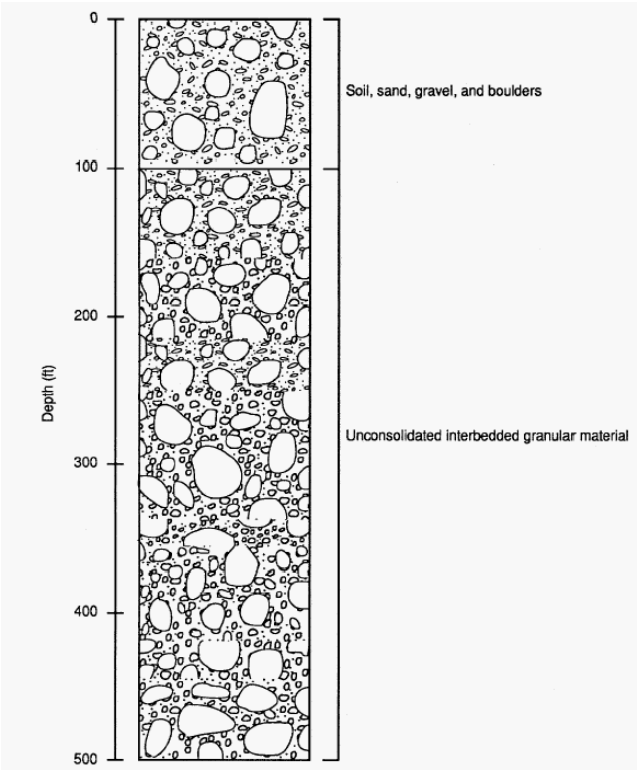


Figure C-23. Hanford, WA Geology

C.1.2.3 Facility Characteristics

The legal owner of the property is DOE, Richland Operations Office. The legal owner of the facility is US Ecology, Inc. of Boise, ID, formerly known as American Ecology Corporation. It is bordered by DOE disposal facilities.

The site offers one of only two currently operating full-service Class A, B, and C LLRW disposal facilities in the nation, although its services are only available to generators in states that are members of the Northwest LLRW Compact and the Rocky Mountain LLRW Compact. The site serves commercial and government customers in the Northwest (ID, WA, OR, UT, AK, HI, MT, and WY) and Rocky Mountain (CO, NV, and NM) Compacts. The facility also disposes of exempt source and byproduct material, as well as naturally occurring and accelerator-produced radioactive materials (NARM). The Richland site offers more than 38 million cubic feet of unused disposal capacity sufficient to accept waste well into the 21st century.

Wastes are disposed in conventional shallow-land burial of packaged materials into unlined trenches. The trenches range from 300-800 feet long, 25–150 feet wide and 30–45 feet deep. There are currently three open operating trenches (Trench 14-W, Trench 11-B, and Trench 18)

and 20 filled trenches whose contents include one nuclear reactor vessel. Examples of waste placement in trenches are illustrated below.

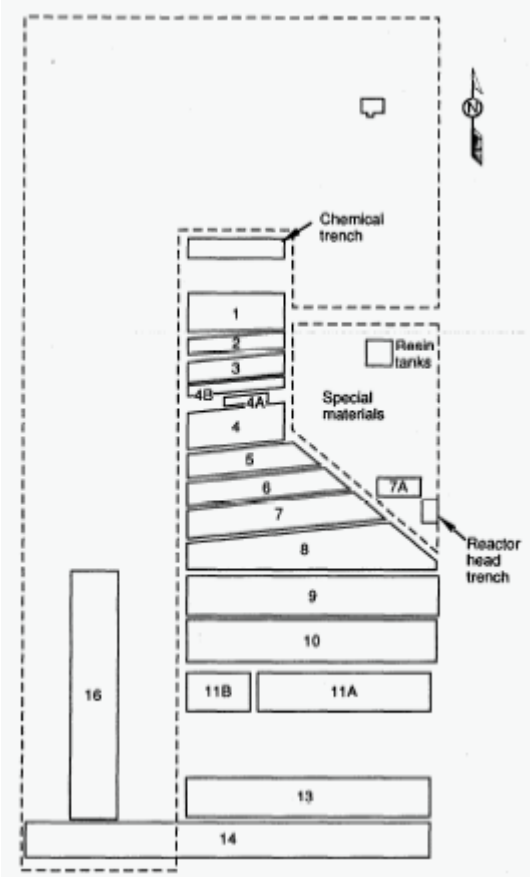


Figure C-24. Hanford, WA Trench Configuration

Figure C-25. Hanford, WA Unlined Operating Trench 18

Figure C-26. Hanford, WA Unlined Stable Storage Trench

The disposal trenches are opened, as needed, and used in an alternating sequence to allow room for the stockpiling of excavated soil and to facilitate trench access. The waste containers are placed in the trench, with a minimum distance of 8 feet left between the top of the waste and the original ground surface. The trench is backfilled with the previously excavated soil. After the trench is filled to the original level, a soil cover is formed and covered with a layer of cobbles and gravel.

C.1.2.4 Waste Characteristics

The Richland site has disposed of approximately 14.3 million cubic feet of waste and 3.5 million curies of LLRW (Washington Department of Health [WADoH] 2011). The facility also accepts NORM/NARM, exempt source material, by-product material, and stabilized radium sources from generators nationwide. Exempt radioactive material from any geographic location can also be accepted.

Prohibited wastes include mixed radioactive and hazardous waste, waste that contains or is capable of generating toxic gases; vapors or fumes, wastes containing pyrophoric, hazardous, dangerous, or chemically explosive materials; materials that could react violently with water or moisture or when subjected to agitation; wastes containing unprocessed liquids; and waste containing amounts of uranium, plutonium, and uranium-233 that would cause the waste to be classified as Special Nuclear Material.

All radioactive waste is received and disposed of in closed containers. Waste packages (boxes) are stacked as tightly as possible to minimize voids between packages. Random placement methods are employed to the extent necessary to adhere to the ALARA concept of radiation

exposure control. Palletized packages are removed from the pallets before disposal. Wastes are segregated by waste class and stability (Class A, Class A Stable, Class B, and Class C).

C.1.2.5 Physical Status

The facility is currently operating with two open trenches. At the current rates of disposal, fewer than five more trenches will be filled, by the time the facility is expected to close in 2056, seven years before the state lease on the land expires.

The facility is scheduled for closure in 2056. In July 1996, U.S Ecology submitted the Facility Closure and Stabilization Plan to the Washington Department of Health for review and approval. The WADoH final environmental impact statement (FEIS) was completed in 2004. The EIS discusses the Model Toxics Control Act (MTCA and the Washington Department of Ecology plan to perform a borehole study at the facility to determine the applicability of the MTCA. The initial borehole study for MTCA was concluded in early 2010. The WADoH issued an amendment to the FEIS in April 2010. The FEIS requires a Close-As-You-Go construction pathway. The amended FEIS approved a Phase 1 interim closure cover. The plan proposes a multilayered cover designed to limit water infiltration and intrusion by humans or animals. The Phase 1 closure plan proposes the immediate installation of an intermediate low-permeability cover over all existing closed waste trenches. The Phase 1 construction was scheduled to begin during the 2011 construction season. The second phase of closure will complete the final cover on top of the Phase 1 cover for all existing closed waste trenches and will occur after the MTCA study is complete. The third phase is ongoing with the currently active and new trenches. The cover will be closely monitored to evaluate its performance. Installation of final covers over currently active and future trenches will be completed by 2058. US Ecology will monitor the site through the expiration of its lease in 2063. The state or the federal government will oversee the site at least through 2163.

The Facility Closure and Stabilization Plan addresses the license closure requirements such as public annual dose limits, cap design, and closure and post closure costs.

At the time of closure, all facility structures will be removed. The structures will only be removed from the facility after any required decontamination or will be placed into open disposal trenches. Closure activities also include the installation of the final cap. The stabilization period is the period after closure in which observation and maintenance is performed to assure the site is stable and ready for institutional control. The custodial period follows the stabilization period. Environmental monitoring will be conducted during the closure and custodial periods.

C.1.2.6 Method Used for Providing Financial Assurances

The financial assurances are provided through the Site Closure Account and the Perpetual Surveillance and Maintenance Account that were created by the Washington Radioactive Waste Act. These accounts are also known as Fund 125 and Fund 500, respectively.

C.1.2.7 Status of Financial Assurances Provided

Closure costs were estimated in 2011 to total approximately $41.3 million. The costs of 100 years of post-closure activities (including monitoring, observing, and maintaining) were estimated in 2011 to total about $28 million (WADoH 2011).

In 2004, the Washington Legislature had removed $13.8 million from the Site Closure Account to address temporary budget shortfalls. Repayment is occurring through annual payments of $966,000 which will continue through 2033. As of November 30, 2015, the balance of the Site Closure Account was $27.18 million (WADoH 2015).

The balance of the Perpetual Surveillance and Maintenance Account (Fund 500) as of November 30, 2015 to be approximately $45.36 million (WADoH 2015). State agencies consider these balances to be sufficient for closure, stabilization, and long-term care during the institutional control period. According to the WADoH, there have been no major changes at the facility since 2011 that would impact the closure or Perpetual Surveillance and Maintenance Accounts (WADoH 2015).

*C.1.3 Energy*Solutions *(Former Chem-Nuclear Systems, LLC) Barnwell, SC LLRW Disposal Facility*

The 235-acre Barnwell facility opened in 1969. The facility is owned by the state of South Carolina and facilitated through the Budget and Control Board. Chem-Nuclear also holds the license, renewable every five years, to operate the site issued by South Carolina Department of Health and Environmental Control (SCDHEC 2007). The facility is located between the DOE Savannah River Site (SRS) and the hamlet of Snelling. Energy*Solutions* currently operates the LLRW disposal facility under SCDHEC Radioactive Materials License 097 (Energy*Solutions* 2013).

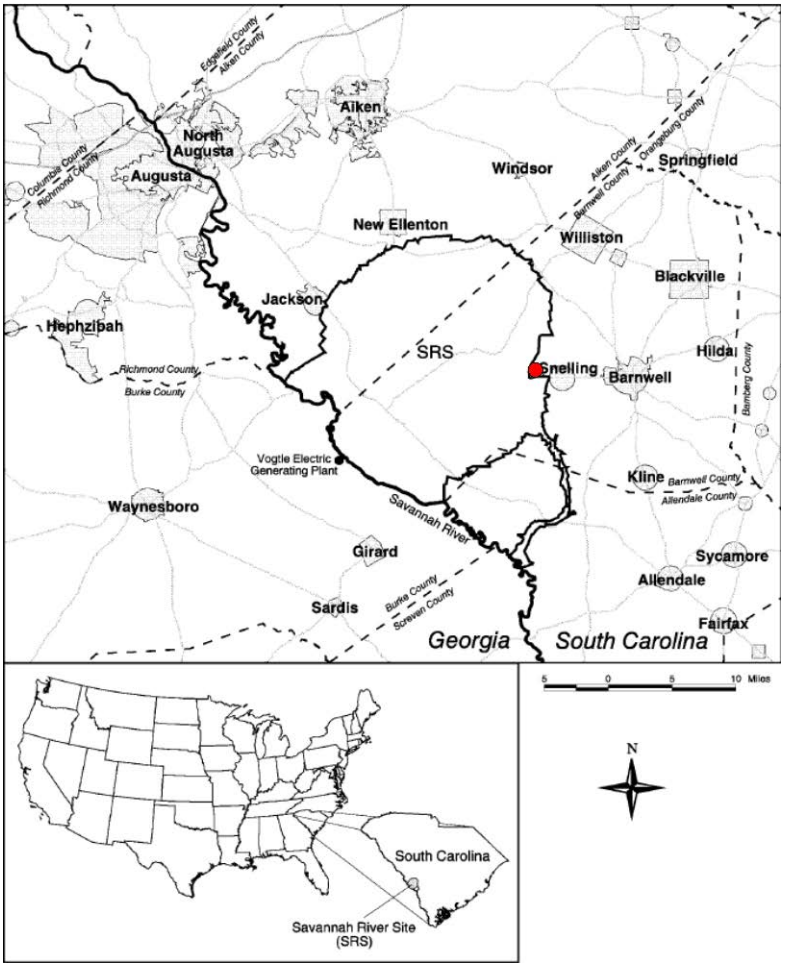


Figure C-27. Location of the Operating Chem-Nuclear Facility at Barnwell, SC

C.1.3.1 History

In August 1969, Chem-Nuclear Services submitted a license application for the disposal of commercial LLRW on property they owned near Barnwell, SC. This property is adjacent to the Savannah River Site and the Allied General Nuclear Fuel Services (AGNS) processing facility that was under construction at that time. AGNS was decommissioned prior to starting operations. In 1971, South Carolina received the property and leased it back to Chem-Nuclear (now owned by Energy*Solutions*) for 99 years.

The application for LLRW disposal was prompted in part by the Atomic Energy Commission's (AEC) moratorium placed on sea disposal of waste in the early sixties, and its closing of burial grounds at Oak Ridge, TN and the National Reactor Test Site in Idaho to commercial waste later in that decade.

The Barnwell facility provided disposal services to generators in all states until 2008. The facility is now open to generators in the Atlantic Compact member states (South Carolina, New Jersey, and Connecticut).

C.1.3.2 Site Characteristics

The facility is in a humid location and receives about 47 inches of precipitation per year. Tritium from the waste was detected in shallow groundwater wells on the facility.

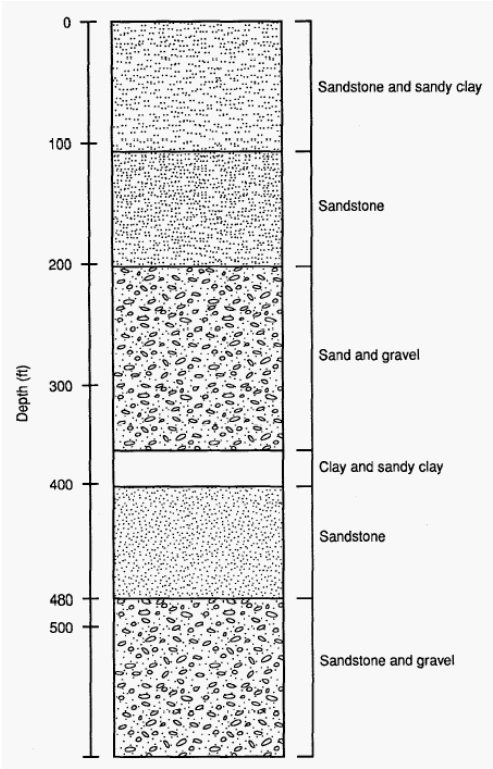


Figure C-28. Barnwell, SC Geology

The SCDHEC reviews annual trend monitoring reports submitted by Energy*Solutions* the report for accuracy and completeness. In the 2015 annual trending report, 27 monitoring locations (both groundwater and surface water) were evaluated for changes in tritium concentrations. The tritium data indicate that four monitoring locations show no evidence of a trend either up or down, five locations show an upward trend and 18 locations show a downward trend during the most recent 5-year period (third quarter 2010 to second quarter 2015 (SCDHEC 2015).

C.1.3.3 Facility Characteristics

LLRW is disposed in a series of trenches. Each trench includes a drainage collection system sloping toward a French drain that leads to a sump. Standpipes allow monitoring of rainwater should it enter the trench.

Waste containers are placed into concrete vaults that may be stacked up to three layers high. Backfill around and over the filled concrete vaults consists of sand and soil. Finally, an engineered cap consisting of multiple layers of sand, clay, high-density polyethylene, and topsoil covers the trench area. Shallow-rooted grasses planted on top of the cap control erosion. This cap serves as a barrier to help isolate the trench from rainwater infiltration.

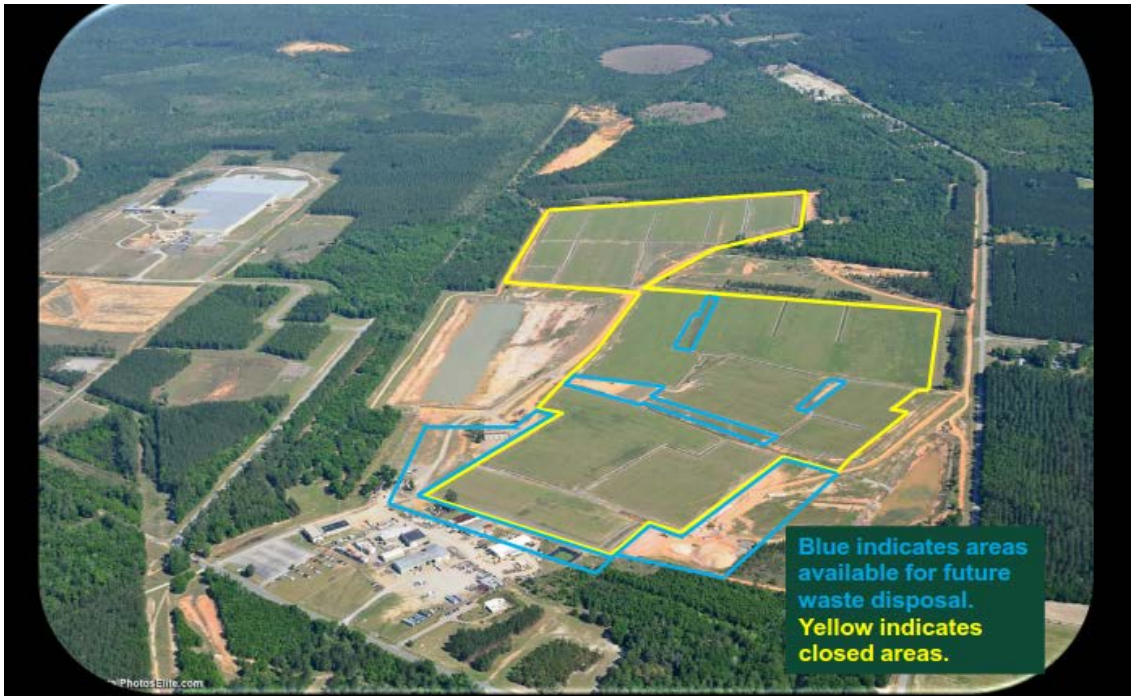


Figure C-29. Aerial Photograph of Barnwell, SC Facility (Source: Energy*Solutions* 2013)

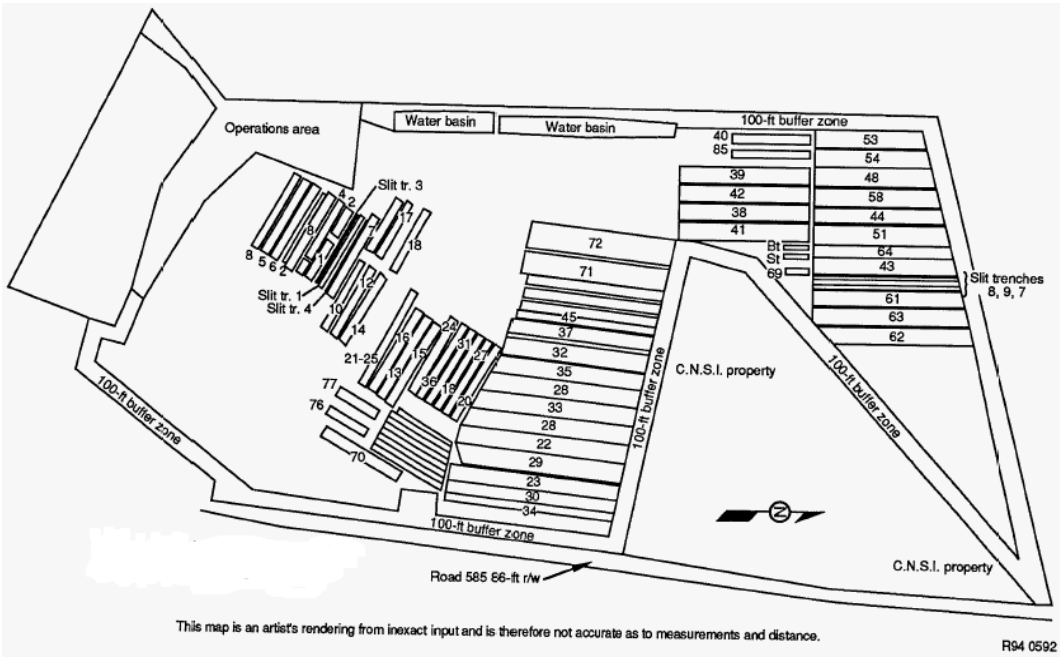


Figure C-30. Barnwell, SC Current Site Configuration

C.1.3.4 <u>Waste Characteristics</u>

Since the commencement of disposal operation s at the Barnwell facility in 1971, about 28 million cubic feet (about 90 percent of the available disposal volume) has been disposed of. About 92 percent of the waste volumes come from nuclear reactors. Current state law prevents disposal of wastes generated outside of the Atlantic Compact region. Class A, B, and C wastes including reactor components, contaminated wood, concrete, glass, metal, fabric, paper, and resins can be placed in the active disposal cells.

Figure C-15. Barnwell, SC Concrete Vault Placement

C.1.3.5 Current and Projected Physical Status

Final closure of the major portions of the Barnwell facility started in 2008. The "Phase I closure" activities involved stabilization and closure including construction of an enhanced cover which included an impermeable synthetic trench caps over 96 acres (Figure C-16). Phase 1 closure was completed in June 2013 (Energy*Solutions* 2014). The facility is currently operating, accepting in-region waste for disposal; this operations period is estimated to continue until June of 2038. A one-year final site closure (Phase II closure) is planned, with a 5 year phase II post-closure monitoring period. Following this, a 100-year long intuitional control period will begin, with responsibility for the facility's post-closure care transferred to the custodial agency (the Board), which is scheduled to end in 2144.

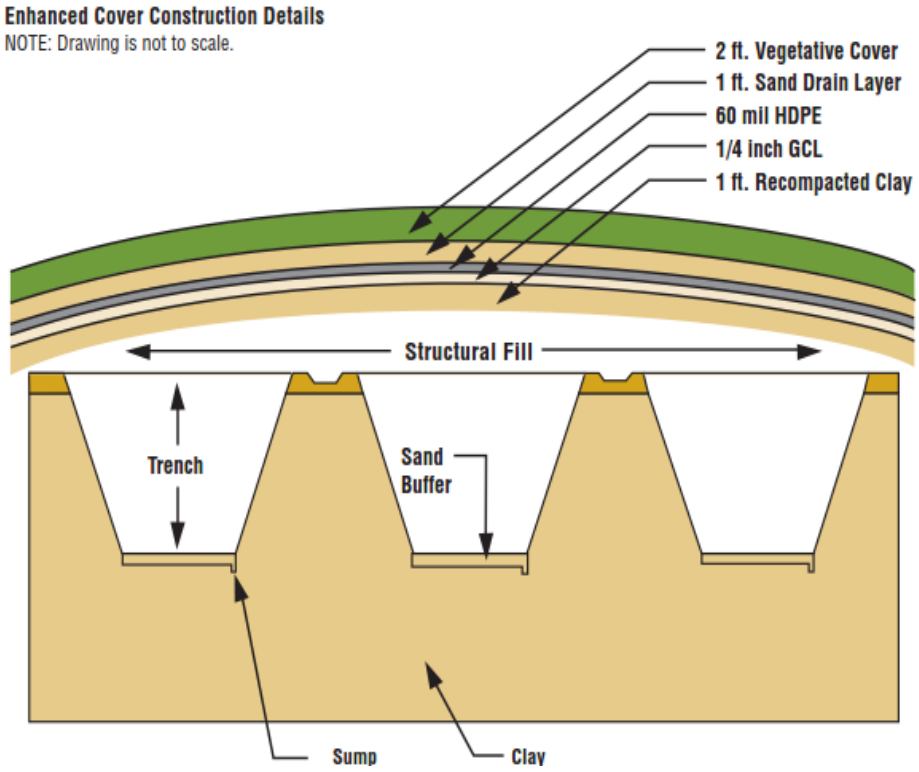


Figure C-16. Enhanced Cover Construction Details , Barnwell, SC Facility (Source: Energy*Solutions* 2014)

C.1.3.6 Method Used for Funding Post Closure Activities

South Carolina's Atlantic Interstate Low-Level Radioactive Waste Compact Implementation Act identified the Decommissioning Trust Fund and the Extended Care Maintenance Fund. The Decommissioning Trust Fund and Extended Care Maintenance Fund were initially funded by a surcharges added to waste disposal rates, however the current disposal rates now include these surcharges. Closure activities have been and will continue to be paid from the Decommissioning Trust Fund. The facility operator is responsible to conduct closure and post-closure observation activities. The Board will reimburse Energy*Solutions* from the fund for associated closure costs, as appropriate. It is not a trust fund, and existing legislation allow the fund to be used as part of the legislature's budget.

C.1.3.7 Status of Financial Assurances Provided

The South Carolina Budget and Control Board commissioned a report in October 2008 to evaluate the adequacy of the Barnwell Extended Care Fund in light of the risks identified and concluded that it is sufficiently funded to cover the costs and uncertainties associated with activities planned for post-closure care of the facility. The report (URS Corporation 2008) concludes that the fund is currently sufficiently funded to cover some but not all of the costs that might be incurred in responding to unplanned events and consequences.

In accordance with Federal guidelines (10 CFR 61.59) and State law (13-7-30 S.C.C.), the State of South Carolina accepts and assumes responsibility for ongoing monitoring, maintenance, and custodial care of the site after the facility is closed. As of December 31, 2013, the Decommissioning Trust Fund Balance was $4.185 Million and the Extended Care Maintenance Fund was $ 145.52 Million (Energy*Solutions* 2014).

C.1.4 Waste Control Specialists, LLC at Andrews, TX

The Waste Control Specialists, LLC (WCS) facility is situated in Andrews County near the border of Texas and New Mexico and the closest population center is Eunice, New Mexico, 6 miles away (Figure C-17). There are no rivers or streams within 5 miles. Annual average precipitation for the area is approximately15 inches. The WCS Facility currently operates multiple facilities as shown on Figure C-18 and labeled as indicated below:

Map No.: Fig. C-18	Facility Description	RML	Hazardous Permit	TSCA Permit
1	Treatment, Processing & Storage	04100	50358	TXD 988088464
2	Hazardous Waste Landfill			
3	Byproduct Facility	05807	-	-
4	Low Level Storage Pad		-	-
5	Federal Waste Facility (FWF)	04100	50397	TXR 060075788
6	Compact Waste Facility CWF)	04100	-	-

The Compact Waste Facility (CWF) is used for disposal of wastes generated by members of the Texas Compact, including Texas and Vermont. The Federal Waste Facility receives LLRW and mixed LLRW from DOE facilities for disposal (Waste Control Specialists LLC [WCS] 2016).

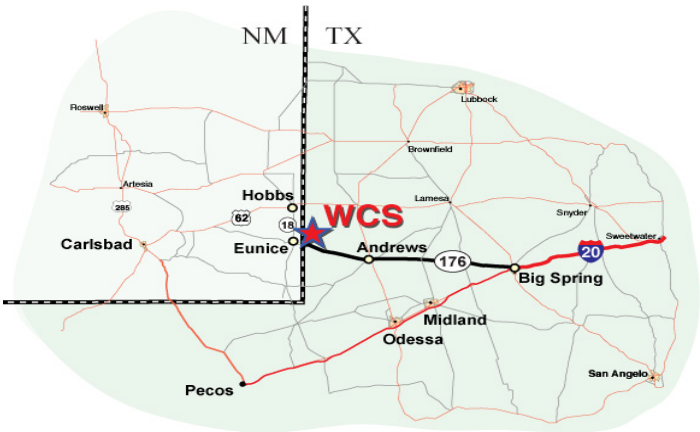


Figure C-17. Location of the WCS Facility near Andrews, TX

Figure C-18. Licensed Facilities at the WCS, TX **Facility** (Facilities described by number on map in Section C.1.4) (**Source: http://www.wcstexas.com/facilities/interactive-wcs-facilities-map/**)

C.1.4.1 History

The WCS facility was initially permitted in 1994, the facility began hazardous waste operations in 1997, the byproduct facility was licensed, and the Byproduct facility was licensed in 2008. The hazardous waste landfill and Byproduct facility are completely independent repositories with each having liner and leachate collection and monitoring systems. The LLRW facilities were licensed in 2009, and construction facilities began in January 2011. The Compact Waste Facility (CWF) first received waste in 2012 and the Federal Waste Facility (FWF) received waste in 2013. The facilities have anticipated operating lives of 35 years.

C.1.4.2 Site Characteristics

The WCS property is underlain primarily by the Late Tertiary/Quaternary-aged pedogenic caprock caliche that developed on all pre-Quaternary strata in the High Plains (Fig. C-19). Quaternary Blackwater Draw eolian sands and younger windblown sands overlie the caprock caliche in the northern and southern parts of the proposed LLRW area. The sands, gravels, and sandstones on which the caprock caliche developed are situated in the same stratigraphic interval and hydrogeologically they represent a single hydrostratigraphic unit overlying the Triassic red beds, the distinctive red and purple claystones, siltstones, and sandstones of the Triassic Dockum Group. The undifferentiated sands, gravels, and sandstones of the Ogallala/Antlers/Gatuña Formations are also known as the OAG unit. The OAG unit is present beneath the entire WCS property at depths ranging from about 20 feet in the vicinity of the proposed disposal site to about 60 to 70 feet on the northern and southern boundaries of the WCS property.

The WCS property is located over a geologic feature referred to as the Red Bed Ridge. The Red Bed Ridge is a prominent buried ridge developed on the upper surface of the Triassic Dockum Group. The ridge may have developed as a local topographic high from erosion, minor compression faulting, and folding during the Jurassic time, or a combination of these two processes. The Cooper Canyon Formation, with characteristically red and purple claystones, siltstones, and sandstones, comprises the upper 600 feet of the Dockum Group immediately beneath the proposed disposal site. The Dockum Group red beds are present beneath the entire WCS property.

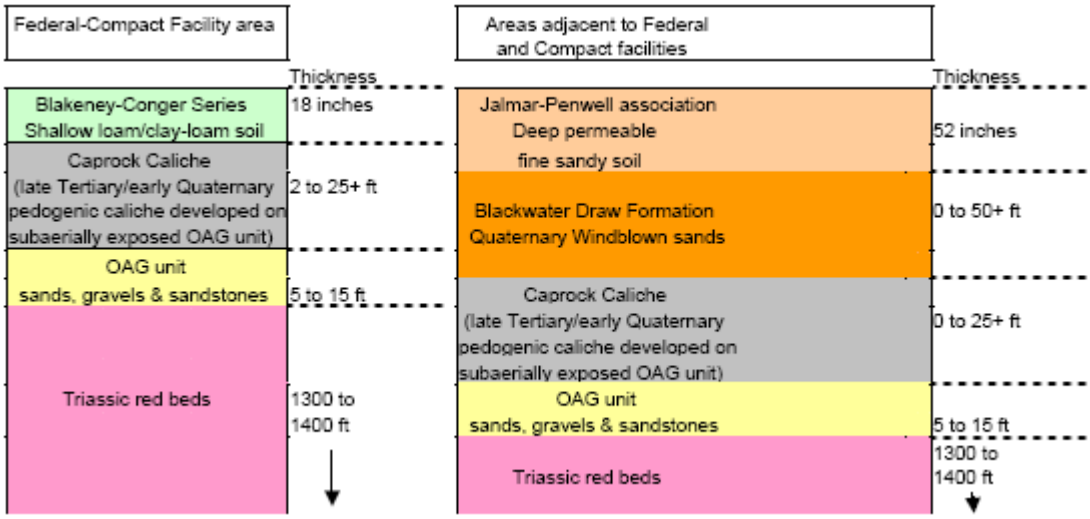


Figure C-19. Andrews, TX Geology

C.1.4.3 Facility Characteristics

Construction on the LLRW facilities began in January 2011. The facilities have anticipated operating lives of 35 years. Separate disposal for Compact and Federal waste will occur and the respective disposal units will subsequently be closed. Each disposal unit will have dedicated support systems and equipment for operations and closure. Disposal units will be incrementally

excavated and filled as waste is received and capped with a final cover system as a progressive closure during operations.

The FWF and CWF have different waste arrays. All containerized wastes in the CWF and FWF is placed in steel-reinforced concrete containers that are placed within a reinforced concrete barrier, and will be covered with an engineered cover system. Currently WCS is authorized to accept soils and soil-like bulk waste not containing transuranic radionuclides or radionuclides with half-lives longer than 35 years and to dispose of these in a disposal unit physically separate from containerized waste.

Figure C-20. WCS, TX CWF Facility

Figure C-21. WCS, TX FWF Facility

Both the FWF and CWF will have at least 5 meters (16.4 feet) of cover materials or Fitted with intruder barriers that are designed to protect against an inadvertent intrusion for at least 500 years in accordance with 30 TAC §336.730(b)(3), and the site will be restored to approximately the pre-existing natural grade.

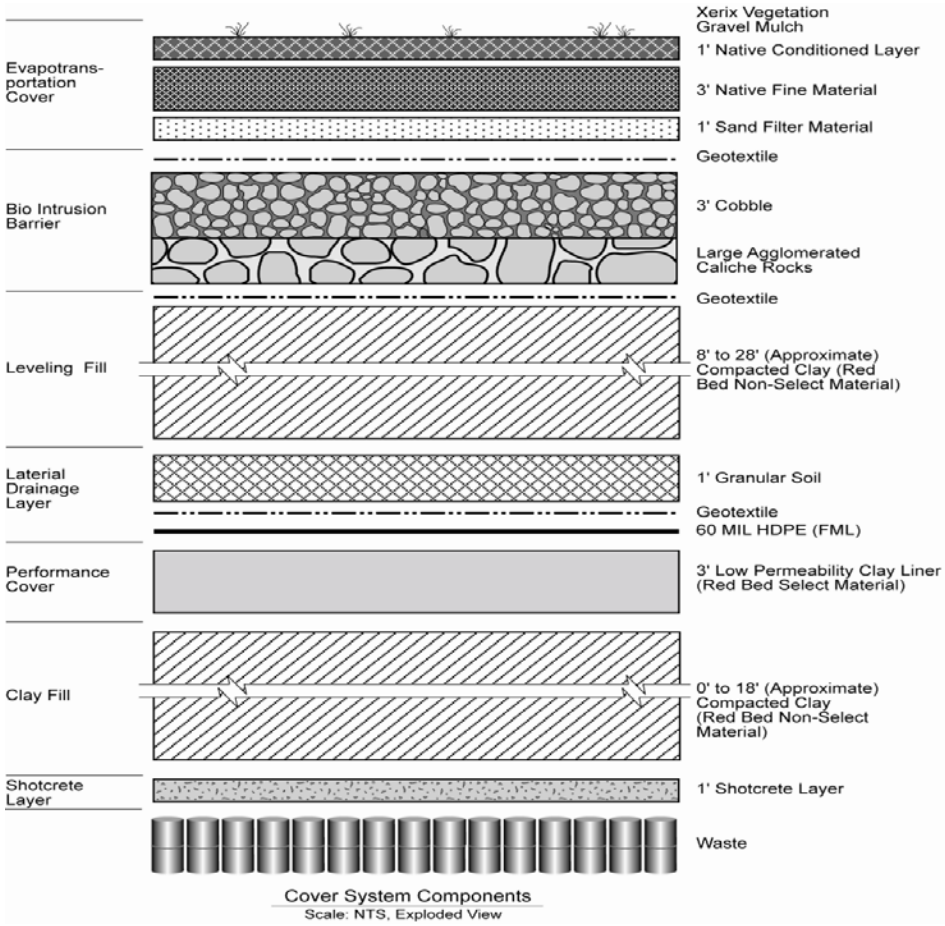


Figure C-22. WCS, TX Proposed Final Cover System

C.1.4.4 <u>Waste Characteristics</u>

The CWF accepts Class A, Class B, and Class C LLRW generated in the member states of the Texas Compact. The waste generators include nuclear electric utilities, industrial facilities, universities, hospitals, and the military. All of the LLRW accepted for disposal must be classified as Class A, B, or C according to the classification system in the Texas Administrative Code [30 TAC §336.362(a)]. The total volume of Compact waste is limited to 9 million feet^3 and the total activity is not to exceed 3.8 million curies. The Texas legislature has pending legislation that would allow limited acceptance of wastes from outside of the Texas Compact.

The FWF accepts LLRW and mixed LLRW from DOE facilities across the country comprised of Class A, B, and C wastes as defined by the U.S. NRC. The FWF capacity is limited, by law, to be no more than 6 million yd^3. The majority of the waste volume is to be comprised of wastes derived from environmental restoration (ER) activities to be conducted at DOE facilities to clean up formerly used sites, while the remainder is projected to be comprised of wastes generated from waste management (WM) activities. The volume of Federal waste to be disposed is limited to 26 million feet^3 and the activity is not to exceed 5.6 million decay-corrected curies of radioactivity, and not more than a total of 8.1 million feet^3 of and total decay corrected

radioactivity of 5.5 million curies of Containerized Class A, Class B and Class C waste collectively

C.1.4.5 Current and Projected Physical Status

This facility has received regulatory approval to receive wastes for disposal and is currently operating. As indicated, WCS also operates adjacent RCRA/TSCA and Byproduct Facility operations. The Byproduct Facility is located within a 16-acre landfill fitted with an engineered liner, associated support structures on the surface, and a buffer zone. The total waste disposal capacity of the Byproduct Facility is approximately 1 million cubic yards.

C.1.4.6 Method Used for Providing Financial Assurances

As required by the License, WCS provided financial assurance in the amount of $139.5 million (in 2010 dollars) prior to accepting waste, $20 million in a surety bond and the remainder in stock held in a third-party trust (Trust). This financial assurance amount applies to both facilities covered under the License (TCEQ 2012).

The issuer of the WCS surety bond, U.S. Specialty Insurance Company, is currently approved by the U.S. Treasury Department for bonding capacity up to $50,730,000, well above the $20 million bond issued on behalf of WCS. The surety company is also rated A+ (Superior) by A.M. Best Company, an independent insurance rating service (TCEQ 2012).

C.1.4.7 Status of Financial Assurances Provided

The Trust provided by WCS is specifically tailored to allow and manage the use of stock investments. It is funded 100 percent with common stock in Titanium Metals Corporation (TIMET), a publicly traded stock on the New York Stock Exchange (NYSE). The trustee is U.S. Bank, National Association, and the TCEQ is the beneficiary. The Trust is structured to mitigate risk by requiring stock with a value greater than the required financial assurance amount to create a cushion or buffer, as well as other protective measures. As one of these additional protective measures, the Trust agreement requires the deposit of $9 million in cash in the Trust each year on or before the anniversary of the initial funding of the Trust. The first payment of $9 million to the Trust was received on November 1, 2012.

The table on the following page summarizes the different financial assurances and approved financial assurance amounts (in 2014 dollars) for the WCS facilities.

The TCEQ believes that the closure, post closure, and corrective action cost estimates are generally representative of costs associated with actual site closures, post-closure maintenance and, if needed, corrective actions (TCEQ 2014). The adequacy of financial assurance for this site is reviewed annually and presented publicly before the Commission. In addition, if the Environmental Radiation and Perpetual Care Account is certified by the legislature, the TCEQ will have access to dedicated fee revenue that can be used in the event of a release or unplanned event requiring corrective action at an abandoned or active radioactive site (TCEQ 2014).

Map No. on Fig. C-18	Facility Description	Waste Control Specialists Facility - Financial Surety Amounts (2014 Dollars)							
		Hazardous			Radiological				Total
		Existing Units	Proposed Units	Post Closure	Decom.	Post Op.	Institutional Control	Corrective Action	
1	Treatment & Storage	$15,262,826	$1,221,105						$18,205,878
2	Hazardous Waste Landfill			$1,721,948					
3	Byproduct Facility				$5,185,043	$88,106	$880,160		$6,153,309
4	Low Level Storage Pad								
5	Federal Waste Facility	$56,336,969		$56,725,606					
6	Compact Waste Facility				$34,306,493	$9,498,675	$23,478,828	$20,604,500	$200,951,070

C.2 *CLOSED COMMERCIAL LLRW DISPOSAL FACILITIES*

Closed commercial LLRW disposal facilities reviewed and characterized are the following:

- ✓ US Ecology Inc. at Beatty, NV
- ✓ US Ecology Inc. at Maxey Flats, KY
- ✓ US Ecology Inc. at Sheffield, IL
- ✓ Nuclear Fuel Services, Inc. at West Valley, NY

As summarized for currently operating and proposed commercial LLRW facilities. For each facility, the following information is summarized:

- ✓ History
- ✓ Site Characteristics
- ✓ Facility Characteristics
- ✓ Waste Characteristics
- ✓ Method Used for Funding Post-Closure Activities
- ✓ Current and Projected Physical Status
- ✓ Status of Financial Assurances Provided

C.2.1 US Ecology Inc. at Beatty, NV

The Beatty facility was the first commercially operated radioactive waste disposal facility to be licensed by the AEC (later NRC). The facility is located in Nye County in the Amargosa Desert approximately 105 miles northwest of Las Vegas, Nevada. Both the facility location and select groundwater monitoring locations are shown below.

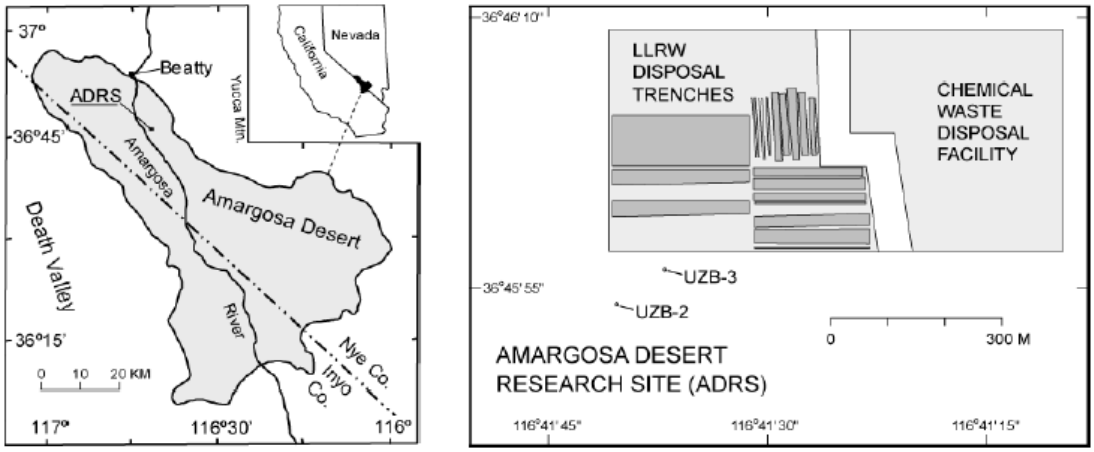


Figure C-23. Location and Layout of Former US Ecology Facility at Beatty, NV

C.2.1.1 History

The site opened in September 1962 and received radioactive waste for burial until December 31, 1992. On January 1, 1993, the facility closed as part of an agreement between the governor of Nevada and the Rocky Mountain Compact. The first operator was California Nuclear, Inc, which transferred the assets to Nuclear Engineering Company (NECO) in 1968. In 1981, the company changed its name to US Ecology. LLRW was disposed of at Beatty primarily by shallow-land burial. On December 30, 1997, the Nevada Department of Health (NDOH) accepted custodial care for the site. US Ecology still operates a RCRA/TSCA disposal facility adjacent to the LLRW site.

C.2.1.2 Site Characteristics

The site in a semi-arid environment and has not exhibited water management problems in the wastes. The intermittent Amargosa River is five miles from the site. Rainfall is less than 5 inches per year. In 1976 the U.S. Geological Survey (USGS) began studies of water movement in the unsaturated zone at a site in the Amargosa Desert near the facility. In 1997 the site became part of the USGS's Toxic Substances Hydrology Program after unexpectedly high levels of tritium were discovered in unsaturated-zone gas samples from the site. The State of Nevada has not classified this as serious.

Sediments in the Beatty area consist mainly of sub-horizontal alluvial sands and gravels. Large areas of extensive coarse gravel deposits exist at depths of about 1 to 2 meters (immediately below the root zone), and again at about 23 to 25 meters. These alluvial fans allow for radionuclide migration and preferential transport of contaminants through the soil.

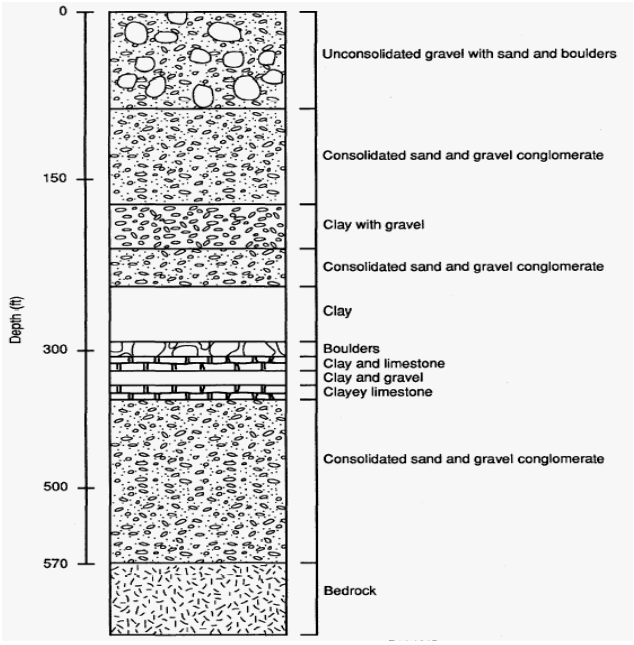


Figure C-24. Beatty, NV Geology

C.2.1.3 Facility Characteristics

Trenches were constructed with conventional earth-moving equipment, following a cut-and-cover procedure. In all, 22 trenches, ranging from 300 to 800 feet long, 4 to 350 feet wide, and 6 to 50 feet deep were created. Because of the high stability of the local soil, trenches were typically cut with nearly vertical side slopes, maximizing the space available for waste disposal.

A 200-foot wide buffer zone and a fence separate it from US Ecology's current operations. US Ecology's current Beatty operation currently accepts hazardous, PCB, and non-hazardous wastes for treatment and disposal adjacent to the closed facility. The Beatty site also hosts chemical oxidation and thermal desorption services. Beatty is one of few sites in the nation that also accepts hazardous / PCB mixed wastes.

C.2.1.4 Waste Characteristics

At the time of disposal, the facility received 4,729,689 cubic feet of waste, containing 640,529 curies of by-product material, 4,035,624 pounds of source material and 605 pounds of SNM.

Beatty allowed the disposal of containerized solid and liquid waste. Liquid waste can be corrosive and damage containers over time. Disposal of liquid LLRW is now forbidden by 10 CFR 61 at operating and proposed LLRW facilities.

C.2.1.5 Current and Projected Physical Status

The former Low Level Radioactive Waste (LLRW) located near Beatty, Nevada was closed in 1992. The LLRW facility resides on land owned by the State of Nevada.

US Ecology's current Beatty operation currently accepts hazardous, PCB, and non-hazardous wastes for treatment and disposal adjacent to the closed facility. The Beatty site also hosts chemical oxidation and thermal desorption services. Beatty is one of few sites in the nation that also accepts hazardous / PCB mixed wastes.

Earlier research has demonstrated lateral movement of tritium and carbon-14 off-site. The prevalent mechanism for radioactive carbon transport appeared to be microbial action on radioactive organic compounds in the waste.

During 2004, tests at the Beatty LLRW site indicated contamination. Nevada State Health Division staff performed six post-closure inspections collected 48 samples at the closed LLRW facility during 2004.

Figure C-25. Beatty, NV Undated Photo

C.2.1.6 Method Used for Providing Financial Assurances

The Nevada Department of Health and Human Services, Radiation Control Program provides for the routine surveillance and long-term maintenance of the closed facility using a state-controlled fund. The Low Level Radioactive Waste Maintenance Fund (budget account 251-3152) was established pursuant to Nevada Revised Statutes Chapter 457 and 459, with funding derived from a state surcharge per cubic foot of waste received at the Beatty facility. This fund is intended for the perpetual care of the Beatty LLRW facility. Currently, US Ecology is contracted to perform the long-term monitoring and maintenance of the LLRW facility.

C.2.1.7 Status of Financial Assurances Provided

Two successive legislatures diverted funds from the perpetual care account to address temporary budget shortfalls (Nevada RCP 2015). The fund amount in the perpetual care account was originally about $14 M. The current fund balance in this perpetual care account is approximately 1.4 M (Nevada RCP 2015). The governor recommended during the fiscal year 2014-2015 budget planning process that approximately $1.14 million be retained in the perpetual care fund for FY2014-2015. The balance fluctuates with the state budget as proposed by the executive branch and approved by the legislature. If additional funds are required for performing required

maintenance oat the facility, a request is submitted to the State for an additional funding appropriation (Nevada RCP 2015).

C.2.2 US Ecology Inc. at Maxey Flats, KY

The Maxey Flats Disposal Site (MFDS) is located about nine miles northwest of Morehead, KY, 65 miles northeast of Lexington, KY and 200 miles southeast of Cincinnati, OH. It is in southeastern Fleming County along KY 1895 near the border with Rowan County. The Commonwealth of Kentucky owns the 280-acre site. The site was opened under a lease arrangement between the State of Kentucky and NECO, later known as US Ecology.

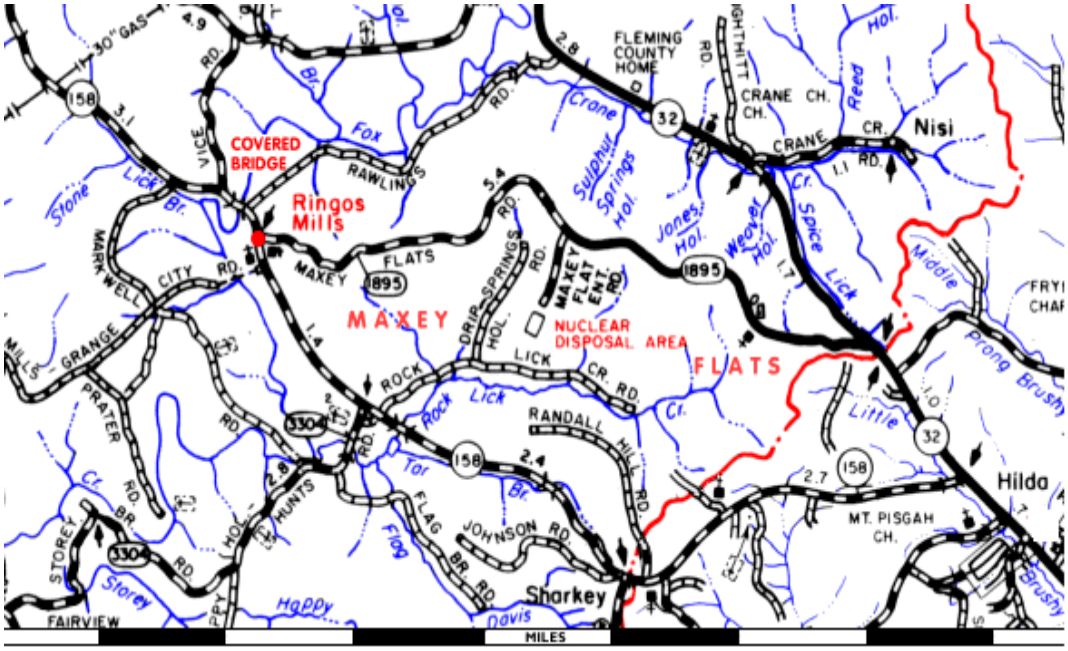


Figure C-26. Location of the Former US Ecology Maxey Flats, KY Disposal Facility

C.2.2.1 History

The MFDS was in operation from 1963 to 1977. The intent was to spur economic development and attract nuclear industry to a disadvantaged area of Kentucky. The site was ordered closed by the Commonwealth of Kentucky in December 1977 after it was discovered that trench leachate was seeping along a thin siltstone bed about 25 feet below ground surface laterally into an adjacent, newly constructed trench. Most of the trenches were excavated to the thin siltstone bed and it served as a conduit for leachate migration.

Continuing contamination migration issues lead to designation as a Superfund site in 1983. During the Superfund work, some of the treated and solidified wastes were interred on site.

C.2.2.2 Site Characteristics

Surface soils at the site generally consist of light-brown silty clay, ranging in depth from 1 to10 feet. In most areas of the disposal site, this cover layer is underlain by a thin layer of siltstone or very fine sandstone, which is directly underlain by shale, siltstone, and sandstone. The trenches lie entirely within the Nancy member of the Borden Geologic Formation. The Nancy member is green shale that manifests plastic behavior when wet, and which is interbedded with siltstone and sandstone. It is an aquitard, having low permeability, and contains isolated groundwater in the soil zone at a depth of 3 to 6 feet. There is a continuous groundwater table at a depth of 30 to 50 feet, but no regional aquifer is present in the area.

Groundwater migration occurs primarily through shale fractures and interlinking sandstone beds. The ridge area where the site is located slopes off sharply on three sides. The area is drained on three sides: to the east by a perennial stream, No-Name Creek, which collects about 75 percent of the surface runoff; to the west by Drip Springs Hollow Creek, and to the south by Rock Lick Creek. The drainage from these tributaries flows into Fox Creek and then into the Licking River.

An example of the site geology at the MFDS is illustrated below:

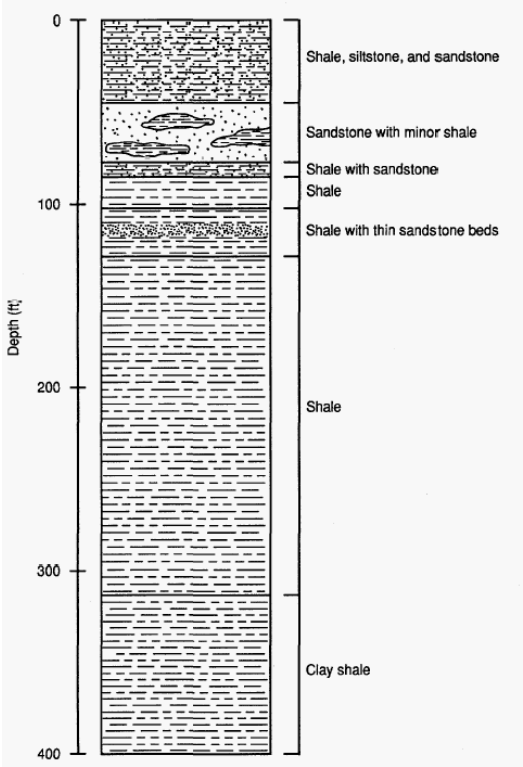


Figure C-27. Maxey Flats, KY Disposal Site Geologic Condtions

C.2.2.3 Facility Characteristics

At the MFDS, the trenches were excavated to their full size when opened, prior to placement of waste containers.

The disposal site at closure consisted of 52 trenches, a number of hot wells (disposal caissons), and several special pits. The trenches ranged from 150 to 680 feet long, 10 to 75 feet wide, and 9 to 30 feet deep. The floor of each trench slopes toward a sump constructed at the low end to permit water collection and removal. The hot wells were lined, variable in size (generally 15 feet deep and several feet in diameter), and capped with concrete. The hot wells were used to dispose of high-activity gamma sources. The special pits, which vary from 15 to 75 feet long, 9 to 25 feet wide, and 5 to 15 feet deep, were used to dispose of large volumes of higher activity waste, such as spent resins from power reactors.

In 1978 the Commonwealth of Kentucky purchased the land. In 1986, EPA added MFDS to the National Priorities List (NPL). The remediation of the site began in 1995 and concluded in 2003. The Superfund Branch, Division of Waste Management, assumed operation and maintenance of the site in February 2003 and full control of the site in October 2003 following the issuance of the Certificate of Completion by EPA.

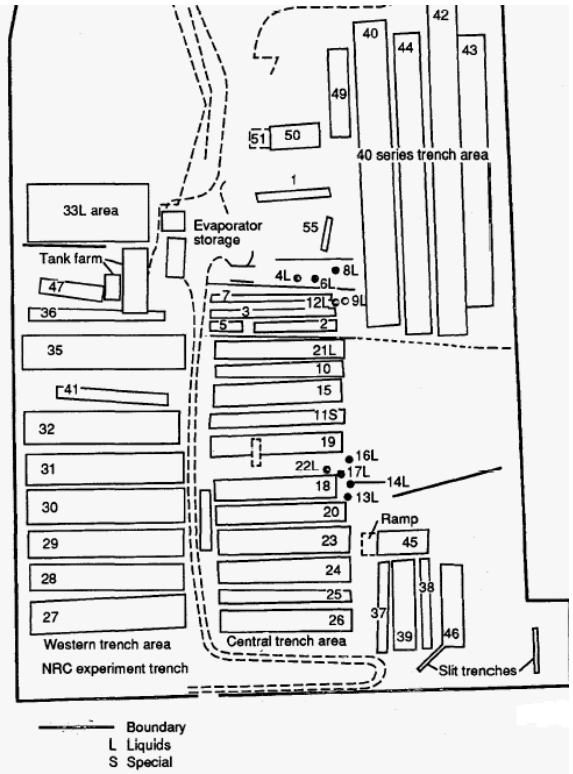


Figure C-28. Maxey Flats, KY Trench Configuration

C.2.2.4 <u>Waste Characteristics</u>

At the time of disposal, the facility received 4,776,836 cubic feet of waste, containing 2,400,690 curies of by-product material, 533,579 pounds of source material and 952 pounds of SNM.

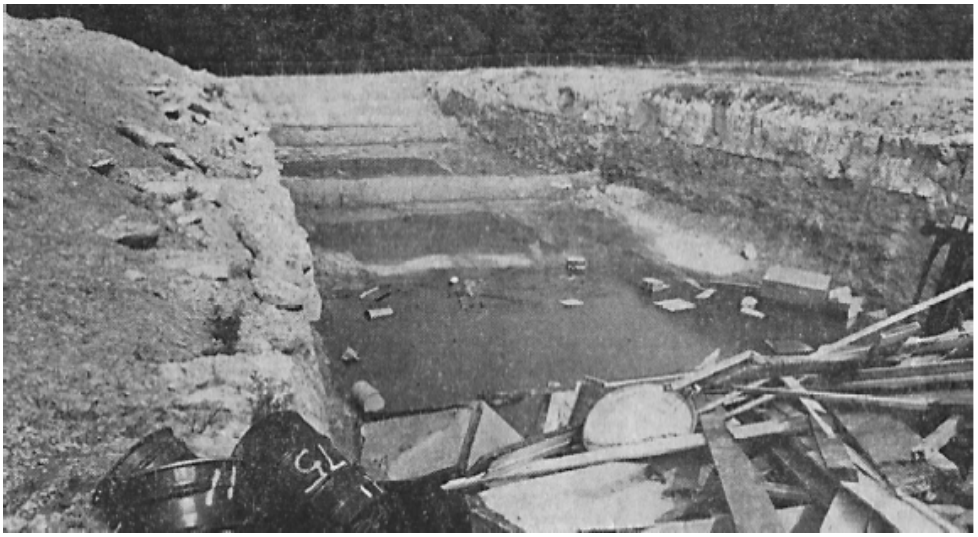


Figure C-29.Maxey Flats, KY Unlined Trench Burial of Waste During 1975

C.2.2.5 Current and Projected Physical Status

This site is closed and inactive. A multi-layer engineered final cover system has been designed and is currently being installed at the facility.

Figure C-30. Maxey Flats, KY During Fall 2001

More than 300 people live within a five-mile radius of the "Restricted Area"; the closest residence is within ¼ mile.

The State of Kentucky maintained the 60-acre synthetic interim cap pending the construction (in progress) of the final multi-layer cap. The EPA and Kentucky estimated that the buried waste had adequately settled in order to allow final cap installation work to begin.

Following construction of the final cap, the Commonwealth will perform custodial and institutional control maintenance necessary to preserve the integrity of the selected final capping remedy in perpetuity.

Figure C-31. Maxey Flats, KY Final Cover Construction in Progress (2015)

C.2.2.6 Method Used for Providing Financial Assurances

The original MFDF closure funding is not addressed in this report. Following closure in and placement on the NPL, the U.S. Department of Justice and EPA entered into a consent decree with 400 private and government parties in 1995. This first consent decree was to fund stabilization and minimize further pollution from the MFDS at an estimated cost of $60 million. Under this decree, 43 companies were ordered to remove approximately 3 million remaining gallons of water from waste burial trenches and install an interim cap. Six federal agencies paid for a majority of this work, estimated to cost $45 million. The private parties and federal agencies agreed to pay $5 million of EPA's past response costs.

In a second consent decree, state, federal, and private parties agreed to pay $8.5 million toward the cleanup and for past response costs.

C.2.2.7 Status of Financial Assurances Provided

The Commonwealth is solely responsible for funding post-closure activities at MFDS in perpetuity. Tax monies will be used to fund these activities

C.2.3 US Ecology Inc. at Sheffield, IL

The Sheffield LLW disposal site is located about 5 miles southwest of Sheffield, IL. Sheffield is about 140 miles west-southwest of Chicago, and about 45 miles east-southeast of Moline.

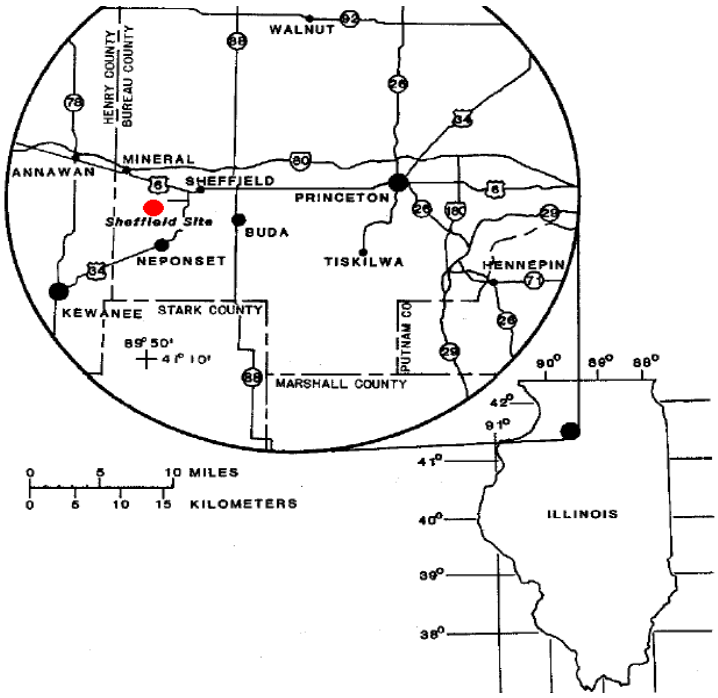


Figure C-32. Location of the Former US Ecology Facility at Sheffield, IL

C.2.3.1 History

The Sheffield facility was in operation from 1967 to 1978. The original operator was California Nuclear, Inc., and later NECO, which became US Ecology. US Ecology also operated adjacent hazardous waste disposal facilities. Sheffield was closed after the operator experienced lengthy delays with its NRC license renewal. Sheffield's operator had requested an increase in the lifetime and capacity of its original 20-acre tract, a request that was denied by the NRC because of the discovery of far more permeable sand and other coarse-grained deposits than had been found in the original site investigation.

C.2.3.2 Site Characteristics

The Sheffield LLW disposal site is located on rolling glaciated terrain. The ground in which the disposal trenches were placed consists of wind-blown silt, pebbly clay, water-deposited sand and gravel, lake deposits of silt and clay, and silty, sandy stream sediments. The site is underlain by both shallow and deep aquifers. The bedrock underneath the site is approximately 450 feet thick and provides a relatively impermeable barrier between the two aquifers. A pebbly sand unit extending across the middle of the site, and continuing offsite to the northeast, lies under approximately two-thirds of the site and forms the most permeable unit at the site. This pebbly sand unit serves as an underground drain, carrying the bulk of the groundwater from the site.

The site is in the headwater tributaries of Lawson Creek, which is 1 mile east of the site at its nearest point. Three small intermittent streams drain the Sheffield site. Two streams drain the southern portion of the site, and the third drains the northern portion of the site. An abandoned

strip mine pit, now filled with water and called Trout Lake, is located 800 feet northeast of the disposal site.

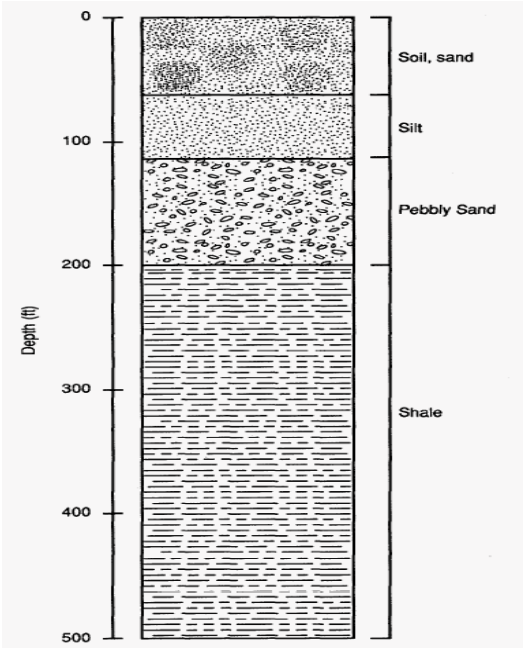


Figure C-33. Sheffield, IL Geology

In December 1977, tritium was found in samples taken from monitoring wells constructed by the USGS in the southeast corner of the site. It appeared that the tritium was migrating from Trench 11 and that the rate of groundwater movement from this trench significantly exceeded the original estimates. To further explore the site hydrogeology, the USGS performed a horizontal boring in the southeast corner of the site between December 1978 and March 1979. The information obtained from this boring indicated that the presence of permeable sand and other coarse-grained deposits was far more extensive than discovered by the original site investigation (Illinois Emergency Management Agency [IEMA] 2009).

In November 2014, IEMA issued an updated site report summarizing the status of the Sheffield LLRW Site (IEMA 2014). Contaminants from LLRW operations are observed in ground water moving in two narrow pathways from the site. However, radionuclide concentrations in public and private drinking water supplies remain at background levels, and overall, the concentrations of tritium observed in groundwater are trending downward.

C.2.3.3 Facility Characteristics

At the Sheffield complex, US Ecology operated three disposal facilities. One of the hazardous wastes sites operated from 1974 to 1983. The second site, totaling less than five acres, operated from 1968 to 1974. The LLRW site of interest operated for ten years between 1968 and 1978, and is south and southeast of the hazardous waste facilities.

The LLRW disposal site originally consisted of 20 acres surrounded by a 170-acre buffer zone. The waste is buried in 21 separate trenches. A typical trench is 500 feet long, 50 to 60 feet wide, and 20 to 25 feet deep. A minimum of 10 feet separates the trenches at the surface. The

dimensions in Figure C-34 are approximate representations. Figure C-35. depicts typical the disposal method used while the facility was still operating.

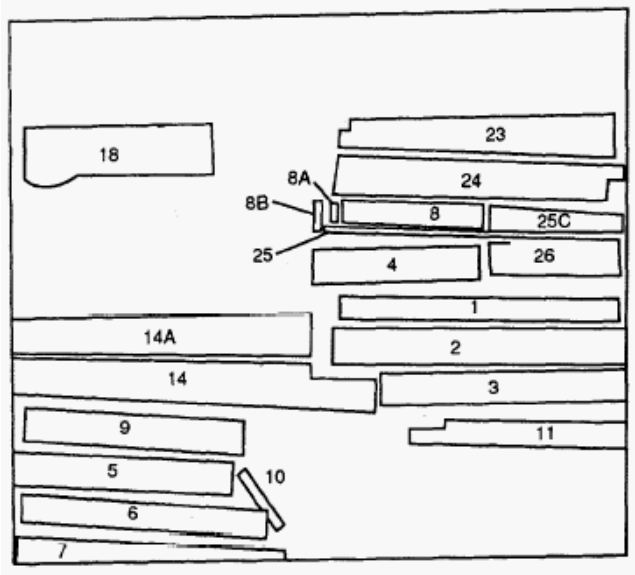


Figure C-34. Sheffield, IL Disposal Trench Configurations

C.2.3.4 Waste Characteristics

At the time of disposal, the facility received 3,119,138 cubic feet of waste, containing 60,206 curies of by-product material, 1,085,455 pounds of source material and 126 pounds of SNM.

The exact contents and inventories of the trenches are unknown as the documentation appears to be of poor quality. Wastes are known to include resins, carcasses of laboratory animals, solidified liquid wastes, clothing, construction materials, cleanup materials, containerized gases, and paper. Wastes were disposed in concrete containers, wood crates, plastic, and cardboard.

Figure C-35. Sheffield, IL Unlined Trench Burial of Waste during 1960s

C.2.3.5 Current and Projected Physical Status

This site is closed and inactive. The LLRW land is owned by the State of Illinois. In 2008, IEMA had the disposal facility cover surveyed to estimate if subsidence has occurred over the trench area, and to assess if precipitation will drain from the site or pond on the surface. The survey concluded subsidence, if any, was minimal and the cap was draining as expected. The site remains stable as of November 2014 when the site status report was last updated by Illinois (IEMA 2014).

C.2.3.6 Method Used for Providing Financial Assurances

In March 1978, US Ecology, Inc. attempted to terminate its license and lease with the State of Illinois. The State responded by filing suit against the company, saying that the company could not sever its contractual relationship with the State. The State sought a $97 million judgment against the company in a dispute over who was responsible for maintenance of the site. In May 1988, US Ecology, Inc. and the State of Illinois entered a settlement agreement that provided a plan for the closure, care, and maintenance of the LLW disposal site. The agreement was submitted to the Illinois Circuit Court of Bureau County and the lawsuit was dismissed with prejudice. Under the terms of the Agreed Order, US Ecology, Inc.: (a) established a long-term maintenance fund of $2.5 million, (b) established a $1.65 million escrow account conditioned on completing the terms of the settlement agreement, (c) completed specified physical improvements to the site including placement of a clay cap, (d) started a chemical and radiological monitoring program, and (e) must maintain the site until June 1998, after which site, buildings, and equipment were to be turned over to the State. During 1999, American Ecology, parent of US Ecology, renegotiated its corrective measures implementation plan agreement for groundwater remedial design monitoring and extraction programs after meeting the above requirements, which allowed the Company's financial assurance requirement to be reduced from a $2.5 million to $1.5 million.

A First Supplement Agreement paved the way for transfer of the disposal site to the IEMA following issuance of an audited annual financial statement of American Ecology showing that American Ecology did satisfy the financial standards. Such an audited annual financial statement was issued in 2000. IEMA assumed ownership of the LLRW site in August 2001.

American Ecology provides letters of credit as a financial assurance bond of $1.5 million. The State also requires certain financial viability tests be met.

C.2.3.7 Status of Financial Assurances Provided

US Ecology remains responsible for certain remedial actions at the facility should any become necessary. The company's liability for such an occurrence is limited to $1.9 million and expires in 2038 (IEMA 2014).

C.2.4 Nuclear Fuel Services, Inc. at West Valley, NY (State Licensed Disposal Area)

C.2.4.1 History

The Western New York Nuclear Service Center (WNYNSC) was established in the 1960s in response to a federal call for efforts to commercialize the reprocessing of spent nuclear fuel from power reactors. Nuclear Fuel Services, Inc. (NFS) operated the WNYNSC, which reprocessed spent fuel from 1966 to 1972. Regulated by the AEC, the plant reprocessed approximately 640 metric tons of spent nuclear fuel to recover usable uranium and plutonium.

In 1972, the plant was shut down to meet regulatory changes, including more stringent seismic criteria and worker safety requirements. In 1976, facing rising estimates of the cost to modify the plant to meet the new safety requirements, the operator announced its withdrawal from the business. Following NFS' withdrawal, the facility returned to New York State ownership and oversight.

The New York State Energy Research and Development Authority (NYSERDA) holds title to the 3,300 acre center on behalf of the people of the State of New York. The location of the facility is shown in Figure C-36. .

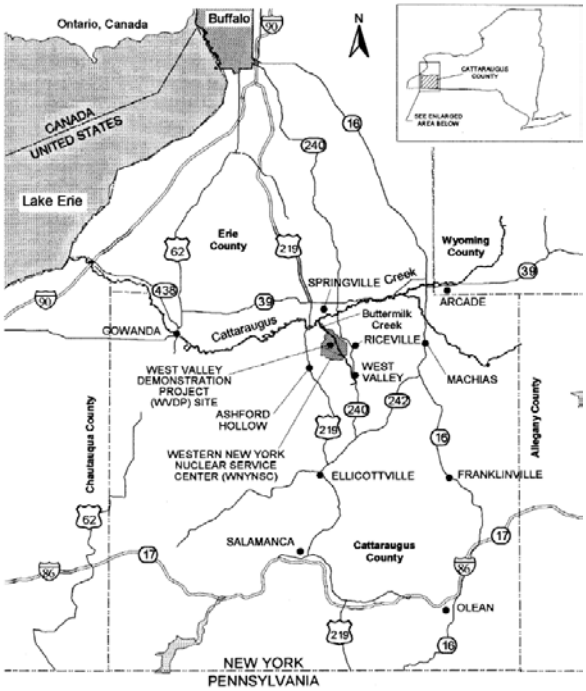


Figure C-36. Location of the Former NFS Facility at West Valley, NY

There are two radioactive disposal areas at West Valley: a five-acre disposal area NRC-licensed disposal area (NDA) for solid waste generated by the reprocessing operations conducted at the by NFS and that had radioactivity levels too high for disposal at the adjacent 15-acre commercial disposal area (the "State-Licensed Disposal Area," or SDA). The “West Valley” location in this report refers to the SDA exclusively. The SDA disposed of a variety of commercial LLRW streams received from off-site generators. There is also a non-radioactive construction and demolition debris landfill on the site premises.

The SDA opened in 1963 and continued to operate until 1975 when NFS’s operations ended and the disposal facility was returned to State control. NYSERDA holds title to the facility on behalf of the people of the State of New York. (See H. Rep. No. 96–1000 at 4 (1980) reprinted in 1980 USSCAN 3102, 3103)

C.2.4.2 <u>Site Characteristics</u>

The disposal facility is located on the south plateau near the middle of the center. The area has good surface drainage into an adjacent stream and lacks near-surface aquifers. The soil where the disposal area is located consists of a top layer of weathered till (which is a brown, firm, silty clay containing bits of gravel and rock) overlying a layer (150 to 300 feet) of unweathered till (a gray, plastic, silty clay having scattered rock fragments and pebbles). An Upper Devonian Shale of the Canadaway Group is the bedrock underlying the tills at the site. It is a moderately hard shale and siltstone bedrock, which may attain a thickness of 500 feet or more beneath the disposal area. . The geology is illustrated below.

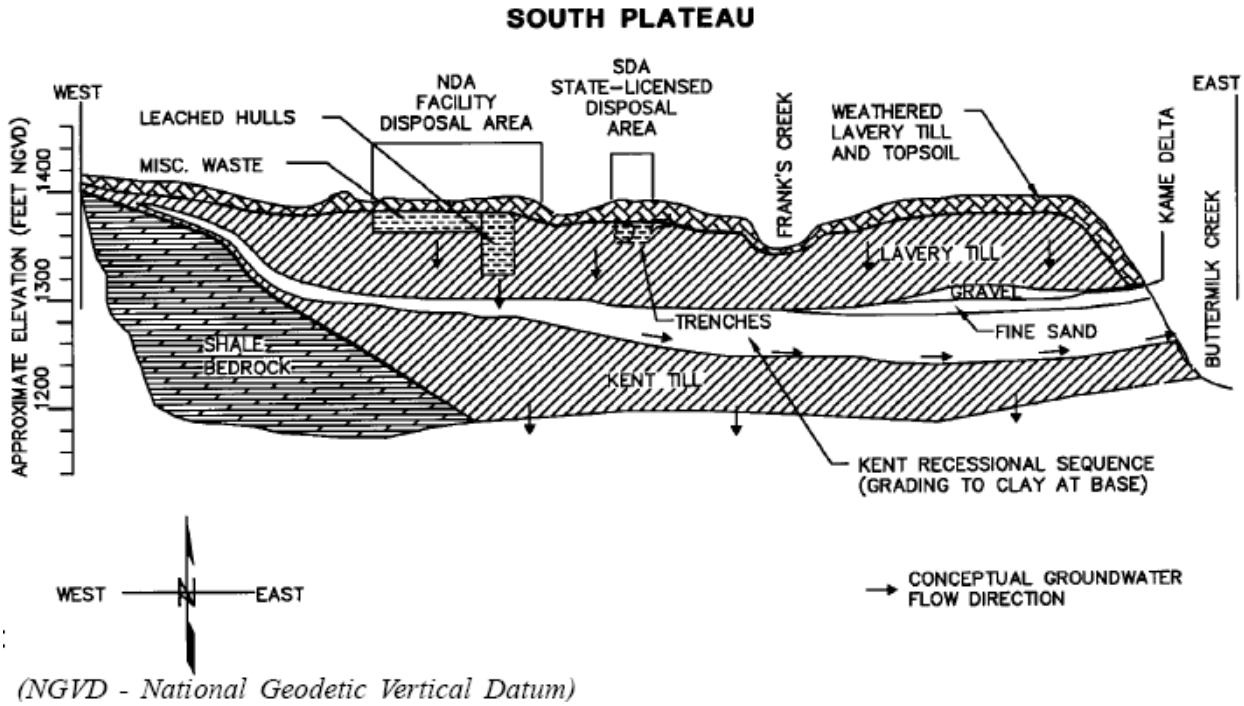


Figure C-37. Geologic Conditions at West Valley, NY SDA Facility - Vertical Exaggeration Approximately 2.5:1

The long disposal trenches are dug into the area's fine-grained, tight blue clay. Although water movement through the clay itself is slow, there were cracks in the trench cover that provide routes for rain and snowmelt to migrate. Once the water was inside the trench, the clay prevented water from exiting the through the soil. In early 1975, this accumulation, coupled with the inability to gain regulatory approval to remove, treat, and discharge the trench water on a controlled basis to adjacent Erdman Brook, led to uncontrolled seepage and overflow of contaminated water from two of the trenches. Burial operations were terminated and the SDA was initially covered with an interim soil cover, and subsequently covered with an interim exposed geomembrane cover (Section C.2.4.5).

C.2.4.3 Facility Characteristics

The SDA consists of 14 trenches containing a range of buried radioactive waste materials. The disposal trenches were excavated in segments as needed, depending on the rate of waste accumulation. The waste containers were placed in the trenches primarily by hand except for heavy containers or those with high surface radiation levels, which were emplaced by means of a crane. After each section of a trench was filled, it was covered with soil, initially to a minimum cap thickness of 4 feet and, after 1968, to a minimum thickness of 8 feet. Trenches numbered 1 through 7 had 4 feet of cap cover until 1978, when an additional 4 feet of cover was added. Erdman Brook is west of the trenches, and Frank's Creek is to their east.

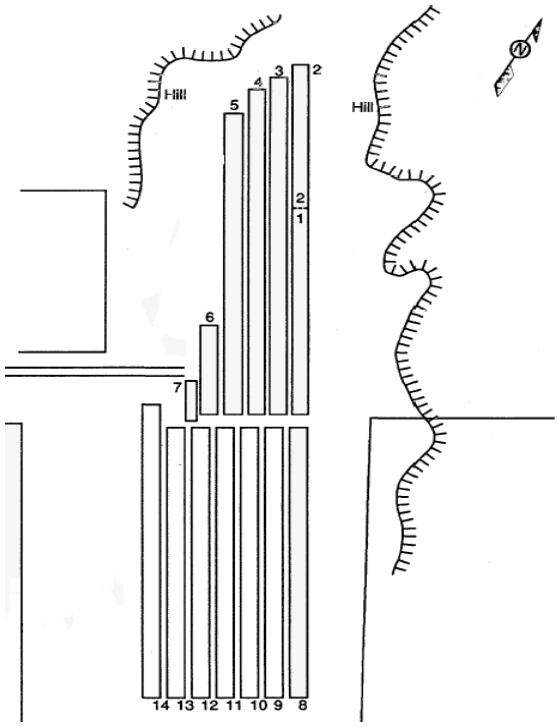


Figure C-38.. West Valley, NY SDA Disposal Trenches Configuration

C.2.4.4 Waste Characteristics

At the time of disposal, the facility received 2,467,161 cubic feet of waste, containing 1,262,300 curies of by-product material, 1,035,631 pounds of source material, and 125 pounds of SNM.

According to the New York State Department of Environmental Conservation:

"…this site pre-dates NRC's Part 61 classification scheme and disposal requirements for LLRW, a very broad cross-section of wastes were disposed of here. This includes the usual LLRW wastes streams from industrial, medical, and research facilities from that era, some wastes now considered to be GTCC, as well as Uranium, Radium, Naturally Occurring Radioactive Material (NORM), low activity Transuranic wastes, various sealed sources, debris from D&D of commercial and defense related sites, some wastes produced as a result of the spent fuel reprocessing activities on the site, even a SNAP reactor, a form of a Radioisotopic Thermoelectric Generator for powering satellites, containing plutonium enriched with Pu-238."

C.2.4.5 Current and Projected Physical Status

This site is currently inactive. Since 1983 when NYSERDA assumed management of the SDA from NFS, NYSERDA has minimized water infiltration into the disposal trenches by installing a protective geosynthetic cover over the trenches and by installing a slurry barrier wall along a portion of the upgradient perimeter of the SDA to minimize groundwater movement into the area. NYSERDA continues to monitor environmental conditions at the SDA pending final closure/decommissioning of the SDA facility. Additional interim modifications to the facility

are not planned, pending preparation and approval of a record of decision (ROD) and implementation of the selected final closure remedy.

The SDA area has one building that is available for support and is normally unoccupied. Support staff are housed at the adjacent West Valley Demonstration Project premises. The geomembrane cover is visible in the Figure C-39.. The yellow lines on the cover are designated walkways used during periodic inspections.

Figure C-39. Aerial Photograph of West Valley, NY SDA Facility (Source: NYSERDA 2015a**)**

A decision regarding the long-term management of the SDA is being addressed as part of the Environmental Impact Statement for Decommissioning and/or Long-term Stewardship at the West valley Demonstration Project and Western New York Nuclear Service Center. Currently, NYSERDA's preferred interim management alternative is to continue active management of the SDA, under regulatory oversight, for up to 10 years (NYSERDA 2015b: State Licensed Disposal Area, May 2015. URL: http://www.nyserda.ny.gov/Cleantech-and-Innovation/ Environment/ West-Valley/State-Licensed-Disposal-Area).

A Phase 1 Decommissioning Plan was issued in March 2009 and revised in December 2009, a Final EIS was issued in January 2010 (DOE and NYSERDA 2010), and a Record of Decision was signed in April 2010. The ROD specified a Phased Decision-making approach as the path

forward for Decommissioning and/or Long-Term Stewardship of the West Valley Demonstration Project and Western New York Nuclear Service Center. Under the Phased Decisionmaking alternative, the work is to be conducted in two phases. During Phase 1, which will take about 10 years, a number of highly contaminated facilities will be removed at a cost of approximately $1 billion. Also, during Phase 1, DOE and NYSERDA intend to conduct additional scientific studies (DOE and NYSERDA 2011) in order to facilitate interagency consensus on decisions regarding steps to be taken to complete decommissioning of the remaining facilities, which include the SDA. A Final Site-wide EIS identifying a preferred decommissioning strategy and assessing decommissioning alternatives for the SDA is scheduled for issuance in 2020.

C.2.4.6 Method Used for Providing Financial Assurances

NFS did establish a perpetual care fund during operations per agreement with New York State. As part of a second agreement in 1980 between DOE and New York, the state has been managing the perpetual care fund for the center. These funds are intended to be paid to DOE upon delivery of the solidified high-level wastes from the West Valley Demonstration Project to a permanent disposal repository and do not include the perpetual care of the SDA. In May 2001, the fund contained about $21.9 million.

NYSERDA currently has responsibility for 100 percent of the costs of monitoring and maintaining the SDA. NYSERDA is a public benefit corporation and legally evolved from a predecessor agency, the New York Atomic and Space Development Authority, which built and maintained the facility. Costs are covered as annual budget items and there is currently no dedicated account for funding perpetual care of the SDA.

C.2.4.7 Status of Financial Assurances Provided

NYSERDA had neither a closure plan nor extended care account specifically for the SDA when it assumed management of the SDA from NFS in 1983.

The New York State budget has a yearly line item for funding continued monitoring and maintenance of the SDA as part of NYSERDA’s ongoing involvement in actions at the WVDP site. This annual appropriation does not include funds for performing future long-term stewardship activities at the SDA. As an organization, NYSERDA is typically not predominantly funded by the State of New York budget. NYSERDA derives much of its basic revenues from an assessment on the intrastate sales of New York State's investor-owned electric and gas utilities, federal grants, and voluntary annual contributions by the New York Power Authority and the Long Island Power Authority.

It is anticipated that additional cost estimates for permanently closing and decommissioning the SDA will be developed during DOE/NYSERDA’s future Phase 2 Decommissioning Plan which address final decommissioning decisions and long-term stewardship needs for the SDA.

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