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Draft

Supplement Analysis of the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington

200 West Area Tank Waste Treatment

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

P.O. Box 550
Richland, Washington 99352

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THE HANFORD SITE

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ACRONYMS AND ABBREVIATIONS

200E	200 East Area
200W	200 West Area
AMPS	Advanced Modular Pretreatment System
AoA	Analysis of Alternatives
BOF	balance of facilities
CFR	*Code of Federal Regulations*
Ci	curie
CO	carbon monoxide
CO2eq	carbon dioxide equivalent
Cs	Cesium
CST	crystalline silicotitanate
DFHLW	direct-feed high-level waste
DFLAW	direct-feed low-activity waste
DOE	U.S. Department of Energy
DST	double-shell waste storage tank
DWPF	Defense Waste Processing Facility
Ecology	Washington State Department of Ecology
EMF	Effluent Management Facility
EPA	U. S. Environmental Protection Agency
ETF	Effluent Treatment Facility
EIS	environmental impact statement
FMCSA	Federal Motor Carrier Safety Administration
FONSI	finding of no significant impact
FWF	WCS Federal Waste Facility
FR	*Federal Register*
GHG	greenhouse gases
gpm	gallons per minute
H2C	Hanford Tank Waste Operations and Closure
HFFACO	Hanford Federal Facility Agreement and Consent Order (*see* TPA)
HLW	high-level radioactive waste
IDF	Integrated Disposal Facility
IHLW	immobilized high-level radioactive waste
IX	ion exchange
IXC	ion exchange column
LAB	analytical laboratory
LAW	low-activity waste
LAWPS	Low-Activity Waste Pretreatment System
LCF	latent cancer fatality
LDR	Land Disposal Restriction
LILO	Load In/Load Out Station
LLW	low-level radioactive waste
LSA	low specific activity
MLLW	mixed low-level radioactive waste
mrem	millirem
NEPA	*National Environmental Policy Act* of 1969

NRC	Nuclear Regulatory Commission
PFNW	Perma-Fix Northwest
PM	process module
PWST	pretreated waste storage tank
RCRA	*Resource Conservation and Recovery Act of 1976*
ROD	Record of Decision
ROI	region of influence
SA	supplement analysis
SNF	spent nuclear fuel
SOF	sum of fractions
Sr	strontium
SRS	Savannah River Site
SRS EA	*Savannah River Site Defense Waste Processing Facility Recycle Wastewater Final EA*
SST	single-shell waste storage tank
START	*Stakeholder Tool for Assessing Radioactive Transportation*
TBI	Test Bed Initiative (Demonstration)
TC&WM EIS	*Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*
TCEQ	Texas Commission on Environmental Quality
TPA	Tri-Party Agreement
TRU	transuranic
TSCR	Tank-Side Cesium Removal
TSD	treatment, storage, and disposal
UDEQ	Utah Department of Environmental Quality
USDOT	U.S. Department of Transportation
WARM	West Area Risk Management
WATT	(200) West Area Tank Waste Treatment
WCS	Waste Control Specialists LLC
WDOH	Washington State Department of Health
WIR	waste incidental to reprocessing
WM PEIS	*Waste Management Programmatic Environmental Impact Statement*
WRF	waste receiver facility
WRPS	Washington River Protection Solutions LLC
WTP	Waste Treatment and Immobilization Plant

1 INTRODUCTION

1.1 Background

The Hanford Site in southeastern Washington state stores approximately 56 million gallons of mixed chemical and radioactive waste in underground tanks—the result of more than four decades of plutonium production (1944 through 1987). The U.S. Department of Energy (DOE) is responsible for the retrieval, treatment, and disposal of this waste in a safe, efficient manner, reducing the threat posed to the Columbia River by Hanford's hazardous, radioactive tank waste (DOE 2023a).

In December 2012, DOE issued the *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE/EIS-0391; DOE 2012) (hereinafter, TC&WM EIS). In the TC&WM EIS, DOE analyzed 17 alternatives,[1] 11 of which involved retrieval, treatment, storage, and disposal of tank wastes, followed by the closure of the single-shell waste storage tanks (SSTs) at the Hanford Site. DOE issued the first in a series of Records of Decision (RODs) for the TC&WM EIS on December 13, 2013 (Volume 78 of the *Federal Register*, page 75913 [78 FR 75913]). For the tank closure portion of the alternatives, which encompasses operations of the tank farms and Waste Treatment and Immobilization Plant (WTP), DOE selected Tank Closure Alternative 2B,[2] which would, among other things (1) retrieve 99 percent of the waste from the SSTs; (2) treat tank waste, including pretreatment of tank waste with separation into low-activity waste (LAW) and high-level radioactive waste (HLW); and (3) dispose of the vitrified LAW and secondary waste and construct immobilized HLW (IHLW) interim storage modules to store the IHLW prior to disposal. Among the other alternatives evaluated in the TC&WM EIS was Alternative 3B, which included proposed treatment of some portion of the LAW not vitrified using the WTP by using nonthermal supplemental treatment (cast stone). The TC&WM EIS analyzed the potential environmental impacts of constructing and operating an onsite treatment (cast stone) facility in 200 West Area (200W) and 200 East Area (200E) as an element of Alternative 3B.

DOE has prepared this Supplement Analysis (SA) in accordance with DOE's *National Environmental Policy Act* (NEPA) implementing procedures (Title 10 *Code of Federal Regulations* [CFR] Part 1021) to assess the Proposed Action of implementing alternative treatment of 200W tank wastes from 22 to 24 SSTs from the S, SX, and U tank farms. Approximately 32 million[3] gallons of pretreated tank waste from 200W would be treated (on or off site) and disposed of at appropriately licensed and permitted commercial treatment, storage, and disposal (TSD) facilities by 2040 (*see* Chapter 2 of this SA for a detailed description of the Proposed Action). The Proposed Action also includes potential construction and operation of an onsite treatment facility to allow shipment of a solidified (or grouted) waste form in lieu of shipping liquid, pretreated

[1] The TC&WM EIS analyzed 11 tank closures alternatives, 3 waste management alternatives, and 3 Fast Flux Test Facility decommissioning alternatives.

[2] The decision in the ROD to implement Alternative 2B stated, "DOE has decided to implement Tank Closure Alternative 2B, 'Expanded WTP Vitrification and Landfill Closure,' without supplemental treatment at WTP and without technetium-99 removal in the WTP Pretreatment facility." This caveat is included in the selected Alternative 2B and not further repeated in this SA.

[3] To provide an understandable point of reference for this volume, an American football field, including the end zones, covers about 57,600 square feet. If it were filled to a depth of 1 foot, it would represent a volume of about 7.5M gallons. Therefore, 32M gallons would represents the volume of liquid that could cover a football field to a depth of a little more than 4 feet.

waste.[4] The Proposed Action would be somewhat different from the actions analyzed in the TC&WM EIS. This SA evaluates the impacts of the Proposed Action against the impacts presented in the TC&WM EIS to determine if there are substantial changes to the proposal or significant new circumstances or information relevant to environmental concerns that would require further NEPA review. Based on this SA, DOE will determine whether the existing TC&WM EIS remains adequate, if a new environmental impact statement (EIS) is warranted, or if the existing EIS should be supplemented. Background information related to the Proposed Action in this SA is as follows.

The WTP, as analyzed in the TC&WM EIS, would start processing tank waste by sending it to the Pretreatment Facility, where it would be separated into HLW and LAW. The process would then send each of these waste streams to the HLW Vitrification Facility and the LAW Vitrification Facility, respectively, for further treatment. The WTP, as analyzed in the TC&WM EIS, also included an analytical laboratory (LAB) and 22 other support facilities referred to collectively as the "balance of facilities" (BOF). When DOE issued the ROD in 2013, its plan was to start operation of all WTP facilities at the same time.

To date, the LAW Vitrification Facility, LAB, and BOF have been constructed and DOE is commencing start-up of the LAW Vitrification Facility. To treat waste as soon as practicable, DOE decided to use Direct-Feed Low-Activity Waste (DFLAW), a sequenced approach that treats a portion of the tank waste first (*see* Section 1.4). Because some of the actions evaluated in this SA are similar to the actions previously evaluated under the DFLAW approach, the following text box is included to provide a description of DFLAW.

Direct Feed Low-Activity Waste (DFLAW)

The DFLAW approach separates and pretreats some of the tank waste from certain underground tanks at the Hanford Site and immobilizes (vitrifies in a glass matrix) the pretreated LAW at the LAW Vitrification Facility.

The DFLAW approach is a two-phased approach that separates and pretreats supernate (essentially the upper-most layer of tank waste that contains low concentrations of long-lived radionuclides) from some of the Hanford tanks, to generate a LAW stream. Phase 1 of the DFLAW approach includes in-tank settling; separation (removal by decanting) of the supernate (including dissolved saltcake and interstitial liquids); filtration; and cesium removal using ion exchange columns (IXC) in a tank-side cesium removal (TSCR) unit. For Phase 2, DOE will treat additional supernate (including dissolved saltcake and interstitial liquids) using the same processes and will deploy either an additional TSCR unit or construct a filtration and cesium removal facility. Collectively, the Phase 1 and Phase 2 pretreatment functions are referred to as the Low-Activity Waste Pretreatment System (LAWPS).

Facilities and equipment necessary to implement the DFLAW approach include the Effluent Management Facility; a TSCR unit and either an additional TSCR unit or a filtration and cesium removal facility (LAWPS); transfer lines; and a storage pad for cesium ion exchange columns (IXCs).

[4] Treatment would include technologies for remove, destroy, or immobilize regulated constituents to ensure the waste acceptance requirements of the appropriately licensed and permitted commercial TSD facility are met and technologies to convert liquid pretreated waste into a solid material. Regulated constituents under the land disposal restriction (LDR) requirements include both inorganic constituents (metals and cyanides) and organic constituents requiring DOE to plan for treatment capability. Treatment requirements are determined when qualification sampling in the SY tank farm results in LDR constituents exceeding the applicable treatment standard.

Solidification vs. Vitrification

The TC&WM EIS includes actions that involve vitrification of HLW and LAW in the HLW Vitrification Facility and the LAW Vitrification Facility, respectively. The TC&WM EIS also includes actions involving potential solidification of LAW (or pretreated waste). As defined below, the term "immobilization" can refer to either vitrification or solidification.

Vitrification – A method used to immobilize waste (radioactive, hazardous, and mixed). This involves adding glass formers and waste to a vessel and melting the mixture into a glass. The purpose of this process is to permanently immobilize the waste and isolate it from the environment. (TC&WM EIS Glossary)

Solidification – A term used to describe the grouting process evaluated in Alternative 3B for treatment of LAW in the Cast Stone Facility. This nonthermal supplemental treatment process would mix LAW with grout-formers (e.g., Portland cement, fly ash, slag) and conditioners to produce a liquid-grout stream that would then be cast into containers for *solidification* into a cement matrix.

Immobilization – Placement of waste within a material such as concrete or glass to reduce (immobilize) the dispensability and leachability of the radioactive or hazardous components within the waste. (TC&WM EIS Glossary)

While the DFLAW approach progresses in 200E, tank waste treatment operations need to progress in parallel in the 200W tank farms. Under the Proposed Action, supernate (including dissolved saltcake and interstitial liquids) would be retrieved from SSTs located in 200W then further separated (via settling and decanting) and pretreated (via filtration and ion exchange). Specifically, this includes waste from 22 to 24 SSTs from the S, SX, and U tank farms as well as double-shell tanks (DSTs) SY-101, SY-102, and SY-103.[5] This *Supplement Analysis of the Final Task Closure and Waste Management Environmental Impact Statement for the Hanford Site* (200W Tank Waste Treatment SA) evaluates this Proposed Action (*see* Section 1.2).

200 West Area Tank Waste Treatment

The 200 West Area Tank Waste Treatment (200 WATT) program includes the current and future capital projects and operational activities that are required to meet the current mission need of pretreating and shipping the waste from the S, SX, and U farm tanks in 200W off site. This proposal is an alternative to the plan evaluated in the TC&WM EIS, which did not include pretreating tank waste in 200W. Current projects associated with this approach include the West Area Risk Management (WARM) capital project and other operational activities, including but not limited to SY Farm Infrastructure Upgrades, Cross-Site Supernate Transfer Line Reactivation, SY-103 Remediation, SY Flush System, Waste Feed Delivery, SY-01A Mixer Pump Removal, and SY Pit Repairs. The 200 WATT program could include construction and operation of an onsite treatment (e.g., grouting) facility in 200W. The activities evaluated in this SA include the 200 WARM Project, onsite treatment facility, and related transportation, treatment, and disposal of waste at appropriately permitted commercial facilities. Disposal would occur outside of Washington state. Other listed operational activities are evaluated, as needed, through the NEPA Review Screening Form process normally followed for tank farm operations.

In 2022, the Hanford Tank Farm contractor, Washington River Protection Solutions (WRPS), published the *Hanford Tank Farms 200 West Area Risk Management Project – Analysis of Alternatives Final Report* (WARM AoA), which assessed alternative risk-handling strategies to reduce and/or mitigate near-term risks of tank waste retrieval in 200W (WRPS 2022). As a result,

[5] DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U tank farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals and will be processed with waste from SY-102 in the WARM pretreatment capability.

the WARM Project was initiated to construct and start up onsite facilities to provide pretreatment capability in 200W. Long-term operations of these onsite facilities would be part of the 200 WATT program described in the preceding textbox. Preliminary design information about the WARM Project is presented in the *Conceptual Design Report for West Area Risk Management* (WRPS 2024).

In parallel with this 200W Tank Waste Treatment SA, DOE is preparing an SA to evaluate a separate proposal referred to as Direct-Feed High Level Waste (DFHLW). The DFHLW approach includes proposed modifications to WTP BOF facilities and systems in 200E to allow HLW to temporarily bypass the WTP Pretreatment Facility and be sent directly to the HLW Vitrification Facility. DFHLW is independent of activities associated with 200W tank waste treatment. The potential impacts of the DFHLW approach are discussed as part of the cumulative impacts analysis in this SA (*see* Section 4).

Also in parallel with this 200W Tank Waste Treatment SA, DOE is performing a Waste Incidental to Reprocessing (WIR) Evaluation to assess whether the retrieved tank waste from 200W, after separation, pretreatment, and treatment (solidification), is waste incidental to the reprocessing of spent nuclear fuel (SNF), is not HLW, and may be managed as low-level radioactive waste (LLW) under the criteria in Chapter II.B.(2)(a) of DOE Manual 435.1-1, *Radioactive Waste Management Manual*. Final issuance of the WIR Evaluation and a WIR Determination would be required to precede actions proposed in this SA.

To support the parallel production of the WIR Evaluation and this 200W Tank Waste Treatment SA, the DOE tank farms contractor prepared a supplemental data report to support the waste classification and radioactive liquid waste transportation categorization (Supplemental Data Report; H2C 2025). The Supplemental Data Report provides information to support the range of estimated volumes and radionuclide inventory for the potential 200W tanks that could be included in the Proposed Action.

1.2 Proposed Action

Retrieving, treating, stabilizing, and safely disposing of mixed radioactive and chemical waste from underground tanks is a high priority for the tank waste mission at the Hanford Site as analyzed as part of the Tank Closure Alternatives in the TC&WM EIS (DOE 2012). A key aspect of implementing that mission is to process tank waste retrievals and treatment in 200W. The specific actions associated with the proposed 200W tank waste treatment evaluated in this SA include:

- Implementation of the 200 WARM Project (pretreatment and the infrastructure to manage pretreated waste). Long-term operations of the 200 WARM facilities would be included as part of the 200 WATT program;
- Construction and operation of an onsite treatment facility[6] to enable grouting and treatment of pretreated waste onsite; and

[6] The onsite treatment facility would need to meet the requirements of the Hanford Federal Facility Agreement and Consent Order Milestone M-062-64 through 66 for a "grouted" final waste form.

- Shipment of approximately 32 million gallons of pretreated waste (in either liquid or solid form) by truck or rail for appropriate treatment and disposal outside the state of Washington.
    - If solidified/treated off site, the shipments of liquid pretreated waste would be sent to one or more appropriately licensed and permitted TSD facility(ies) for treatment and then disposed of at an appropriately licensed and permitted out-of-state disposal facility.
    - If solidified/treated at the proposed onsite treatment facility, the shipments of solidified waste would be sent to an appropriately licensed and permitted out-of-state disposal facility.

The waste feed for the pretreatment process modules (PMs) would originate in the SY tank farm and include planned retrievals from 22 to 24 SSTs from the S, SX, and U tank farms,[7] which would be fed to the SY tank farm and supporting infrastructure where key radionuclides (e.g., cesium-137 [Cs-137] and strontium-90 [Sr-90]) would be removed by settling, decanting, filtration, and ion exchange (IX) using crystalline silicotitanate (CST) media. The pretreated waste (after filtration and IX in the PMs) would be sent to a new pretreated waste storage tank (PWST) prior to being transferred to a new load-in load-out (LILO) station for truck transport to an appropriately licensed and permitted onsite or offsite treatment facility. If any waste is determined to not be able to be pretreated and/or treated on site or off site, the current assumption is that the cross-site transfer lines (as analyzed in the TC&WM EIS) or tanker trucks would be used to transfer waste to 200E for future treatment at the WTP. Specific details about the Proposed Action are presented in Chapter 2 of this SA.

1.3 Purpose and Need for the Proposed Action

The purpose and need discussed in the TC&WM EIS relative to tank closure and waste management have not substantively changed since 2012. This purpose and need are to:

- Safely retrieve and treat radioactive, hazardous, and mixed tank waste; close the SST system; and store and/or dispose of the waste generated from these activities at the Hanford Site. Further, DOE needs to treat the waste and close the SST system in a manner that complies with federal and applicable Washington State laws and DOE directives to protect human health and the environment. Long-term actions are required to permanently reduce the risk to human health and the environment posed by post-retrieval residual waste in the 149 SSTs and 28 DSTs.

[7] DOE, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) engaged in mediated Holistic Negotiations and reached agreement on, among other things, modification of milestones in the Hanford Federal Facility Agreement and Consent Order (HFFACO, or Tri-Party Agreement [TPA]) and amendment to the Consent Decree in *State of Washington v. United States Department of Energy*, E.D. Wash., No. 2:08-cv-5085-RMP. Retrieval of waste from the 200W SSTs will be consistent with the new interim milestone M-045-135 in the HFFACO Action Plan, Appendix D "Work Schedule Milestones and Target Dates," to complete retrieval of 22 SSTs located in the S, SX, and U tank farms by 2040, contingent on DOE having a regulatory pathway to grout and dispose of the waste off site. DOE may also retrieve waste from two additional SSTs in the S, SX, and U tank farms under certain circumstances, as provided in the amended Consent Decree in *State of Washington. v. United States Department of Energy*, E.D. Wash., No. 2:08-cv-5085-RMP, ECF No. 269 (Jan. 8, 2025).

- Expand or upgrade existing waste treatment, storage, and disposal capacity at the Hanford Site to support ongoing and planned waste management activities for onsite waste.

The Proposed Action evaluated in this SA would facilitate management of the tank waste in 200W in accordance with the agreement reached in Holistic Negotiations among the DOE, State of Washington, and the U.S. Environmental Protection Agency (EPA) (*see* text box).

HOLISTIC AGREEMENT

The Washington State Department of Ecology (Ecology) filed a lawsuit against DOE in 2008, *State of Washington v. Chu*, No. 2:08-cv-05085-FVS (E.D. Wa.), in which the State of Oregon later intervened. In order to settle this litigation, the parties entered into a Consent Decree in 2010. The 2010 Consent Decree established milestones for the retrieval of waste from certain SSTs and for construction and initial operation of the facilities that constitute the WTP: the HLW, LAW, and Pretreatment facilities; the LAB; and the BOF. However, technical and funding issues regarding the retrieval of tank waste and startup of WTP facilities arose. In 2016, the court approved an Amended Consent Decree with modified milestones including completion of hot commissioning of the WTP LAW Vitrification Facility by December 31, 2023. Additional amendments to the Consent Decree were made in 2018 and 2020. In July 2022, the court extended numerous milestones, including extending the milestone for LAW hot commissioning to August 2025.

In May 2024, the DOE, Ecology, and EPA announced that an agreement had been reached under Holistic Negotiations, which began in 2020, that proposed a realistic and achievable course for continuing the tank waste retrieval and treatment mission through 2040. The new agreement includes three parts: (1) Settlement Agreement, (2) changes to the Consent Decree, and (3) changes to the Hanford Federal Facility Agreement and Consent Order (HFFACO, or Tri-Party Agreement [TPA]). More information about the highlights of the Holistic Negotiations can be found at https://www.hanford.gov/files.cfm/Public-Meetings_Presentation_Holistic-Agreement_FINAL-(006).pdf.

In December 2024, DOE issued the *Responsiveness Summary for proposed changes to the Tri-Party Agreement and consent decree on Hanford Site tank waste* (DOE, EPA, and Ecology 2024). This document is one of the final steps prior to finalizing the proposed changes. The authoring agencies reviewed and considered all comments received and discussed potential changes raised by the comments submitted.

The Consent Decree was amended by court order and the proposed changes to the TPA were finalized in January 2025.

1.4 National Environmental Policy Act Documents Relevant to the Proposed Action

Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC&WM EIS) (DOE/EIS-0391; DOE 2012). The construction of the WTP was originally analyzed in the 1996 *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE/EIS-0189; DOE 1996). The TC&WM EIS (DOE 2012) revised and updated the analyses of the 1996 document, which addressed retrieval, treatment, and disposal of the tank waste, by also evaluating the impacts of different scenarios for final closure of the SST system. The TC&WM EIS provides the current baseline against which the potential impacts from the Proposed Action in this SA can be compared and evaluated. The Final TC&WM EIS analyzed 17 alternatives, 11 of which involved retrieval, treatment, storage, and disposal of tank wastes and closure of the SSTs. The TC&WM EIS 2013

ROD (78 FR 75913) announced that DOE intended to pursue Tank Closure Alternative 2B; it stated the following as to tank waste:

> "This ROD includes decisions involving the following major activities from Tank Closure Alternative 2B: Retrieval of 99 percent of the tank waste by volume; use of liquid-based retrieval systems; leak detection monitoring and routine maintenance; new waste receiver facilities, as needed; additional storage facilities, as needed; additional storage facilities for canisters; operations and necessary maintenance, waste transfers and associated operations such as use of the 'hose in hose' transfer lines or installation of new transfer lines, where needed; and upgrades to existing DST and SST systems which includes piping and other ancillary equipment as needs are identified. Tank waste treatment includes pretreatment of all tank waste, with separation into LAW and HLW. New evaporation capacity, upgrades to the ETF [Effluent Treatment Facility], new transfer lines and processing of both vitrified LAW and secondary waste for disposal are included in this decision. Disposal activities include disposal of LAW onsite and construction of enough IHLW Interim Storage Modules to store all the IHLW generated by WTP treatment prior to disposal."

As stated in Section 1.1 of this SA, the TC&WM EIS also evaluated Alternative 3B, which included nonthermal treatment of some portion of the pretreated LAW in an onsite Cast Stone Facility, including construction and operation of a Cast Stone Facility in both 200E and 200W. Selection of this alternative was not included in the 2013 ROD.

One of the key differences between the Proposed Action evaluated in this SA and the decisions in the 2013 ROD is that the treated waste (where treatment includes solidification/grouting) is proposed to be disposed of in appropriately licensed and permitted commercial disposal facilities outside of Washington state, as opposed to disposal on the Hanford Site.

Amended ROD for Cesium and Strontium Capsules. DOE issued an amended ROD (AROD) for the TC&WM EIS for the management of cesium and strontium capsules at Hanford (83 FR 23270, May 18, 2018). This AROD is not related to the 200W tank waste treatment but is included here for completeness.

Amended ROD for DFLAW Approach. On January 28, 2019, DOE issued another AROD related to the DFLAW approach (84 FR 424). This 2019 AROD was supported by an SA that evaluated implementation of the DFLAW approach (DOE/EIS-0391-SA-02) (DOE 2019). Per the 2019 AROD:

> "DOE/EIS-0391-SA-02 concluded that the DFLAW facilities and functions, except for the IX Column Storage Pad, were addressed in the TC&WM 2013 ROD. The SA also concluded that the IX Column Storage Pad does not represent a substantial change to DOE's proposal or significant new circumstances or information relevant to environmental concerns. There are no additional mitigation measures required beyond those commitments in the 2013 TC&WM EIS ROD. The 2013 TC&WM EIS ROD addressed the functions necessary to implement DFLAW, with the exception of those related to the IX Column Storage Pad. DOE's decision is to

> amend the TC&WM EIS ROD to include construction and operation of the IX Column Storage Pad to support implementation of DFLAW." [8]

Amended ROD for Secondary Waste Management. The DFLAW approach and other, non-DFLAW activities that are planned or ongoing at the Hanford Site (e.g., tank farm and 222-S laboratory operations) will generate an increased volume of liquid and non-liquid secondary waste over normal tank farm operations. These wastes include secondary waste generated by, or derived from, the vitrification of LAW using the DFLAW approach, as well as other secondary waste. In 2023, DOE prepared an SA to evaluate transportation and treatment of certain secondary waste at licensed and permitted commercial treatment facilities that are located off the Hanford Site (DOE/EIS-391-SA-03; DOE 2023b). SA-03 also evaluated disposal of some of these secondary wastes (after treatment) offsite at licensed and permitted commercial disposal facilities. DOE published an AROD to document that decision (88 FR 6241; January 31, 2023).

Per the 2023 AROD:

> "DOE prepared a supplement analysis (DOE/EIS-0391-SA-03; SA), which evaluated DOE's proposal to transport and treat certain solid and liquid secondary wastes at licensed and permitted commercial treatment facilities off the Hanford Site. DOE also proposes to potentially dispose of some of these secondary wastes (after treatment) offsite at a licensed and permitted commercial disposal facility. This action would be implemented on an interim basis until such time as an enhanced onsite treatment capability is available for Direct-Feed Low-Activity Waste (DFLAW) operations (estimated to be approximately 10 years)."

The AROD concluded:

> "Based on the analysis in the SA, DOE determined that the Proposed Action for secondary waste management does not represent a substantial change to the proposal evaluated in the TC&WM EIS or significant new circumstances or information relevant to environmental concerns that would require preparation of a supplemental EIS. DOE therefore determined that no further NEPA analysis was required. There are no additional mitigation measures required beyond those commitments in the 2013 TC&WM EIS ROD. As stated in that ROD, all practicable means to avoid or minimize environmental harm have been adopted. DOE's decision is to transport and treat certain solid and liquid secondary wastes at licensed and permitted commercial treatment facilities off the Hanford Site. DOE's decision is also to dispose of some of these secondary wastes (after treatment) offsite at the WCS FWF [Federal Waste Facility], a licensed and permitted commercial disposal facility."

[8] An ion exchange column (IXC) is a cylindrical vessel filled with ion exchange media that selectively removes or exchanges ions from a solution as it flows through. Inside the column, the media is charged with ions that can swap with undesirable ions in the solution, effectively purifying or altering its chemical composition. The process is widely used in waste treatment applications, allowing targeted removal of specific ions based on the media's charge properties. In the case of DFLAW and 200W alternative tank waste treatment, the IXCs use CST as the media.

Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS) (DOE/EIS-0200; DOE 1997). During the 1990s, DOE anticipated a need for managing wastes at locations other than where the waste was generated. To address this need, DOE conducted analyses for management of radioactive and hazardous wastes, including LLW and mixed LLW (MLLW). The WM PEIS analyzed the transportation of large volumes of LLW across the country by truck and rail for treatment and disposal. As described in more detail in Section 3.3.4 of this SA, the WM PEIS provides a comparative data set for potential nationwide impacts of radioactive waste transportation and DOE has developed a screening approach based on the results in the WM PEIS to determine whether more detailed analysis of proposed radioactive waste transportation is warranted.

Final Test Bed Initiative Demonstration Environmental Assessment (TBI EA) (DOE/EA-2086; DOE 2023c). DOE-EM evaluated an engineering-scale Test Bed Initiative (TBI) Demonstration, which will separate and pretreat approximately 2,000 gallons of Hanford Site tank waste supernate, which will then be treated (solidified) and disposed of at one or more offsite, permitted and licensed, MLLW disposal facilities. DOE issued a Finding of No Significant Impact (FONSI) concurrently with the Final TBI EA (DOE 2023d). Activities associated with the TBI Demonstration were initiated in 2024 and are expected to be completed in 2025.

1.5 Scope and Organization

DOE NEPA regulations state that "DOE shall prepare a supplemental EIS if there are substantial changes to the proposal or significant new circumstances or information relevant to environmental concerns" (10 CFR 1021.314(a)). DOE's NEPA regulations also state that when it "is unclear whether or not an EIS supplement is required, DOE shall prepare a Supplement Analysis" (10 CFR 1021.314(c)). This SA provides sufficient information for DOE to determine whether (1) to supplement an existing EIS, (2) to prepare a new EIS, or (3) no further NEPA documentation is required (10 CFR 1021.314(c)(2)(i)–(iii)).

This SA analyzes whether implementing 200W tank waste treatment constitutes a substantial change to the original proposed action evaluated in the TC&WM EIS or there are substantial new circumstances or information about the significance of adverse effects compared to those presented in the TC&WM EIS. Chapter 2 of this SA presents a description of the Proposed Action, while Chapter 3 presents a comparative analysis of the potential environmental impacts of the Proposed Action and those presented in the TC&WM EIS. Chapter 4 presents potential cumulative impacts of the Proposed Action when combined with other present and reasonably foreseeable future actions. Chapter 5 provides DOE's preliminary conclusion. Chapter 6 presents a bibliographic listing of the references cited in this SA.

This SA also includes two appendices with supporting information for project background on tank-side cesium removal (TSCR) in 200E (Appendix A) and the analysis of potential transportation accidents (Appendix B).

2 PROPOSED ACTION

2.1 Overview of the 200W Tank Waste Treatment

The Hanford Site is planning to proceed with tank waste retrievals and treatment in 200W. As evaluated in the TC&WM EIS, the waste in SSTs in the S, SX, and U tank farms will be retrieved. The tank waste will be transferred to DSTs in the SY tank farm. Under the Proposed Action evaluated in this SA, tank waste in SY DSTs would be pretreated in the proposed onsite facilities included in the 200 WARM Project. The Proposed Action also includes construction and operation of an onsite solidification/treatment facility. The pretreated liquid waste would either be treated on site or transported to an appropriately licensed and permitted offsite facility for treatment. The final solidified waste form from either onsite or offsite treatment would be disposed of at an appropriately licensed and permitted commercial out-of-state disposal facility.

As background, under the DFLAW approach, DOE has decided to separate LAW from other waste in the Hanford Site tanks and vitrify (immobilize in a glass matrix) a portion of the LAW. During DFLAW, the supernate portion of the radioactive waste in 200E is transferred and pretreated in the Low-Activity Waste Pretreatment System (LAWPS) to remove Cs-137 and solids. The pretreated waste is then fed to the LAW Vitrification Facility. The vitrified waste will then be disposed of on site at the Integrated Disposal Facility (IDF) in 200E. The actions evaluated under DFLAW are similar to those proposed under the 200 WATT program.

In addition to the 200E tank farms SST retrievals and pretreatment in LAWPS, waste from the 200W tank farm SSTs also needs to be retrieved and pretreated to support the long-term River Protection Program mission. The 200 WATT program would support the 200W SST retrievals and manage the retrieved waste.

The Proposed Action involves retrieval of approximately 32 million gallons of supernate (including dissolved saltcake and interstitial liquid) from 22 to 24 SSTs located in the S, SX, and U tank farms as well as waste from DSTs located in the SY tank farm.[9] Note that the retrieval actions themselves are not the subject of this SA. Retrieval of tank waste was an action specifically identified and evaluated in the TC&WM EIS and thus is not a change from that analysis. The Proposed Action in this SA also includes construction and operation of onsite facilities in 200W (i.e., the 200 WARM Project), onsite or offsite treatment (grouting) of pretreated tank waste, out-of-state disposal of solidified waste, and related transportation activities (*see* Figure 2-1).

The 200 WARM onsite facilities would include a tank farm pretreatment system for waste retrieved from SSTs and processed through the DSTs in the SY tank farm. All of the 200 WARM facilities would be located within the 200W industrial-exclusive zone as evaluated in the TC&WM EIS. An additional staging area would be required in 200W for empty and loaded portable tanks to facilitate offsite shipment of liquid pretreated waste.

[9] The estimate of approximately 32 million gallons of waste is based on the retrieval volumes from 22 to 24 underground SSTs with the highest activity located in the S, SX, and U tank farms as well as the waste from DSTs SY-101, SY-102, and SY-103 (DSTs SY-101 and SY-102 will be retrieved to provide tank space for subsequent S, SX, and U tank farm SST retrievals. Waste from tank SY-103 will be transferred to tank SY-102 prior to SST retrievals and will be processed with waste from SY-102 in the 200 WARM pretreatment capability). This volume is approximate and may be higher or lower depending on retrieval operations.

The new tank farm pretreatment system would provide the following:

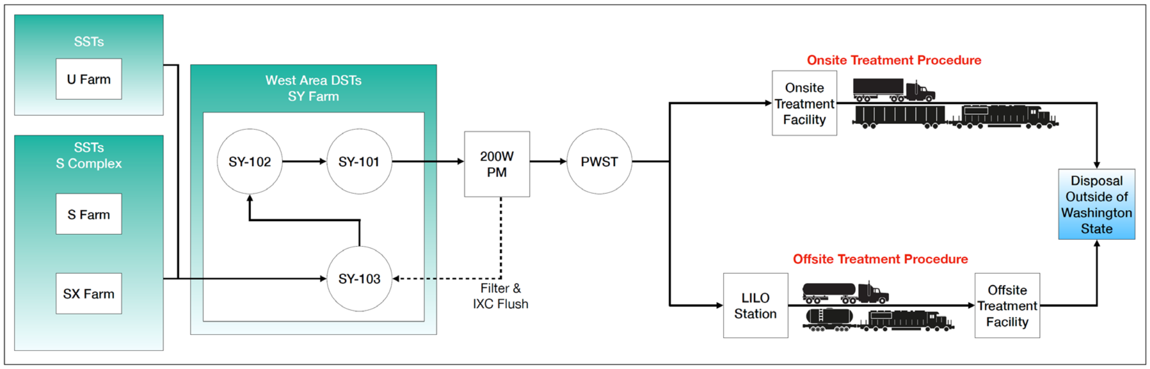
- Operation of two or more modular PM treatment units and supporting infrastructure.
- Filtration of solids to a level to protect the functionality of the ion exchange columns (IXCs). The IXCs would be designed to remove key radionuclides (e.g., Cs-137 and Sr-90) to a level that is compliant with treatment and disposal facility waste acceptance criteria and the definition of LLW (10 CFR 61.55).[10]
- One or more PWSTs to add storage capability (either aboveground or belowground) for the pretreated waste. (The current conceptual design report indicates that the PWST would be belowground [WRPS 2024].)
- Transfer capabilities for pretreated waste from the PWST to a LILO station.
- Collection and routing of process-generated effluents back to the DSTs in the SY tank farm and dispose of secondary waste.
- Interim storage for the IXCs.

The conceptual design of the 200 WARM onsite facilities includes the PM treatment units, an IXC storage pad, PWST capability, a tanker truck LILO station, and all associated infrastructure for piping, ventilation, instruments and controls, electrical, and potable and non-potable water (WRPS 2024).

After pretreatment, as opposed to the approach used in 200E under DFLAW,[11] the pretreated waste from the 200W PM system would be transported either to an onsite treatment facility for solidification/grouting or to one or more appropriately licensed and permitted commercial facilities in U.S. Department of Transportation (USDOT)-compliant tankers and/or portable tanks (as identified in Section 2.4.3) off the Hanford Site. Treatment would include processes to change the physical form from a liquid to a solid and to treat regulated constituents (inorganics and organics) prior to disposal outside of Washington state. This latter approach would be consistent with the approach evaluated in the TBI Demonstration (*see* Section 1.4; DOE 2023c) for grouting and to treat inorganic constituents. The 200W tank waste treatment would include the treatment of regulated organic constituents.

Figure 2-1 provides a simplified process flowsheet for the proposed 200W tank waste treatment. Figure 2-2 presents the conceptual layout of the onsite facilities.

[10] Estimated key radionuclide removal efficiencies are based on information in H2C (2025).
[11] The DFLAW approach involves transferring the pretreated waste to the LAW Vitrification Facility melters on site at the WTP, where it will be vitrified (immobilized in a glass matrix) for disposal on site at the IDF.



Acronyms:

DST	double-shell tank	PWST	pretreated waste storage tank
IXC	ion exchange column	PM	process module
LILO	load-in and load-out	SST	single-shell tank

Figure 2-1 200 West Area Tank Waste Treatment Process Flowsheet

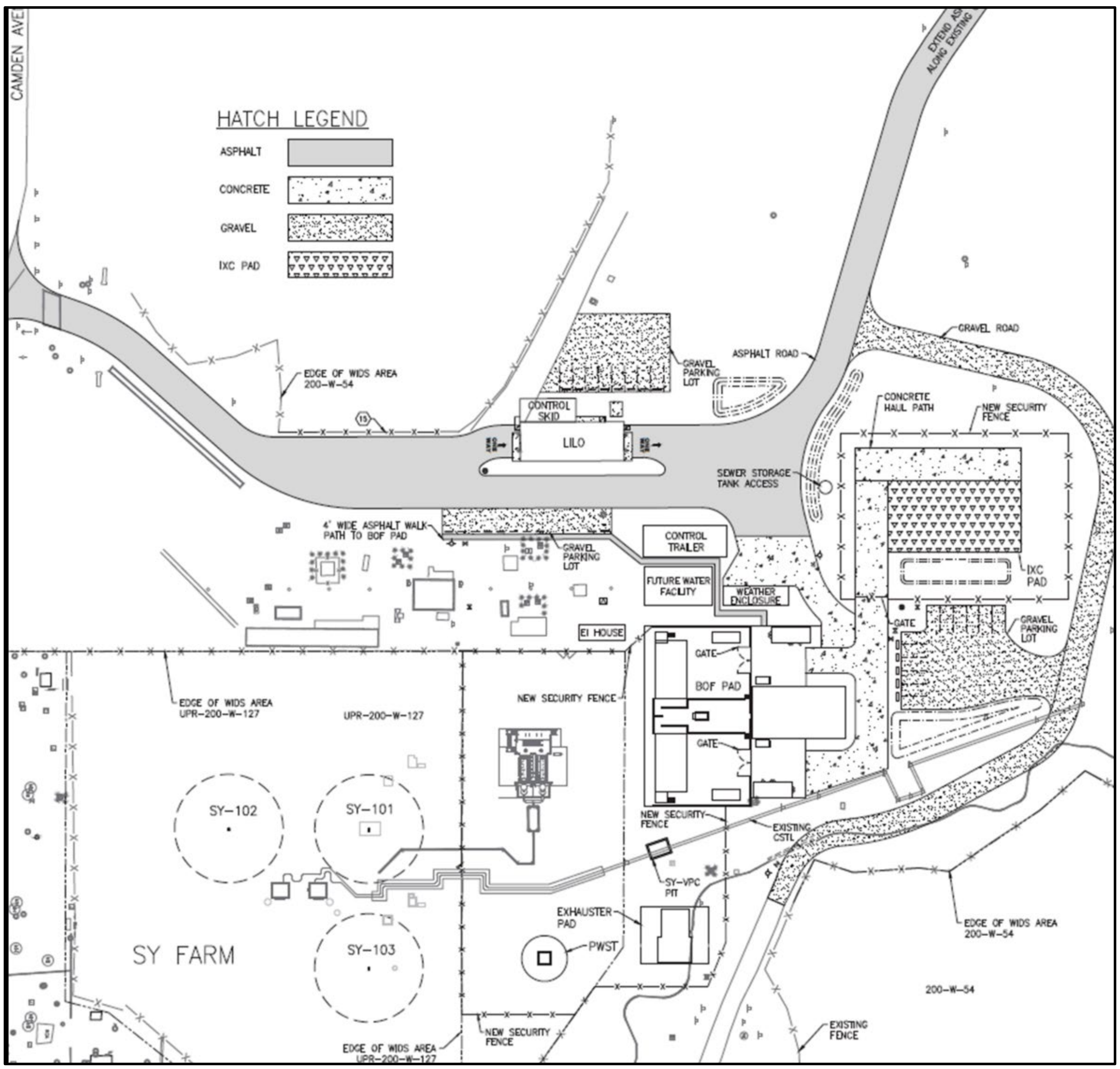


Figure 2-2 200 WARM Project Onsite Facilities – Conceptual Layout

2.2 Proposed 200 WARM Project - Onsite Facilities

2.2.1 Process Module Treatment Units

The 200 WARM AoA describes various handling strategies for management of 200W tank waste (WRPS 2022). Alternatives considered in the AoA include two in-tank treatment technologies and two near-tank treatment options. The two near-tank treatment options include a once-through system and a system that involves recirculation. DOE elected to further evaluate handling strategy 3C, which refers to a near-tank, once-through pretreatment process (DOE 2023e). This alternative would use a key radionuclide removal system, based on LAWPS deployed at the 200E AP-Tank Farm (and evaluated in the DFLAW SA-02 [DOE 2019]).[12] Supernate would be transferred from SY-101 and undissolved solids would be removed via filtration and returned to SY-103. Cs-137 and Sr-90 would be removed from the waste using selective IX, and the pretreated waste would be temporarily stored in the PWST prior to transfer to the LILO station (*see* Section 2.2.4).

The 200W tanks contain both soluble and insoluble radionuclides.[13] All of the 200W SST retrieval streams would be received into the SY tank farm DSTs. Most of the solids in the retrieved waste streams are expected to settle in the receipt tank and will continue (under normal operations) to be removed from the SY tank farm and transferred to 200E through the Cross-Site Transfer Line in order to allow continued pretreatment operations. Once the receipt tank is filled, the settled waste would be decanted[14] from the receipt tank into the qualification tank for further settling while awaiting results of qualification sampling.[15] Once qualified, the liquid waste would again be decanted from the qualification tank to the PM feed tank that would provide feed to the 200W PM system, located adjacent to the SY tank farm.

In the TC&WM EIS, the WTP Pretreatment Facility in 200E would perform the IX function now proposed for the PMs. In the DFLAW SA-02 (DOE 2019), DOE determined that the use of PMs (or modular pretreatment systems like TSCR/LAWPS) for pretreatment of tank waste for DFLAW was not a substantial change to the proposal evaluated in the TC&WM EIS.

The 200 WARM Project onsite facilities would consist of two or more modular PMs, each within enclosures and equipped with filters, four IXCs in series, and one delay tank. The facilities would be located in an area near the SY tank farm and include the two process enclosures (about 1,200 square feet), two ancillary enclosures (about 720 square feet), an electrical enclosure (about 420 square feet), a control trailer (about 1,600 square feet and potentially including a septic tank), a weather enclosure, and a change trailer (2,900 square feet). The ancillary enclosures would house the service air, instrument air, and reagent (potable water and sodium hydroxide) systems. The

[12] TSCR is Phase 1 of LAWPS, a demonstration project with a 5-year design life. The follow-on to this 5-year demonstration is a separate project that involves the design and construction of a higher throughput, more permanent and advanced pretreatment unit called Advanced Modular Pretreatment System (AMPS), LAWPS Phase 2. While TSCR consists of a filter system and three IXCs, the AMPS conceptual design has a similar filter system, but with four IXCs. The four-IXC configuration allows for better column loading, which leads to fewer column changeouts. In addition, AMPS is designed to be a more permanent system that incorporates lessons learned from TSCR and is "modular" for future changes. TSCR was designed to primarily remove Cs-137. H2C (2025) includes the expected removal efficiencies for Cs-137 and Sr-90.

[13] Waste from these tanks may consist of three phases: supernate, saltcake, and sludge.

[14] The term "decant" is used in this SA when describing moving waste between receipt tank, qualification tank, and feed tank within the SY tank farm. Decanting is the process of pumping only the liquid fraction from the tank without disturbing the solid layer.

[15] Waste qualification means that it would be sampled to demonstrate that it meets waste transportation requirements, the offsite treatment and disposal facilities waste acceptance criteria, and LDR requirements.

electrical enclosure would contain the controllers, switchgear, motor control centers, and other necessary equipment for the PMs. The weather enclosure would be a heated area to protect spare IXCs and chemical storage from the cold environment.[16] The weather enclosure is designed to have the same capabilities as the Advanced Modular Pretreatment System (AMPS) weather enclosure in 200E.

2.2.2 Waste Transfer System

Tank waste supernate would be transferred (decanted) from SY-101 by waste pumps, through the PMs, and into the PWST. A pump would transfer the pretreated waste from the PWST to the LILO station to be staged for transport either by pipeline to an onsite treatment facility (*see* Section 2.3) or into the tanker trucks or portable tanks for shipment to an onsite or offsite treatment facility (*see* Section 2.4) via truck or rail. Additionally, redundant pumps would serve a recirculation function, one for SY-101 and the other for the PWST. The LILO station would not have any pumps; however, the sump drain line would return spilled liquids to SY-103.

All selected piping for the WARM Project waste transfer system would be buried, double-contained piping. The TC&WM EIS evaluated waste transfers using pumps and piping for normal maintenance, operations, and retrievals (TC&WM EIS, Section 2.2.1.3.1).

2.2.3 Pretreated Waste Storage Tank

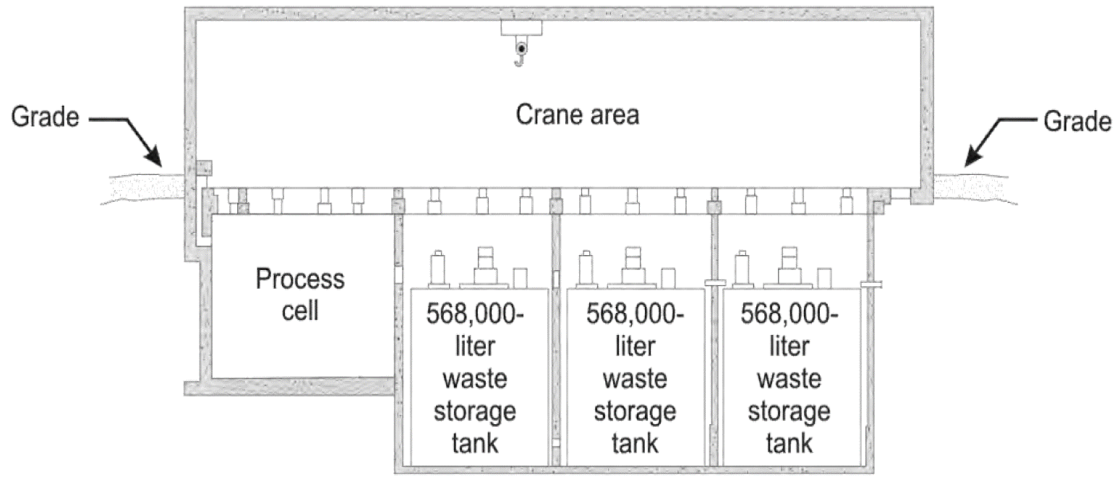
The pretreated waste coming from the PMs would be collected in a PWST. The PWST, which would be a new dangerous-waste tank, would be designed and permitted in accordance with the Washington Administrative Code (WAC) 173-303-640, *Tank Systems*[17] for either aboveground storage or belowground storage. Design specifications for the PWST are provided in WRPS (2024). The minimum working capacity of the preliminary design would be over 100,000 gallons and the initial sizing of the PWST capacity would be about 130,000 gallons. Future design evolution could require an additional PWST, which would be similar to, or smaller than, the first. The PWST(s) would be in the same general location as the PMs (i.e., near the SY tank farm).

The design of the PWST has not been finalized but potential impacts associated with its construction and operation likely would be similar to those associated with the waste receiver facilities (WRFs) evaluated in the TC&WM EIS (*see* Section 2.2.2.1.5 of DOE 2012).[18] The PWST would not be expected to include a process cell and may not have separate storage tanks; however, its intended function would be like that of the WRF. Figure 2-3 is a reproduction of the WRF figure from the TC&WM EIS. The three waste storage tanks in the WRF would have contained over 450,000 gallons of Hanford Site tank waste.

[16] Chemicals would include a mild caustic used for filter/IXC flushing. The flushed chemicals would return to SY-103.

[17] WAC 173-303-640 *Tank Systems* is based on the EPA's *Resource Conservation and Recovery Act* regulations at 40 CFR Part 264 Subpart J, *Tank Systems.*

[18] Examples of the similarities include permitting as a dangerous waste tank with all of the associated design and safety requirements, smaller footprint of land disturbance, smaller contained waste volume, and similar function.



Note: To convert liters to gallons, multiply by 0.26417.
Source: DOE 2003b.

Figure 2-3 Waste Receiver Facilities Evaluated in the TC&WM EIS

2.2.4 Load In/Load Out Station

The LILO station would be designed to receive pretreated waste from the PWST to load tanker trucks (or portable tanks). Each tanker truck or portable tank would be expected to contain 5,000 gallons of pretreated waste (*see* Section 2.4). The LILO station would have a control skid to provide compressed air to the tanker. A planned flush water facility would tie into the existing raw water system to provide water to the LILO station. The proposed design of the LILO station is similar to that of an existing truck loading station in 200 E AP-Tank Farm, which was part of the facility operations evaluated in the TC&WM EIS.[19] The LILO station could process up to 5 tanker trucks (or portable tanks) per day (although as identified in Section 2.4.1, the average projection is closer to 11−12 trucks per week). While unloading a truck or portable tank would be considered an abnormal situation, a hose connected to a gravity-drain pipe would provide this capability should the need ever arise. The pipe would route from the tanker truck (or portable tank) to a sump drain that connects directly to SY-103. A full-length truck scale would aid in overflow prevention during the loading of pretreated waste. Design specifications for the LILO station are provided in WRPS (2024).

General operation of the LILO station and its associated tanker trucks/portable tanks are generally covered under the TC&WM EIS (as updated by SA-03 [DOE 2023b]) when utilized to perform onsite and offsite waste shipments.

DOE would require a laydown area for staging the empty and filled portable tanks to facilitate seamless operations. For the purposes of analysis, this laydown area would require a footprint of about two acres within the 200W Industrial-Exclusive Zone.

[19] As described in Section 2.3, if the onsite treatment facility location is close enough to transfer waste via pipeline, a pipeline connection option would be implemented between the LILO station and the onsite treatment facility.

2.2.5 Interim Storage of Ion Exchange Columns

The IX system in the 200 WARM onsite facilities would include four IXCs operated in series (WRPS 2024). Their function would be like those used in the existing TSCR in 200E under DFLAW; however, the 200 WARM IXCs would be expected to remove approximately 96.8 percent of the Sr-90 from the supernate (H2C 2025). The spent IXCs would be removed from the PMs using a forklift, moved to the proposed IXC storage pad, and anchored onto the storage pad. A reinforced haul path would be constructed to connect the PMs and the IXC storage pad. The haul path would be used by the forklifts to deliver the new IXCs to the PMs and to transfer the loaded IXCs from the PMs to the IXC storage pad. Additionally, DOE would construct a new bypass road to the east of the IXC storage pad to route any facility traffic around the process facilities (*see* Figure 2-2).

The 200E IXC storage pad would be sized to support 160 IXCs. The size of the proposed 200W IXC storage pad would be identical to the existing 200E storage pad (about 34,000 square feet). The TC&WM EIS did not include a storage pad for loaded IXCs; however, the DFLAW SA-02 determined that the addition of the IXC storage pad in 200E was not a substantial change to the proposed action evaluated in the TC&WM EIS (DOE 2019). This 200W Tank Waste Treatment SA evaluates the addition of another IXC storage pad in 200W.

2.3 Onsite Soldification/Treatment Facility

DOE is considering two treatment options as part of the Proposed Action. The first option would be to ship the approximately 32 million gallons of liquid pretreated waste off site in USDOT-compliant tanker trucks or portable tanks. These shipments would initiate from the LILO station on the Hanford Site to appropriately licensed and permitted commercial TSD facilities (*see* Section 2.4) for offsite treatment prior to disposal. DOE is also considering the development of an onsite capability for grouting and treatment to facilitate shipping a solid waste form in lieu of the pretreated liquid. This onsite facility would include treatment of constituents (both organic and inorganic) to meet applicable land disposal restriction (LDR) requirements. This onsite facility would be owned and operated by DOE or a DOE contractor.

A specific design or location for an onsite treatment facility does not currently exist;[20] however, the TC&WM EIS evaluated the construction and operation of an onsite Cast Stone Facility, which was analyzed as a grouting or treatment facility, to allow onsite treatment options for Hanford Site tank waste supernate. Alternative 3B in the TC&WM EIS evaluated the construction and operation of one of these facilities in 200E and another in 200W. Sections 2.2.2.2.4 and E.1.2.3.7 of DOE (2012) describe the cast stone process and facility assumed for the TC&WM EIS analysis:

- The cast stone process involves mixing LAW with a Portland-cement-type grout, pumping it into disposal containers, and allowing it to solidify. Waste feeds to the cast stone process would consist of LAW that had been pretreated in the WTP Pretreatment Facility (DOE 2012, Section 2.2.2.2.4).

[20] The design and siting of the onsite treatment facility would undergo a detailed review prior to implementation, which would include a review under the normal site processes for NEPA screening, to ensure that potential impacts are still well represented by the TC&WM EIS and this SA.

- Storage vessels may be needed for Portland cement, fly ash, slag, and stabilizing chemicals if the dry blend mixture cannot be procured. Waste feeds would be directly transferred from retrieval operations or staged in a receiver tank (DOE 2012, Section 2.2.2.2.4). (For the proposed onsite treatment facility, stabilizing chemicals would include additives, reductants, and oxidizers.)

- Waste and grout additives (including treatment reagents, stabilizing chemicals, reductants, and oxidizers) would be mixed and poured into disposal containers that were assumed to each contain about 13.1 cubic yards of solidified waste form, each weighing approximately 22 tons (DOE 2012, Section E.1.2.3.7.2). The TC&WM EIS assumed that 513,200 tons of cast stone waste (approximately 23,270 containers) would be produced in the Cast Stone Facility (DOE 2012, Section 2.5.2.3.2)

- The Cast Stone Facility was assumed to be located northeast of the 202-S REDOX Facility in 200W and would have a footprint of about 41,000 square feet (almost 1 acre). The facility was assumed to include the following process systems: LAW receipt, conditioning, and storage; dry material storage and blending; LAW stabilization; cast stone container filling; curing and container staging; container decontamination and venting; container storage and transport; and various process support systems (DOE 2012, Section E.1.2.3.7.4).

The concept of an onsite facility to support 200W tank waste treatment is expected to be similar in concept to that described in the TC&WM EIS, since both facilities encompass technology to create a regulatory-compliant, solidified waste form. The disposal containers could be different because they are proposed to be disposed of at an appropriately licensed and permitted out-of-state disposal facility as opposed to the IDF on the Hanford Site. The final configuration of the disposal containers would be coordinated with the disposal facility to ensure that they meet applicable waste acceptance criteria, facility handling requirements, and USDOT shipping requirements (e.g., weight limitations per shipment).

The current System Plan (DOE 2023a) discusses the potential for onsite treatment and out-of-state disposal of pretreated LAW. The System Plan assumes that pretreated waste would be solidified and poured into soft-sided containers in a reusable steel overpack, which could be transported via truck or railcar to an appropriately licensed and permitted TSD for out-of-state disposal (DOE 2023a, Section 5.2.3.3.2).

The concept for the proposed onsite solification/treatment facility, including the details related to transport of the pretreated liquid from the 200 WARM facilities to the treatment facility, is in its early development. This SA considers two options for conveyance of the pretreated liquid: (1) installation of an underground transfer line (similar to those described in Section 2.2.2) between either the PWST or LILO station to the treatment facility (if the treatment facility were sited in close proximity to the proposed WARM facilities); and (2) use of tanker trucks or portable tanks similar to the offsite transportation described in Section 2.4 for the liquid pretreated waste (if the treatment facility were sited in a more distant, onsite location). Possible locations for the 200W treatment facility include the same location assumed for the Cast Stone Facility in the TC&WM EIS (northeast of the 202-S REDOX Facility) (DOE 2012, Section E.1.2.3.7.3) or a location that is more closely adjacent to the proposed WARM facilities.

Construction of an onsite solidification/treatment facility that is owned and operated by DOE would likely be a capital project and need to comply with DOE Order 413.3B. As such, the schedule for availability of an onsite facility is uncertain and would also be dependent on available funding. Because the onsite treatment facility may not be available at assumed outset of the Proposed Action, this SA evaluates two bounding scenarios, (1) a 100-percent shipment of liquid pretreated waste (assuming that the onsite solidification/treatment facility is not available by 2040), and (2) a 100-percent shipment of solidified waste (assuming that the onsite treatment facility is available by the assumed start date of the Proposed Action – 2030). Regardless of the actual implementation date of the onsite treatment facility, the range of impacts presented by these two bounding scenarios would be reflective of the potential impacts of the Proposed Action. DOE could also entertain a contractor-owned and operated facility onsite, which may streamline schedule constraints, however, environmental impacts would be the same regardless of ownership or operational control.

Treatment of regulated constituents in conjunction with solidification to meet LDR requirements would be included in the treatment process, as needed, including treatment capability for both organic and inorganic constituents. Treatment for regulated constituents that would either remove, destroy, or immobilize the constituents would be provided, as required, to ensure the waste acceptance criteria of the appropriately licensed and permitted commercial TSD facility would be met.

DOE may also consider partnering with industry to potentially develop a new near-site treatment facility to either replace or supplement the treatment options discussed herein. This is not currently an element of the Proposed Action evaluated in this SA because the consideration is not sufficiently defined at this time and so is not yet ripe for analysis or decisionmaking. If DOE establishes a proposal to develop this near-site capability, DOE will determine the need for additional NEPA analysis, as appropriate.

2.4 Offsite Transportation, Solidification/Treatment, and Disposal

As identified in Section 2.1, the pretreated waste collected in the PWST would be managed in one of two ways: (1) it would be transferred to the LILO station and then transported offsite in liquid form, or (2) it would be transferred via pipeline, USDOT-compliant tanker truck, or USDOT-compliant portable tanks to a proposed onsite solidification/treatment facility (*see* Section 2.3). If pretreated liquid waste was transported offsite, DOE would use USDOT-compliant tankers and/or portable tanks to ship the pretreated waste to one or more out-of-state, appropriately licensed and permitted commercial facilities for solidification/treatment and disposal. If the proposed onsite facility was available, solidification/treatment would occur on site, and the solidified waste form would be transported to the appropriately licensed and permitted commercial facilities for out-of-state disposal. This section describes the potential waste streams that would be proposed for offsite transportation, treatment, and disposal (Section 2.4.1), the offsite treatment of pretreated waste (Section 2.4.2), the transportation of pretreated or solidified waste (Section 2.4.3), and the out-of-state disposal of the solidified waste form (Section 2.4.4).

The expected mode for transportation would be via legal-weight truck; however, shipment by rail would also be a possibility and could occur once the process becomes more fully implemented.

Where appropriate, the following subsections provide insight into the possible rail shipments of either pretreated liquid waste or solidified waste.

2.4.1 Pretreated Waste Stream

As identified in Section 1.1, DOE's tank farm contractor prepared the Supplemental Data Report for the in-process WIR Evaluation and this SA (H2C 2025). The Supplemental Data Report provides the estimated radionuclide characteristics for 44 of the 200W tanks and, based on the potential removal of key radionuclides by pretreatment, provides the expected pretreated waste radionuclide inventories (on a tank-by-tank basis). The proposed SST retrievals and pretreatment could be initiated as early as 2028; however, the analysis in this SA assumes that the Proposed Action would begin full operations in 2030 and onsite retrieval actions would be completed by 2040. If 200 WARM facilities and 200W tank waste treatment began before 2030, the annual impacts would be expected to be smaller than presented in Chapter 3.

The Supplemental Data Report includes radionuclide inventories and volumes for 44 tanks in 200W being considered for 200W tank waste treatment (S, SX, and U tank farm SSTs and SY DSTs), which includes a total of about 39 million gallons of tank waste (H2C 2025). As identified in Section 2.1, the Proposed Action would initially retrieve waste from 22 to 24 SSTs in 200W by 2040 (approximately 32 million gallons). The specific SSTs that would be retrieved would be identified in future tank waste retrieval work plans. After the initial retrieval, pretreatment, and disposal, DOE would consider continuing the 200W tank waste treatment until the full 39-million gallon inventory in the 44 200W tanks from the S, SX, and U tank farms is processed. This continuation would be a reasonably foreseeable action and is addressed in Chapter 4 of this SA.

Also noted in Section 1.1 of this SA, DOE is preparing a WIR Evaluation in parallel with this SA. At this time, DOE has not determined the specific SSTs in the S, SX, and U tank farms from which waste would be retrieved. The approximately 32-million gallon volume reflects the retrieval of 24 SSTs with the highest activity from key radionuclides plus the volume of DSTs SY-101 and SY-102. These may not necessarily be the tanks selected for retrieval; however, this assumption provides the bounding estimate for health and safety impacts from the Proposed Action.[21]

DOE would ensure that wastes proposed for offsite shipment, treatment, and disposal would be able to meet waste acceptance criteria for treatment and disposal at the out-of-state TSD facility. This would be applicable whether the treatment was performed at an onsite treatment facility or off site at an appropriately licensed and permitted commercial TSD facility. Based on the information in the Supplemental Data Report, no shipments of pretreated liquid or solidified waste would exceed Class C concentrations per 10 CFR 61.55. The tank-by-tank evaluation in the Supplemental Data Report indicates that about 30 percent of the total tank volume would meet short-term and long-term concentration limits to be disposed of as Class A MLLW. The other

[21] Depending on the tanks selected, the total volume could range from about 15.3 million gallons to about 33.5 million gallons. If the maximum volume (33.5 million gallons) were used, the total volume of shipments would increase by less than 5 percent. Selection of the 32 million gallons for the analysis in this SA ensures that the maximum activity is addressed in potential impacts.

approximately 70 percent would meet concentration limits for Class C MLLW but may not meet Class A limits (H2C 2025).[22]

DOE expects that, if transported as a liquid, all pretreated liquid waste would be transported in low specific activity (LSA)-II transportation category packages (e.g., tanker trucks or portable tanks) either by road or rail (H2C 2025, Table 7-9). These USDOT-compliant tankers or portable tanks could all be filled to capacity and still meet the LSA-II requirements. Because the treatment process would increase the volume without increasing the radionuclide content or concentration, the disposal containers loaded with solidified waste would also be transported in LSA-II category packages.

As stated above, the Supplemental Data Report provides expected radionuclide inventories in the pretreated waste for each of the 44 200W tanks. To provide an understanding of the range of potential impacts that could be realized depending on which tanks are selected for retrieval under the Proposed Action, this SA takes the following approach based on information provided in the Supplemental Data Report (H2C 2025):

- Each of the 44 200W tanks has a specific concentration of radionuclides per unit volume for the pretreated waste.

- Each truck shipment of liquid pretreated waste would consist of 5,000 gallons. Rail shipments are assumed to include up to two portable tanks per railcar.

- The radionuclide inventory of a truck shipment of solidified waste would be bounded by the inventory of a liquid waste shipment. The disposal containers for solidified waste would contain about 13.1 cubic yards of solidified waste. If the inventory of a 5,000-gallon portable tank were solidified, it would result in about 37 cubic yards of solidified material. Therefore, a solid waste container would generally contain about 35 percent of the radionuclide inventory shipped as a liquid in a 5,000-gallon tank.

- The analysis for this SA sorted the 200W tanks by the total numbers of curies in the liquid pretreated waste per 5,000-gallon shipment. This ranks the waste tanks by the potential hazard for each potential set of shipments.

- The 44 tanks were divided into quartiles of 11 tanks. These quartiles are referred to as Group A (highest radionuclide inventory) to Group D (lowest radionuclide inventory).

- The average radionuclide characteristics of the various waste tank groups of liquid pretreated waste are provided in Table 2-1.

[22] The assumption for removal of key radionuclides includes 99.9 percent of the Cs-137 and 96.8 percent of the Sr-90 per Appendix D of H2C (2025).

Table 2-1 Average Radionuclide Concentrations; Shipment of the Liquid Pretreated Waste (by Group)

Radionuclide	Average Concentration (curie/shipment)			
	Group A	Group B	Group C	Group D
Tritium (H-3)	3.51×10^{-2}	2.39×10^{-2}	3.45×10^{-2}	2.13×10^{-2}
Carbon-14	1.61×10^{-2}	1.75×10^{-2}	2.29×10^{-2}	1.56×10^{-2}
Cobalt-60	5.96×10^{-4}	3.78×10^{-4}	3.63×10^{-4}	1.72×10^{-4}
Nickel-63	1.08×10^{-1}	1.74×10^{-1}	1.91×10^{-1}	7.90×10^{-2}
Strontium-90	2.14×10^{1}	1.46×10^{1}	1.22×10^{1}	1.06×10^{1}
Technetium-99	5.88×10^{-1}	9.19×10^{-1}	7.59×10^{-1}	5.13×10^{-1}
Iodine-129	5.19×10^{-4}	8.51×10^{-4}	7.51×10^{-4}	5.11×10^{-4}
Cesium-137	2.81×10^{-1}	4.38×10^{-1}	4.83×10^{-1}	2.18×10^{-1}
Neptunium-237	4.85×10^{-4}	7.95×10^{-4}	7.90×10^{-4}	6.37×10^{-4}
Plutonium-238	8.45×10^{-4}	5.58×10^{-4}	4.27×10^{-4}	2.49×10^{-4}
Plutonium-239	3.64×10^{-2}	1.99×10^{-2}	1.85×10^{-2}	9.89×10^{-3}
Plutonium-240	7.44×10^{-3}	4.06×10^{-3}	3.89×10^{-3}	2.07×10^{-3}
Americium-241	6.99×10^{-2}	3.55×10^{-2}	2.00×10^{-2}	8.72×10^{-3}
Plutonium-241	1.05×10^{-2}	5.36×10^{-3}	6.14×10^{-3}	3.44×10^{-3}
Curium-242	8.66×10^{-4}	5.86×10^{-4}	3.68×10^{-4}	2.08×10^{-4}
Plutonium-242	3.64×10^{-7}	2.83×10^{-7}	2.03×10^{-7}	1.14×10^{-7}
Americium-243	4.54×10^{-5}	2.08×10^{-5}	1.14×10^{-5}	5.25×10^{-6}
Curium-243	2.54×10^{-5}	4.70×10^{-5}	8.70×10^{-6}	4.56×10^{-6}
Curium-244	4.00×10^{-4}	7.55×10^{-4}	1.39×10^{-4}	7.22×10^{-5}
Total average curies per truck shipment	**22.57**	**16.27**	**13.71**	**11.5**

Source: H2C 2025, Table 7-3

The volume of waste shipped off site could vary from year to year; however, this SA assumes a steady-state shipping campaign of about 11 years (2030–2040). Because the shipping campaign for liquid, pretreated waste is assumed to consistently use 5,000-gallon LSA-II tankers or portable tanks, and the total volume of the retrieved waste stream is about 32 million gallons, about 6,400 shipments of pretreated waste would be required over the 11-year period, or about 582 tanks or tanker trucks per year (about 12 per week).

For purposes of this SA, for solid waste shipments, there would be an increased volume of about 50 percent as a result of the addition of treatment reagent materials (e.g., cementitious-based formulations, additives, reductants, and oxidizers).[23] Therefore, the total volume of solid waste shipped over the same 11-year period would be about 48 million gallons (237,700 cubic yards). Assuming 13.1 cubic yards per solidified waste disposal containers, about 18,145 containers of solidified waste would be required over the 11-year period, or about 1,650 containers per year (about 33 per week).

[23] According to PNNL (2013), the volume of pretreated liquid waste increases by an expansion factor ranging from 1.5 to 1.8 when solidified. The lower end of the range (1.5), used in the Draft WIR Evaluation, results in the highest projected radionuclide concentration and the highest waste classification estimate. The expansion factor, final waste volume, and associated impacts vary based on the tank waste composition and grout formulation used.
For consistency and the purpose of this analysis, this SA also uses a 1.5 expansion factor; however, if the actual expansion was higher during implementation of the Proposed Action, some of the impacts presented in this SA could be higher as well (e.g., air emissions, shipment numbers, and disposal volumes could increase by as much as 20 percent for the 100-percent solidified waste scenario). The resources evaluated in Section 3.3 discuss the potential increase.

In addition to the increased volume of solidified waste (50 percent), the solidified waste also has a higher density than the liquid pretreated waste. These factors contribute to the increase in the number of shipments between pretreated liquid and solidified waste.

Section 2.4.2 identifies the assumptions for the distribution of waste (pretreated liquid or solidified) that would be sent to each offsite treatment facility, which also provides the basis for the number of shipment miles associated with the Proposed Action.

2.4.2 Offsite Solidification/Treatment of Pretreated Waste

The pretreated liquid would be solidified and meet applicable *Resource Conservation and Recovery Act of 1976* (RCRA) treatment standards to enable the waste to meet requirements for land disposal of mixed waste. The treatment standards would also include treatment of hazardous constituents in the waste stream, as applicable, to meet TSD disposal requirements.

Offsite treatment (including solidification/grouting) of the pretreated waste would occur at one or more of three licensed and permitted commercial TSD facilities in the western United States:

- Waste Control Specialists (WCS) Federal Waste Facility (FWF) in Andrews County, Texas
- Energy*Solutions* in Clive, Utah.
- Perma-Fix Northwest (PFNW) in Richland, Washington (treatment only)

At each of the three facilities, pretreated liquid would be solidified such that the solidified waste form would have an increased volume. The Energy*Solutions* Treatment Facility is designed for radioactive waste that requires treatment for RCRA constituents prior to disposal. Incorporation of the waste into a solid physical form would also be required to meet the waste acceptance criteria for land disposal of waste at the WCS FWF or Energy*Solutions*.

WCS is permitted, licensed, and authorized to receive, treat, and dispose of Class A, Class B, and Class C LLW and MLLW. Waste from DOE facilities is typically disposed of in WCS' FWF. The WCS waste acceptance criteria document, *FWF Generator Handbook* (WCS 2015), addresses operations and regulatory parameters, pre-shipment requirements, documentation, and transportation, and provides various forms including a waste profile sheet. The *WCS Waste Acceptance Plan* (WCS 2014) provides additional information related to the waste acceptance process, including waste form requirements and a description of the generator and waste approval processes. WCS has indicated that it has a capacity to treat and dispose of between 1 million and 2 million gallons per year of liquid pretreated waste from the Hanford Site. WCS could accommodate the 1 million gallons per year from Hanford immediately without impacting other waste treatment or disposal commitments. WCS could accommodate 2 million gallons per year within 1 year without the need for additional facilities or resources (WCS 2024a). After receipt and processing of portable tanks of pretreated waste (or the disposal container overpacks for solidified waste from an onsite treatment facility) at the FWF, WCS would ensure that the containers meet release criteria prior to returning the containers to the Hanford Site (WCS 2015, Section 9.3). According to the *FWF Generator Handbook* (WCS 2015), WCS would dispose of the solidified waste form in modular concrete canisters (either cylindrical or rectangular). Wastes are received on site at WCS via highways and direct rail access (WCS 2015).

Energy*Solutions* operates a MLLW treatment and disposal facility west of the Cedar Mountains in Clive, Utah. Clive is located along Interstate 80, about 60 miles west of Salt Lake City, Utah. The Clive LLW facility is licensed by the Utah Department of Environmental Quality (UDEQ) for the treatment and disposal of Class A MLLW that meets specified waste acceptance criteria (Energy*Solutions* 2015). Disposal of the stabilized waste in the existing MLLW facility at the Energy*Solutions* site would be conducted in accordance with the facility's operating license (Radioactive Material License No. UT 2300249; UDEQ 2023). Energy*Solutions* has indicated that it has capacity to treat and dispose of 1 million gallons per year of liquid, pretreated waste from the Hanford Site, and stay within its existing permitted capacity (Energy*Solutions* 2024).

Energy*Solutions* receives waste shipped via bulk truck, containerized truck, enclosed truck, bulk railcars, rail boxcars, and rail intermodals. The transportation access allows Energy*Solutions* to operate throughout the entire year. The disposal site is accessed by the Union Pacific Railroad at Energy*Solutions*' private siding. Energy*Solutions* uses more than 10 miles of track and three locomotives for railcar management. The covered railcar thaw shed, rotary dumper, and railcar decontamination facilities allow for the efficient unloading, decontamination, and return of rail shipments (Energy*Solutions* 2015). Similar to WCS, EnergySolutions would ensure that the re-useable portable tanks or disposal container overpacks would meet release criteria before being returned to the Hanford Site.

Operations at PFNW are conducted in accordance with radioactive material licenses issued by the Washington State Department of Health (WDOH 2024) and a permit for treatment and storage of dangerous waste issued by Ecology (Permit Number WAR 000010355). The radioactive material licenses and permit authorize PFNW to possess and process radioactive material, including treatment and stabilization. The license also limits the quantity of radioactive material at the facility and describes operating requirements related to radiation monitoring, inventory control, waste receipt and shipment, recordkeeping, reporting, and environmental monitoring.

PFNW does not have the capability to dispose of the solidified MLLW; however, the facility is responsible for the final disposition of the solidified waste form after treatment. The pretreated waste would have to meet PFNW's waste acceptance criteria prior to receipt at the facility. If DOE used PFNW to treat liquid pretreated waste, the solidified waste form would then need to be transported to WCS or Energy*Solutions*, depending on its final waste classification. PFNW has indicated that it has capacity to treat about 360,000 gallons per year of liquid pretreated waste from the Hanford Site, which would be within its existing permitted capacity (PFNW 2024). The analysis in this SA assumes that the solidified waste would be sent to WCS. This assumption maximizes potential shipment miles and associated potential impacts.

For the purposes of this SA (for the 100-percent liquid shipment scenario), the analysis assumes that pretreated liquid would be sent to a combination of WCS, Energy*Solutions*, and PFNW. The 32 million gallons would represent 2.91 million gallons per year over 11 years (2030–2040). Seventy percent of the pretreated waste would be expected to be above Class A concentrations and be sent to a combination of WCS (2 million gallons) and PFNW (37,000 gallons) for treatment;

all of the solidified waste from this treatment would be disposed of at WCS. The remainder (873,000 gallons) would be expected to be sent to Energy*Solutions* for treatment and disposal.[24]

2.4.3 Transportation of Pretreated Waste or Solidified Waste for Treatment and/or Disposal

As described earlier, the expected volume of the LSA-II tankers or portable tanks for the shipment of pretreated liquid waste is 5,000 gallons each. Figure 2-4 provides a representative picture of a USDOT-compliant tanker truck and portable tank. Solidified waste would be transported in disposal containers that also meet USDOT specifications.

Figure 2-4 Representative Photos of a DOT-Compliant Tanker Truck and Portable Tank

Offsite transportation of radioactive waste (liquid or solid) would follow the USDOT requirements for hazardous materials. Radioactive materials must be packaged in accordance with the level of hazard associated with the potential release of material that might occur during normal transport conditions or accidental release of the material during transport. The greater the hazard, the more robust the packaging required to transport the material. All radioactive material transportation would be performed in compliance with 49 CFR Part 173. Transportation of radioactive waste by rail would also be performed in accordance with 49 CFR Part 174. For the purpose of the analysis in this SA, DOE assumes that two 5,000-gallon portable tanks or three solidified waste disposal containers could be shipped on a single railcar.

This SA assumes that 5 loaded railcars would be shipped in a single train consist.[25] The most likely scenario for implementation would be between 5 and 30 railcars per train shipment. While there is the possibility that less than 5 railcars would be shipped on a single shipment, this would be unlikely and the overall annual average would be higher than 5.

[24] As noted in Section 2.4.1, approximately 70 percent of the pretreated waste would be expected to be greater than Class A LLW and would only be allowed to be treated and disposed of at WCS. This distribution also accounts for the 2 million-gallon capacity for treatment of pretreated waste at WCS (WCS 2024a).

[25] A train "consist" is defined as the total of the railcars and locomotives that make up the whole train, which is defined in this SA as a rail shipment https://www.trainconductorhq.com/what-is-a-locomotive-consist/.

USDOT-certified packages must pass stringent tests as part of their certification. Per the requirements of 49 CFR 173.411(b)(5), a cargo tank or a tank car may be used as a package for transporting LSA-I and LSA-II liquids and gases, provided that:

- It is capable of withstanding a test pressure of 265 kilopascals (38.4 pounds per square inch absolute); and

- It is designed so that any additional shielding that is provided must be capable of withstanding the static and dynamic stresses resulting from handling and routine conditions of transport and of preventing more than a 20-percent increase in the maximum radiation level at any external surface of the tanks.

As identified in Section 2.4.1 of this SA, DOE expects that an average of about 582 truck shipments of pretreated liquid would be required annually for a period of 11 years and that approximately 30 percent of the pretreated waste would be expected to meet Class A limits. An additional 91 truck shipments of solidified waste would also need to be transported from PFNW after treatment (assumed to all go to WCS). Section 2.4.2 provides the expected capacity for each of the commercial treatment facilities. Therefore, this SA uses these assumptions in the following tables to establish the analytical bases for those resources that depend on the estimated number of shipment miles (i.e., air quality, human health, and transportation) and transportation mode.

Table 2-2 presents the analytical parameters associated with the truck transportation of the 100-percent liquid shipment scenario for offsite treatment. Table 2-3 presents similar information for the potential truck transportation of the 100-percent solidified waste scenario that would result from onsite treatment. As shown in Table 2-3, there would be a larger number of truck shipments associated with shipping solidified waste from an onsite treatment facility. This is due to the 50-percent increase in total volume from the addition of treatment reagent materials and the estimated size of the disposal containers (13.1 cubic yards of solidified waste, each weighing about 22 tons). In terms of weight, this is roughly equivalent to the weight of 5,000 gallons of liquid, pretreated waste (about 21 tons). Therefore, the analysis assumes that a single tank or a single solidified waste disposal container would be loaded on a truck for transport off the Hanford Site.

For possible rail shipments, this SA evaluates potential shipments of liquid pretreated waste and solidified waste from an onsite treatment facility. All liquid pretreated waste for transport to WCS or Energy*Solutions* would be loaded into 5,000-gallon portable tanks and shipped off site on trucks (either to a local rail spur [2,873,000 gallons per year] or to PFNW [37,000 gallons per year]). The analysis assumes that the portable tanks would be transported individually by trucks to a rail spur (e.g., in Richland near PFNW or some other location within the surrounding Tri-Cities, Washington, area) and two portable tanks would be placed on each railcar for shipment to either WCS or Energy*Solutions* (using the same 70/30-percent distribution). As discussed earlier, the analysis assumes that an average of 5 loaded railcars would be included in each train shipment. All solidified waste resulting from onsite treatment would also be shipped off site on trucks to a nearby rail spur (one container per truck); the analysis assumes that three of the 13.1-cubic yard disposal containers would be placed on each railcar for shipment to either WCS or Energy*Solutions* and that 5 railcars would be included in each train shipment. Tables 2-4 and 2-5 present the analytical parameters used for the rail analysis for pretreated liquid waste for offsite treatment and solidified waste from onsite treatment, respectively. The estimated rail mileage from Richland to

Table 2-2 Analytical Parameters: Offsite Solidification/Treatment – Truck Transport

TSD Facility	One-way Distance (miles)	Gallons per year	Shipments per year[a]	Highway miles per year	Round-Trip miles per year[b]
WCS[c] Andrews County, TX	1,600	2,000,000	400	640,000	1,280,000
Energy*Solutions* [c] Clive, Utah	680	873,000	175	119,000	238,000
200W to PFNW Richland, WA (liquid)	25	37,000	8	200	400
PFNW to WCS (solid)	1,575	55,500[d] (275 cubic yards)	21[e]	33,100	66,200
Totals		**2,910,000**	**604[f]**	**792,300**	**1,584,600**

PFNW = Perma-Fix Northwest; TSD = treatment, storage, and disposal; WCS = Waste Control Specialists

a Liquid shipments would be in 5,000-gallon tankers or portable tanks.

b Round-trip highway miles are used for air emissions and nonradiological traffic impacts.

c The distribution among WCS, EnergySolutions, and PFNW is based on the estimated distribution of Class A and Class C MLLW and the estimated capacity of each facility. The volumes would be within their respective capacity and permitting limits.

d The solidified waste form would represent an increased volume (by about 50 percent) due to the addition of treatment reagent materials. (Does not contribute to the total gallons of liquid shipped per year.)

e Assumes the use of a disposal container that holds 13.1 cubic yards of solidified waste (consistent with TC&WM EIS assumptions).

f Because of the assumed 873,000 gallons assumed to be shipped to Energy*Solutions*, the analysis reflects a partial shipment (which would not occur); therefore, the summation of the liquid shipments results in a deviation of one additional shipment than would be expected.

Table 2-3 Analytical Parameters: Onsite Solidification/Treatment – Truck Transport

TSD Facility	One-way Distance	Gallons per year (cubic yards)[a]	Shipments per year[b]	Highway miles per year	Round-Trip miles per year[c]
WCS[d] Andrews County, TX	1,600	3,055,500 (15,128)	1,155	1,848,000	3,696,000
Energy*Solutions*[d] Clive, Utah	680	1,309,500 (6,484)	495	336,600	673,200
Totals		**4,365,000 (21,612)**	**1,650**	**2,184,600**	**4,369,200**

TSD = treatment, storage, and disposal; WCS = Waste Control Specialists

a The solidified waste form would represent an increased volume (by about 50 percent) due to the addition of treatment reagent materials.

b Solidified waste shipments would be in disposal containers holding 13.1 cubic yards of waste material.

c Round-trip highway miles are used for air emissions and nonradiological traffic impacts.

d The distribution between WCS and Energy*Solutions* is based on the estimated distribution of Class A and Class C MLLW (70 percent to WCS, 30 percent to Energy*Solutions*). The volumes would be within their respective capacity and permitting limits.

WCS and Energy*Solutions* was obtained using DOE's computer model *Stakeholder Tool for Assessing Radioactive Transportation* (START).[26]

[26] Information regarding START is available at https://start.energy.gov/Account/Login?ReturnUrl=%2f.

Table 2-4 Analytical Parameters: Offsite Solidification/Treatment – Rail Transport

TSD Facility	One-way Distance	Gallons per year	Shipments per year[a] Truck/Rail	Miles per year Truck/Rail	Round-Trip miles per year Truck/Rail [b]
200W to Richland, WA (truck)	25	2,910,000[a]	582/0	14,550/0	29,100/0
WCS Andrews County, TX	2,155	2,000,000	0/40	0/86,200	0/172,400
Energy*Solutions* Clive, Utah	837	873,000	0/18	0/15,100	0/30,200
PFNW to WCS (solid)	1,575	55,500[c] (275 cubic yards)	0/2[d]	0/3,200	0/6,400
Totals		**2,910,000**	**582/60**	**14,550/104,500**	**29,100/209,000**

N/A=not applicable; PFNW = Perma-Fix Northwest TSD = treatment, storage, and disposal; WCS = Waste Control Specialists

a Liquid shipments would be in 5,000-gallon tankers or portable tanks. Trucks carry single tanks to a rail spur or PFNW. Railcars carry two tanks to the TSD. Each train shipment consists of 5 loaded rail cars.

b Round-trip miles are used for air emissions and nonradiological traffic impacts. Railcars would be used to return empty tanks and/or disposal container steel overpacks.

c 55,500 gallons represents the solidified volume associated with 37,000 gallons of pretreated liquid waste treated at PFNW that would be sent to WCS for disposal, with 3 disposal containers per railcar.

d The distribution among WCS, Energy*Solutions*, and PFNW is based on the estimated distribution of Class A and Class C MLLW and the estimated capacity of each facility. The volumes would be within their respective capacity and permitting limits.

Table 2-5 Analytical Parameters: Onsite Solidification/Treatment – Rail Transport

TSD Facility	One-way Distance	Gallons per year (cubic yards/yr)	Shipments per year[a] Truck/Rail	Miles per year Truck/Rail	Round-Trip miles per year Truck/Rail [c]
200W to Richland, WA (truck)	25	4,365,000 [b] (21,612)	1,650/0	41,250/0	82,500/0
WCS[d] Andrews County, TX	2,155	3,055,500 (15,128)	0/77	0/165,900	0/331,800
Energy*Solutions*[d] Clive, Utah	837	1,309,500 (6,484)	0/33	0/27,600	0/55,200
Totals		**4,365,000 (21,612)**	**1,650/110**	**41,250/193,500**	**82,500/387,000**

N/A=not applicable; TSD = treatment, storage, and disposal; WCS = Waste Control Specialists

a All disposal containers of solidified waste would be transported off site by truck. Trucks carry single containers to a nearby rail spur. Railcars carry three 13.1 cubic yard containers to the TSD. Each train shipment consists of 5 loaded rail cars.

b The solidified waste form would represent an increased volume (by about 50 percent) due to the addition of treatment reagent materials.

c Round-trip miles are used for air emissions and nonradiological traffic impacts. Railcars would be used to return empty tanks and/or disposal container steel overpacks.

d The distribution between WCS and Energy*Solutions* is based on the estimated distribution of Class A and Class C MLLW and the estimated capacity of each facility. The volumes would be within their respective permitting limits.

2.4.4 Disposal of Solidified Waste Forms

As identified in Section 2.4.2, the out-of-state disposal of the solidified waste would occur at WCS and/or Energy*Solutions*, depending on the MLLW classification (Class A MLLW can be disposed of at Energy*Solutions* and WCS; Class B and C MLLW can only be disposed of at WCS). Based on the expected distribution of Hanford Site waste that would be sent to WCS and Energy*Solutions* and the expected volumes of the solidified waste for disposal under the Proposed Action, DOE expects to send about 15,128 cubic yards WCS and 6,484 cubic yards for Energy*Solutions.*

Whether disposed at WCS or Energy*Solutions*, all wastes would be verified to meet the TSD's waste acceptance criteria prior to shipment from the Hanford Site (WCS 2015; Energy*Solutions* 2015).

3 ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

DOE conducted an initial screening review to identify the differences between the Proposed Action and the actions evaluated in the TC&WM EIS. Resource areas that would be unaffected or any impacts that would be minimal and clearly bounded by the TC&WM EIS analyses were eliminated from detailed analysis in this 200W Tank Waste Treatment SA. Section 3.2 describes the results of that initial screening review. For those resource areas that warranted additional evaluation, Section 3.3 provides the analysis of the potential environmental impacts associated with the differences identified in Section 3.2.

3.2 Initial Screening Review

Implementation of the Proposed Action represents the following primary differences from the facilities and actions analyzed in the Final TC&WM EIS (and previous SAs): (1) construction and operation of pretreatment facilities in 200W (200 WARM Project); (2) solids and key radionuclide removal external from the WTP Pretreatment Facility (or the LAWPS installed in 200E); (3) the construction and operation of an additional IXC storage pad in 200W; (4) interim storage of pretreated supernate in storage tanks (PWST and LILO station), (5) construction of a 2-acre staging and laydown area for empty and full portable tanks and/or disposal container overpacks, (6) construction and operation of an onsite treatment facility; and (7) shipment of the pretreated supernate or solidified waste form to an appropriately licensed and permitted onsite or offsite TSD for treatment and out-of-state facility for disposal. The following paragraphs discuss each of these elements, and Table 3-1 provides a comparative analysis for each of the environmental resource areas evaluated in the TC&WM EIS. In general, location and functional equivalency were the basis for the comparative evaluation and assessment.

1. **200 WARM Project** – The TC&WM EIS included evaluation of the WTP Pretreatment Facility in 200E, which would provide pretreatment of supernate in the 200 Area tank farms. The DFLAW approach in 200E included the implementation of an Effluent Management Facility (EMF), LAWPS pretreatment capability, and new transfer lines between facilities. The potential impacts of the WTP Pretreatment Facility were evaluated in the TC&WM EIS, and impacts from the EMF (added under the DFLAW approach) were bounded by the analysis of the WTP Pretreatment Facility (*see* Table 3-1). The TSCR/LAWPS and transfer lines were demonstrated in the DFLAW SA-02 to be substantively similar to the function of the facilities evaluated in the TC&WM EIS (DOE 2019).

   Similar to DFLAW, the implementation of the 200 WARM Project onsite facilities would require the potential addition of both hose-in-hose transfer lines and buried transfer lines. In the TC&WM EIS, DOE evaluated upgrades to the tank farms, which included replacement of components, such as pumps and surface leak detectors, and installation of transfer lines. DOE uses numerous existing transfer lines—both buried and hose-in-hose—in the 200 Areas to move waste among tanks and tank farms. The TC&WM EIS evaluated several new transfer lines in the 200 Areas that would be used to move tank waste between 200W and 200E to support WTP and SST retrieval. The 200 Areas are heavily impacted and highly disturbed areas. The new transfer line segments associated with the 200 WARM Project would traverse this same area near the SY tank farm. In Section E.1.2.2.7.4, "Future Transfer Lines," of the Final TC&WM EIS, DOE pointed out that because the exact locations of the waste transfer lines could not be anticipated for all waste movements needed in the future, the TC&WM EIS analyzed three lines—a primary, a secondary, and a spare—located along each potential transfer route that might be needed to move liquid waste to and from various facilities. The TC&WM EIS did not identify any potentially significant impacts from these lines. Moving radioactive waste through both permanent and temporary transfer lines is a common practice at the Hanford Site, and the potential impacts of this activity were analyzed in the TC&WM EIS; impacts from the anticipated new transfer line segments, buried or hose-in-hose, are well represented by the analysis in the EIS (*see* Table 3-1 below).

2. **Removal of Solids and Key Radionuclides** – The WTP Pretreatment Facility evaluated in the TC&WM EIS included "ultrafiltration" and "cesium ion exchange," both of which involve the removal of solids and key radionuclides from tank waste. DFLAW, under LAWPS, includes a phased approach that was initiated with the use of a single TSCR unit (Phase One) followed by either an additional TSCR unit or construction and use of a permanent cesium removal capability (Phase Two). Like DFLAW, the approach proposed for waste pretreatment in 200W employs similar technologies for solids and key radionuclides (cesium and strontium) removal as the WTP Pretreatment Facility, with the exception that the proposed IX media is non-elutable.[27] The potential impacts of the WTP Pretreatment Facility were evaluated in the TC&WM EIS and impacts from the DFLAW removal of solids and key radionuclides, including the IXC storage, were determined in the DFLAW SA-02 to not be substantively different than the analysis in the TC&WM EIS (*see* Table 3-1) (DOE 2019). For the 200 WARM Project, solids would be removed from the supernate by settling and filtration. Key radionuclides removed from the supernate would be managed similar to the DFLAW approach.

3. **IXC Storage Pad** – The TC&WM EIS did not specifically analyze construction and use of a concrete pad for the interim storage of the loaded IXCs. The TC&WM EIS also did not analyze the long-term storage of key radionuclides in loaded IXCs on a pad. However, the DFLAW SA-02 evaluated both of these activities and determined that the construction and operation of an IXC storage pad in 200E was not a substantial change from the Proposed Action evaluated in the TC&WM EIS.

   The IXC storage pad proposed for the 200W would be identical to the pad constructed for 200E for DFLAW. The fenced location of the proposed pad would be northeast of the proposed PM location and the SY tank farm and would be in an area that is currently industrial and generally previously disturbed. With regard to operation of the IXC storage

[27] Non-elutable IX media bind the radionuclides permanently and require storage of the IXCs until final disposition (current baseline assumption is vitrification), as opposed to elutable IX media, which allow the radionuclides to be chemically stripped from the media and sent to the HLW feed stream (as assumed in the TC&WM EIS for the Pretreatment Facility) or back to a DST (as originally planned for the DFLAW analyzed in Appendix E of the TC&WM EIS for the "Vision for WTP Project Transition to Operations").

pad, the potential risks of an accident involving tipover of an IXC would be the same as evaluated in the DFLAW SA-02 (DOE 2019).

4. **Interim Storage of Pretreated Supernate** – Under the 200 WARM Project, pretreated supernate (after removal of solids and key radionuclides) would be collected in the PWST, transferred to the LILO tanks, and then loaded into tanker trucks or portable tanks for transport off site or to a new onsite treatment facility. As reported in Section 2.2.2.1.5 of the TC&WM EIS, "storage and waste treatment facilities may be required to facilitate waste transfers." The TC&WM EIS evaluated the construction and operation of WRFs, which essentially serve the same purpose as the PWST and LILO tanks. Discussion of the similarities of the proposed tanks to a WRF is presented in Section 2.2.3 of this SA.

5. **Staging Laydown Area** – The Proposed Action would include providing an area for storage and staging of 5,000-gallon portable storage tanks to allow for uninterrupted processing, offsite shipment, treatment, and return of the tanks or disposal container overpacks (for solidified waste from onsite treatment). The preliminary estimate of the necessary footprint is about 2 acres. This size would accommodate about 90, 5,000-gallon portable tanks or overpacks with adequate spacing to facilitate truck and portable crane access. There would be a mix of full tanks or overpacks waiting for truck transport to the rail spur and empty tanks waiting to be filled. Some or all of this staging laydown area may be covered to protect the tanks and overpacks from the weather.

6. **Construction and Operation of an Onsite Solidification/Treatment Facility** – As discussed in Section 2.3 of this SA, DOE could establish an onsite facility in 200W to grout/treat the pretreated liquid waste to facilitate shipment of a solid waste form to an appropriately licensed and permitted commercial TSD facility. The conceptual design of the onsite facility would be similar to that analyzed in the TC&WM EIS under Alternative 3B. When comparing the overall impacts presented in the TC&WM EIS for Alternative 2B (as selected in the 2013 ROD) and Alternative 3B (which included the treatment of a portion of the LAW by onsite cast stone facilities in 200W and 200E), the potential impacts of Alternative 3B are the same or smaller than those in Alternative 2B for all environmental resource areas except land use. Under Alternative 3B, there would be additional land disturbance for the cast stone facilities that would not be expected under Alternative 2B. The changes in impacts associated with the onsite treatment facility are addressed in Section 3.3 for each of the affected resource areas.

7. **Offsite Shipment to a Commercial TSD** – Under the Proposed Action, DOE would either solidify/treat pretreated liquid waste at an onsite treatment facility or load permitted tankers or portable tanks with pretreated liquid waste and transport those loads to an appropriately licensed and permitted commercial TSD for solidification/treatment and out-of-state disposal. If the onsite treatment facility were developed, the solidified waste would be shipped to an appropriately licensed and permitted commercial TSD for out-of-state disposal. The offsite shipment, treatment, and out-of-state disposal of tank waste was not specifically evaluated in the TC&WM EIS. However, the Secondary Waste Management SA-03 evaluated the offsite shipment of both solid and liquid LLW from the Hanford Site to various TSD facilities across the United States (DOE 2023b). The Secondary Waste Management SA-03 evaluated annual transportation of about 243,000 gallons of secondary

liquid LLW/MLLW and 2.04 million gallons of secondary solid LLW/MLLW for the next 10 years. The SA-03 determined that the increased volume of offsite treatment and out-of-state disposal of LLW and MLLW under that proposal would not represent a substantive change relevant to environmental concerns from the proposal evaluated in the TC&WM EIS. Additionally, with the TBI EA (DOE 2023c), DOE prepared a FONSI for the proposal to pretreat approximately 2,000 gallons of Hanford Site tank waste supernate, which will then be treated and solidified at offsite, permitted, commercial facilities and disposed of outside of Washington state (DOE 2023d). These both are instances in which DOE has implemented similar proposals, albeit at a smaller scale. The additional offsite transportation, treatment, and disposal of Hanford Site waste is evaluated in Section 3.3 of this SA.

Table 3-1 provides a comparative evaluation of the potential impacts to each of the environmental resource areas analyzed in the TC&WM EIS. The center column presents the summary of potential impacts from the TC&WM EIS for Alternative 2B (which was selected in the 2013 ROD [78 FR 75913]) and Alternative 3B (which included the construction and operation of a Cast Stone Facility for onsite treatment). The right-hand column provides an assessment of the potential impacts from implementation of the Proposed Action for that resource.

Table 3-1 Comparative Resource Screening Analysis of Environmental Impacts

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
Land Use	Presented as percent of total land commitment within either the Industrial-Exclusive Zone[a] or Borrow Area C,[b] as appropriate **Alternative 2B** 41.3 acres of new facilities. Total land commitment of 249 acres (2 percent) associated with tank closure within the Industrial-Exclusive Zone. (TC&WM EIS, Section 4.1.1.3.1) **Alternative 3B** 42.6 acres of new facilities. Total land commitment of 251 acres (2 percent) associated with tank closure within the Industrial-Exclusive Zone. (TC&WM EIS, Section 4.1.1.5.1)	The footprint of the proposed 200W onsite facilities, including the IXC storage pad, staging laydown area, and the onsite treatment facility, is within the Industrial-Exclusive Zone,[a] which includes the tank farms in the 200 Areas and the WTP complex. The new onsite facilities would require no Borrow Area C[b] materials. There would be negligible differences in the potential land use impacts as evaluated for Alternative 2B and Alternative 3B. The key differences would be the development of almost an acre for the onsite treatment facility within 200W and the fencing around the PM facilities, PWST, and the storage pad and the potential adjustment of a gravel haul road and bypass road. These differences would all be within the Industrial-Exclusive Zone.
Visual Resources	**Alternatives 2B and 3B** Little change in the overall visual character of the 200 Area. With respect to visual impacts resulting from mining activities at Borrow Area C, both alternatives would result in a moderate change to the area as viewed from nearby higher elevations (principally Rattlesnake Mountain, a Traditional Cultural Property) and State Route 240. (TC&WM EIS, Section 2.8.1.1)	Implementation of the Proposed Action would not introduce any uniquely different or larger facilities that would change the potential impacts to visual resources presented in the TC&WM EIS for Alternative 2B. Additional trucks on the highway or entering or departing from the commercial treatment or disposal facilities would not cause notable visual impacts.
Noise and Vibration	**Alternatives 2B and 3B** Negligible offsite impact of onsite activities. Minor traffic noise impacts. (TC&WM EIS, Section 2.8.1.3)	The proposed 200W facilities are functionally equivalent to those evaluated in the TC&WM EIS and subsequent SAs and would not change the potential noise or vibration considerations evaluated for Alternative 2B or 3B. There would be negligible noise impacts from the construction of the pad and use of a forklift to place the IXCs on the storage pad. There would be no other noise impacts from operation of the IXC storage pad or the staging laydown area. There could be increased noise from construction and operation of the onsite treatment facility; however, considering the distance to the nearest offsite receptor, noise impacts would be negligible. The offsite shipment of pretreated liquid or solidified waste would result in a slight increase in truck traffic south from the Hanford Site (toward Texas or Utah). Per Section 2.4.1, about 12 shipments per week would be expected for transportation of liquid waste to a TSD facility. If an onsite treatment facility is established, the number of potential truck shipments would increase to about 33 per week.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
		While additional truck traffic would increase the potential noise in the area immediately south of the Hanford Site, there would not be large numbers of trucks transporting waste at the same time. Each incremental truck shipment would contribute small increases in noise, which would dissipate quickly. It would not be discernible from the existing truck and vehicle traffic noise.
Air Quality	Peak-year incremental criteria pollutant – Most stringent guideline/standard (micrograms per cubic meter) **Alternative 2B** Carbon monoxide (1-hour) standard = 40,000/40,500 Nitrogen oxides (1-hour) standard = 188/35,200 PM_{10} (24-hour) standard = 150/4,910 $PM_{2.5}$ (24-hour) standard = 35/4,910 Sulfur oxides (1-hour) standard = 197/105 Peak year incremental toxic chemical concentrations (micrograms per cubic meter) Ammonia (24-hour) ASIL = 70.8/12.0 Benzene (annual) ASIL = 0.0345/0.00459 Mercury (24-hour) ASIL = 0.09/0.117 Toluene (24-hour) ASIL = 5,000/3.62 Xylene (24-hour) ASIL = NL/1.1 (TC&WM EIS, Tables 4-3 and 4-4) **Alternative 3B** Carbon monoxide (1-hour) standard = 40,000/62,000 Nitrogen oxides (1-hour) standard = 188/38,000 PM_{10} (24-hour) standard = 150/4,910 $PM_{2.5}$ (24-hour) standard = 35/4,910 Sulfur oxides (1-hour) standard = 197/88.2 Peak year incremental toxic chemical concentrations (micrograms per cubic meter) Ammonia (24-hour) ASIL = 70.8/12.2 Benzene (annual) ASIL = 0.0345/0.00622 Mercury (24-hour) ASIL = 0.09/0.00786 Toluene (24-hour) ASIL = 5,000/6.26 Xylene (24-hour) ASIL = NL/1.86 (TC&WM EIS, Tables 4-3 and 4-4)	The proposed 200W facilities are functionally equivalent to those evaluated in the TC&WM EIS and subsequent SAs and would not introduce new sources or significant increases in air quality considerations beyond those potential impacts evaluated for Alternatives 2B and 3B. There would be typical emissions related to land disturbance and construction of the concrete pad, staging laydown area, and 200W facilities. There would be negligible emissions from the transport vehicle during storage of the IXCs and during their final disposition. One of the larger incremental increases to air emissions would be associated with the onsite treatment facility; however, those emissions were accounted for in Alternative 3B. There would be no air emissions associated with operations of the IXC storage pad or staging laydown area. The proposed transportation of pretreated liquid or solidified waste to offsite TSD facilities would result in emissions from the transport vehicles, which is evaluated in Section 3.3.1 of this SA.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
Geology and Soils	**Alternatives 2B and 3B** Small impact from construction, including potential for short-term soil erosion. Excavation depths limited to 12 meters (about 40 feet). New permanent land disturbance: 276 acres for Alternative 2B and 271 acres for Alternative 3B (3B includes a smaller disturbance of Borrow Area C). (TC&WM EIS, Section 2.8.1.5)	The footprint of the proposed 200W facilities, including the IXC storage pad, staging laydown area, and the onsite treatment facility, is within the Industrial-Exclusive Zone,[a] which includes the tank farms in the 200 Areas and the WTP complex. Although construction of the storage pad, staging laydown area, and onsite treatment facility would increase the amount of non-permeable surfaces from that evaluated in the TC&WM EIS, there would be no discernible differences in the potential impacts to geology and soils as evaluated for Alternatives 2B or 3B because the area has been highly disturbed and is gravel and fill. The storage pad and onsite treatment facility would be designed to meet applicable seismic criteria requirements.
Water Resources	**Alternatives 2B and 3B** Surface Water – Short-term increase in stormwater runoff during construction, but no direct disturbance to surface-water features. No direct, routine discharge of effluents during operations to surface waters or to the subsurface. Water use will not exceed site capacity. Vadose Zone and Groundwater – Potential for SST retrieval leaks in the short term without any recovery once in the subsurface. Groundwater mounds could begin to re-expand due to increased discharge of sanitary wastewater, nonhazardous process wastewater, and treated radioactive liquid effluents to onsite treatment and disposal facilities during waste treatment. (TC&WM EIS, Section 2.8.1.6)	Surface Water – The proposed 200W facilities are functionally equivalent to those evaluated in the TC&WM EIS and subsequent SAs, would not introduce new potential surface water releases or water uses beyond those potential impacts evaluated for Alternatives 2B and 3B, and would be smaller in size than the original LAWPS facility evaluated in the TC&WM EIS. Although construction of the storage pad, staging laydown area, and onsite treatment facility would increase the amount of non-permeable surfaces, there would be a negligible effect on surface water runoff. As noted in Section 4.1.6 of the TC&WM EIS, no portion of the 200 Areas lies within a floodplain. Although the southwest corner of 200W is within the probable maximum flood zone of Cold Creek, no facilities would be constructed there under any tank closure alternative, including the current proposal evaluated under this SA. Vadose Zone and Groundwater – Similar to surface water, the Proposed Action would not introduce new potential impacts to the vadose zone or groundwater beyond those potential impacts evaluated for Alternatives 2B or 3B. Under normal conditions, there would be no releases to groundwater from key radionuclide removal, storage of loaded IXCs, staging laydown area, or operation of an onsite treatment facility. Because the loaded resin would be dried before storage, there would be no potential for groundwater impacts in the event of a postulated accident. Portable tanks would be monitored for leakage and would only be staged for a few days at a time.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
		Offsite transportation would not have any potential for impacts to surface or groundwater except during accident conditions. These are discussed in Section 3.3.4.
Ecological Resources	Terrestrial Resources – 3 acres of sagebrush habitat affected in 200E that would be unmitigable. No affected sagebrush habitat in 200W. Wetlands – No impact on wetlands within the 200 Area. Aquatic Resources – No impact on aquatic resources within the 200 Area. Threatened and Endangered Species – No impact on any federally listed threatened or endangered species. Potential impacts on two State-listed species in 200E. No potential impact in 200W. (TC&WM EIS, Section 4.1.7.3) **Alternative 3B** Terrestrial Resources – Construction of new facilities would impact a total of 9.9 acres of sagebrush habitat. Within 200W, construction would take place on 2.2 acres of sagebrush habitat within the area identified for the Cast Stone Facility, which was identified as not mitigable. Wetlands – No impact on wetlands within the 200 Area. Aquatic Resources – No impact on aquatic resources within the 200 Area. Threatened and Endangered Species – No impact on any federally-listed threatened or endangered species. Potential impacts on the loggerhead shrike (Federal species of concern and state candidate) and sage sparrow (state candidate) have been observed within the area identified for the Cast Stone Facility. Due to the presence of sagebrush habitat within this area, other special status species could potentially be present. (TC&WM EIS, Section 4.1.7.5)	The footprint of the proposed 200W facilities, including the IXC Storage Pad, staging laydown area, and onsite treatment facility, is within the Industrial-Exclusive Zone,[a] which includes the tank farms in the 200 Areas and the WTP complex. There would be no differences in potential impacts to ecological resources as evaluated for Alternatives 2B and 3B. There would be no potential for impacts to ecological resources from the operation of the IXC storage pad, operation of the onsite treatment facility, or from offsite transportation of pretreated or solidified waste. Prior to construction of the onsite facilities, DOE's tank farm contractor would follow the requirements in the *Hanford Site Biological Resources Management Plan* to ensure that there would not be any inadvertent impacts to biological resources beyond those identified in the TC&WM EIS (DOE 2017). As part of the normal evolutionary process of environmental review, DOE performs an ecological clearance review of the specific potential areas of disturbance associated with proposed project construction. In February 2025, DOE prepared a review for potential disturbances associated with the 200 WARM facilities. The ecological clearance identified potential areas of compensatory mitigation in accordance with the Biological Resources Management Plan (HMIS 2025a; DOE 2017). Actual compensatory requirements will be assessed after project completion. The ecological clearance process will re-evaluate the area once siting locations for the onsite treatment facility and , staging laydown area are finalized.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
Cultural and Paleontological Resources	**Alternatives 2B and 3B** Prehistoric, historic, and paleontological resources – No impacts. American Indian Interests – After closure, the 200 Area's containment structures and closure barriers will be visible from higher elevations. (TC&WM EIS, Section 2.8.1.8)	The footprint of the proposed 200W facilities, including the IXC storage pad, staging laydown area, and onsite treatment facility, is within the Industrial-Exclusive Zone,[a] which includes the tank farms in the 200 Areas and the WTP complex. There would be no significant differences in potential impacts to cultural and paleontological resources as evaluated for Alternatives 2B and 3B. There would be limited potential for additional impacts to cultural and paleontological resources from the IXC storage pad or the treatment facility. Prior to construction, the tank farm contractor would follow the requirements in the *Hanford Site Cultural Resources Management Plan* to identify and minimize inadvertent impacts to cultural resources (DOE 2003). As part of the normal evolutionary process of environmental review, DOE performs a cultural clearance review of the specific potential areas of disturbance associated with proposed project construction. In February 2025, DOE prepared a review for the potential disturbances associated with the 200 WARM facilities. The cultural clearance determined that no impacts to cultural resources were anticipated from project activities within the project area (HMIS 2025b). The cultural clearance process will re-evaluate the area once siting locations for the onsite treatment facility and staging laydown area are finalized.
Socioeconomics	**Alternative 2B** Peak annual workforce (full-time equivalent) = 6,860 Peak daily commuter traffic (vehicles per day) = 5,500 Peak daily truck loads, off site = 48 Impact on the region of influence (ROI) – Potential for change in the socioeconomic ROI, including increases in population, demand and cost for housing and community services, and level-of-service impacts on local transportation. (TC&WM EIS, Section 4.1.9.3) **Alternative 2B** Peak annual workforce (full-time equivalent) = 5,260 Peak daily commuter traffic (vehicles per day) = 4,200 Peak daily truck loads, off site = 36 Impact on the ROI – Potential for change in the socioeconomic ROI, including increases in population, demand and cost for housing and community services, and level-of-service impacts on local transportation. (TC&WM EIS, Section 4.1.9.5)	The proposed 200W facilities are functionally equivalent to those evaluated in the TC&WM EIS and would not require substantively more resources than full WTP operations. Therefore, the Proposed Action would not require a substantively increased workforce beyond that evaluated for Alternative 2B or 3B. There would be negligible impacts to socioeconomic resources from construction of the IXC storage pad, staging laydown area, or the onsite treatment facility and accelerated pretreatment of the 200W waste in parallel with the 200E waste (under DFLAW). There would also be a small number of additional truck drivers to implement the offsite shipment of pretreated waste (approximately 12−33 truck trips per week). The increased truck traffic (12−33 trips per week, or 3−7 trips per day) would be less than the difference of the estimates in peak daily truck loads from Alternative 2B and 3B (48 and 36, respectively).

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
Public and Occupational Health and Safety (Normal Operations)	**Alternative 2B** Normal Operations *Offsite population impact – life of project* Dose (person-rem)/latent cancer fatality (LCF) = 1,600/1 *Peak year maximally exposed individual impact* Dose (mrem/yr)/increased risk of an LCF = 10/6×10^{-6} *Peak year onsite maximally exposed individual impact* Dose (mrem/yr)/increased risk of an LCF = 1.7/1×10^{-6} *Radiation worker population impact – life of project* Dose (person-rem)/LCF = 11,000/7 *Average annual impact per radiation worker* Dose (mrem/yr)/increased risk of an LCF = 160/1×10^{-4} *Peak year noninvolved worker impact* Dose (mrem/yr)/increased risk of an LCF = 3.4/2×10^{-6} (TC&WM EIS, Section 4.1.10.3) **Alternative 3B** Normal Operations *Offsite population impact – life of project* Dose (person-rem)/latent cancer fatality (LCF) = 1,200/0.7 *Peak year maximally exposed individual impact* Dose (mrem/yr)/increased risk of an LCF = 8.5/5×10^{-6} *Peak year onsite maximally exposed individual impact* Dose (mrem/yr)/increased risk of an LCF = 1.4/8×10^{-7} *Radiation worker population impact – life of project* Dose (person-rem)/LCF = 9.800/6 *Average annual impact per radiation worker* Dose (mrem/yr)/increased risk of an LCF = 160/1×10^{-4} *Peak year noninvolved worker impact* Dose (mrem/yr)/increased risk of an LCF = 3.0/2×10^{-6} (TC&WM EIS, Section 4.1.10.5)	The proposed 200W facilities are functionally similar to those of the WTP Pretreatment Facility and the Cast Stone Facility, which were evaluated in the TC&WM EIS and subsequent SAs. However, a pretreatment capability was not previously considered for 200W. The DWPF SA-02 analyzed the IXC storage pad and storage of the IXCs on the pad in 200E and determined that the additional worker and public impacts would be minimal. Potential health and safety impacts to workers and the public from the proposed onsite facilities are evaluated in more detail in Section 3.3.2. Increasing the amount of offsite treatment and disposal of pretreated waste would transfer some of the potential worker health impacts from onsite DOE contractors to those working at the commercial TSD facilities; however, these impacts are expected to be similar to those presented in the TC&WM EIS for this activity. Alternative 3B (health impacts of which are all lower than those of Alternative 2B) included the potential impacts of operating a Cast Stone Facility in 200W. These elements of the Proposed Action are evaluated in more detail in Section 3.3.2 of this SA.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
Public and Occupational Health and Safety (Facility Accidents)	**Alternatives 2B and 3B** Facility Accidents *Offsite population consequences* Dose (person-rem)/LCFs = 75,000/50 *Maximally exposed offsite individual consequences* Dose (rem)/increased risk of LCF = $4.3/3\times10^{-3}$ *Noninvolved worker consequences* Dose (rem)/increased risk of LCF = 13,000/1 *Offsite population risk* Annual number of LCFs/number of LCFs over the life of the project = 0/1 *Maximally exposed offsite individual risk* Annual increased risk of an LCF/increased risk of an LCF over life of the project = $1\times10^{-6}/3\times10^{-5}$ *Noninvolved worker risk* Annual increased risk of an LCF/increased risk of an LCF over life of the project = $8\times10^{-3}/2\times10^{-1}$ (TC&WM EIS, Section 2.8.1.11)	The proposed 200W facilities are functionally similar to those of the WTP Pretreatment Facility and the Cast Stone Facility, which were evaluated in the TC&WM EIS and subsequent SAs. However, a pretreatment capability was not previous considered for 200W. The DWPF SA-02 analyzed the IXC storage pad and storage of the IXCs on the pad and determined that accident risks would not be substantively different than those presented in the TC&WM EIS (DOE 2019). Potential accidents associated with the Cast Stone Facility (essentially equivalent to the proposed onsite treatment facility) were included in the TC&WM EIS (Table 4-54), and the potential consequences were much smaller than the bounding WTP accident (i.e., MEI = 0.0035 mrem; population = 0.021 person-rem). More details related to potential health and safety impacts from facility accidents associated with the proposed onsite facilities are included in Section 3.3.3.
Public and Occupational Health and Safety (Transportation)	**Alternative 2B** Transportation *Incident-free transportation (Dose/LCF)* Workers = 260 person-rem/0.16; Public = 73 person-rem/0.04 *Traffic accidents* (nonradiological fatalities) = 0.05 Assumed no offsite radioactive waste shipments *Offsite population (accident risk)* Dose (person-rem)/LCFs = $3.5\times10^{-6}/2.1\times10^{-9}$ (TC&WM EIS, Section 4.1.12.3) **Alternative 3B** Transportation *Incident-free transportation (Dose/LCF)* Workers – 1,080 person-rem/0.65; Public = 267 person-rem/0.16 *Traffic accidents* (nonradiological fatalities) = 0.38 Included offsite radioactive waste shipments *Offsite population (accident risk)* Dose (person-rem)/LCFs = $0.07/4.3\times10^{-5}$ (TC&WM EIS, Section 4.1.12.5)	There would be an increase in health risks to transportation crews for the shipments of pretreated or solidified waste and a small increase in health risks to the population along transportation routes. Furthermore, there would be an increased accident risk associated with the offsite transportation of the pretreated or solidified waste. These elements of the Proposed Action are evaluated in further detail in Section 3.3.4 and Appendix B of this SA.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
Industrial Safety	**Alternative 2B** Worker Population Impact – Total Project Total recordable cases (fatalities) = 3,880 (0.50) (TC&WM EIS, Table 4-98) **Alternative 2B** Worker Population Impact – Total Project Total recordable cases (fatalities) = 3,440 (0.45) (TC&WM EIS, Table 4-98)	The proposed 200W facilities are functionally similar to those evaluated in the TC&WM EIS and subsequent SAs and would not introduce any new industrial hazards that were not included in the evaluation of Alternatives 2B and 3B. The addition of the IXC storage pad, staging laydown area, and the onsite treatment facility would introduce negligible industrial safety risks as a result of the construction activities. Operations of the facilities would not add staff that could increase the estimated total recordable cases or fatalities. The Proposed Action would not introduce any new industrial hazards that were not included in the evaluation of Alternatives 2B or 3B.
Waste Management	**Alternative 2B** <u>Disposed of offsite and/or stored onsite</u> (cubic meters unless otherwise noted) IHLW glass (# of canisters) = 14,200 (12,000) IHLW cesium and strontium glass (# of canisters) = 400 (340) HLW melters (# of melters) = 1,350 (11) Mixed TRU waste (includes tank and secondary, CH and RH) = 206 Hazardous waste = 79,600 <u>Disposed of onsite</u> ILAW glass (# of canisters) = 213,000 (92,300) LAW melters (# of melters) = 8,000 (31) LLW (secondary) = 37,600 Liquid LLW (liters) = 9,690 Closure LLW = 679 MLLW (secondary) = 36,900 Closure MLLW = 468,000 (TC&WM EIS, Table 4-86) **Alternative 3B** <u>Disposed of offsite and/or stored onsite</u> (cubic meters unless otherwise noted) IHLW glass (# of canisters) = 10,300 (8,700) IHLW cesium and strontium glass (# of canisters) = 400 (340) HLW melters (# of melters) = 1,100 (9) Mixed TRU waste (includes tank and secondary, CH and RH) = 3,846 Hazardous waste = 79,700	The proposed 200W facilities are functionally similar to those evaluated in the TC&WM EIS and subsequent SAs and do not introduce new waste types beyond those evaluated for Alternatives 2B and 3B. The 200 WARM Project would involve temporary storage of the key radionuclides removed from the tank waste (e.g., Cs-137 and Sr-90) until the IX media and key radionuclides could be run through the HLW Vitrification Facility. Based on the DFLAW SA-02, this approach does not substantively change waste management impacts from those presented in the TC&WM EIS. The proposal includes possible offsite treatment and disposal of liquid pretreated waste, which is not specifically evaluated in the TC&WM EIS. The other option for treating pretreated liquid waste is through a proposed onsite treatment facility, which was evaluated in the TC&WM EIS in Alternative 3B. The waste management elements of the Proposed Action are evaluated in more detail in Section 3.3.5 of this SA.

Resource Area	Impacts in 2012 TC&WM EIS for Alternative 2B and Alternative 3B	Assessment of Impacts for 200W Alternative Tank Waste Treatment
	<u>Disposed of onsite</u> ILAW glass (# of canisters) = 65,800 (28,510) Cast stone waste = 233,000 LAW melters (# of melters) = 2,260 (9) LLW (secondary) = 22,100 Liquid LLW (liters) = 9,690 Closure LLW = 679 MLLW (secondary) = 35,100 Closure MLLW = 468,000 (TC&WM EIS, Table 4-88)	

a Industrial-Exclusive Zone: Land within the 200 Area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes as designated by DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* and *Record of Decision* (64 FR 61615, November 12, 1999).

b Borrow Area C: Located south of 200W along State Route 240. It is a proposed supply site for the sand, soil, and gravel needed to support the RCRA Subtitle C closure cap portion of the alternatives discussed in the TC&WM EIS.

ASIL = Acceptable Source Impact Level; CH = contact-handled; DFLAW = direct-feed low-activity waste; DWPF = Defense Waste Processing Facility; HLW = high-level radioactive waste; IDF = Integrated Disposal Facility; IHLW = immobilized high-level radioactive waste; ILAW = immobilized low-activity waste; IXC = ion exchange column; LAW = low-activity waste; LAWPS = Low-Activity Waste Pretreatment System; LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; mrem/yr = millirem per year; NL = not listed; PM = process module; PMn = particulate matter with an aerodynamic diameter less than or equal to n micrometers; PWST = pretreated waste storage tank; RCRA = Resource Conservation and Recovery Act; RH = remote-handled; ROI = region of influence; SA = Supplement Analysis; SST = single-shell waste storage tank; TRU = transuranic; TSD = treatment, storage, and disposal; WARM = West Area Risk Management; WTP = Waste Treatment and Immobilization Plant.

3.3 Additional Evaluations

The environmental resource area screening process described in Section 3.2 (Table 3-1) identified five resource areas related to the proposed implementation of the Proposed Action for further evaluation: (1) air quality, (2) public and occupational health and safety (normal operations), (3) public and occupational health and safety (facility accidents), (4) public and occupational health and safety (transportation), and (5) waste management.

3.3.1 Air Quality

The Proposed Action would include the construction of additional facilities in 200W that would be similar to those evaluated under the DFLAW approach in 200E (DOE 2019). It would also include construction and operation of a staging laydown area and an onsite treatment facility similar to that described and evaluated as a primary element of Alternative 3B in the TC&WM EIS. Otherwise, the proposal does not involve the construction or operation of any facilities that have not been evaluated previously under NEPA (including subsequent SAs) or existing facilities that have not been licensed and permitted for air emissions by the applicable state regulatory agency. Therefore, the Proposed Action would not involve any new sources of facility air emissions at the Hanford Site, the offsite commercial treatment facilities, or any out-of-state disposal facilities. The TC&WM EIS presented potential emissions of criteria and toxic air pollutants associated with the construction, operation, and deactivation of proposed facilities in Appendix G of the TC&WM EIS. Greenhouse gases (GHG) are discussed in Section G.5 of the TC&WM EIS. The estimated emissions of carbon dioxide for Waste Management Alternative 2 (selected in the ROD) are presented in Table G-167 of the TC&WM EIS (DOE 2012). It should be noted that use of an onsite treatment facility for treatment of a portion of LAW, as evaluated under Alternative 3B (instead of using the LAW Vitrification Facility for immobilization of all LAW as analyzed under Alternative 2B), would result in an overall decrease in GHG emissions related to onsite operations. Total carbon dioxide emissions for Alternative 2B were estimated at 20.2 million metric tons (MT); for Alternative 3B, total carbon dioxide emissions were estimated at 11.9 million MT.

The transportation of pretreated or solidified waste by truck or rail to offsite TSD facilities would generate vehicle emission pollutants, including GHG. Potential air quality emissions were evaluated in the TC&WM EIS (Appendix G) for each alternative for the construction, operation, deactivation, and closure project phases.[28] These evaluations did not include offsite transportation of waste for treatment and/or disposal for Alternative 2B, but did include some offsite transportation of radioactive waste as an element of Alternative 3B. To estimate the relative contribution of air emissions that include offsite transportation of pretreated or solidified waste for treatment and/or disposal, DOE compared the transportation emissions of carbon monoxide, nitrogen oxides, and GHGs to similar emissions for Tank Closure Alternative 2B (the bounding value) during operations.

There are four scenarios to consider for this analysis; truck transport of liquid or solidified waste and rail transport of liquid or solidified waste. These are addressed separately below.

[28] Table G-167 provides estimated annual average emissions of carbon dioxide by alternative as opposed to by project phase.

Truck Transportation

To estimate vehicle emissions of total hydrocarbons, carbon monoxide, nitrogen oxides, and total GHGs (expressed as carbon dioxide equivalent [CO_2eq]), total truck transportation miles were multiplied by emission rates for each pollutant (Table 3-2). These emission rates are consistent with those used in SA-03 for secondary waste management. Truck miles were calculated from the estimated number of truck shipments and the miles of each trip (*see* Table 2-2). GHG emission rates vary by driving conditions, with slower speeds yielding higher GHG emissions per mile and higher speeds producing lower emissions per mile (Quiros et al. 2017). The GHG emission rate for regional highway driving conditions was selected because it best characterizes the average driving conditions for the transportation routes for the shipments to PFNW, WCS, or Energy*Solutions*, which are characterized by varying amounts of higher-speed Interstate highway and slower-speed hill-climb driving conditions. The GHG emission rate for regional highway driving is approximately equal to the average of the GHG emission rates for Interstate and hill-climb driving conditions.

Table 3-2 Emission Rates for Heavy-Duty Diesel Vehicles Used to Estimate Emissions for Transportation of Pretreated or Solidified Waste

Emission Pollutant	Emission Rate (grams/mile)[a]
Total hydrocarbons[b]	0.269
Exhaust carbon monoxide[b]	2.000
Exhaust nitrogen oxides[b]	4.169
Total particulate matter less than 2.5 microns[b]	0.119
Total GHG (CO_2eq)[c]	1,755

CO_2eq = carbon dioxide equivalent; GHG = greenhouse gas; $PM_{2.5}$ = particulate matter less than 2.5 microns

a Emission rate for GHG is dependent on driving conditions. Emission rates are based on grams per mile.

b Source: EPA 2021.

c Source: Quiros et al. 2017, Table 2.

The estimated truck emissions from transporting pretreated liquid waste and solidified waste are presented in Tables 3-3 and 3-4, respectively. The estimated annual truck emissions would represent a small addition to the projected emissions from the TC&WM EIS. Because of the increased volume of solidified waste and subsequent higher number of shipments, the solidified waste scenario bounds the potential air quality impacts and is therefore used for comparative discussions to the TC&WM EIS.

The air quality impacts in the TC&WM EIS included the operational emissions of the WTP Pretreatment Facility concurrently with the operation of WTP and the 200 Area tank farms. As noted in the DFLAW SA-02, the Pretreatment Facility has been indefinitely delayed. Conservatively adding the emissions from offsite truck transportation of solidified waste would increase Alternative 2B estimated emissions by about 0.56 percent for carbon monoxide, 1.04 percent for nitrogen oxides, and about 0.033 percent for particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$).[29] This proposed offsite transportation would not substantially increase the annual estimated emissions of carbon monoxide, nitrogen oxide, or $PM_{2.5}$. The TC&WM EIS did not estimate emissions of total hydrocarbons, so there is no direct comparison. The truck transportation of solidified waste would add such a small amount of hydrocarbons (1.09 MT per year) to the environment, air quality impacts would not be expected.

Table 3-3 Estimates of Emissions (MT per year) for Truck Transportation of Pretreated Liquid Waste

TSD Facility	Round Trip Truck Miles/Year	Emission Pollutant (MT per year)				
		Total HC	Exhaust CO	Exhaust NOx	Total $PM_{2.5}$	Total GHG (CO_2eq)
WCS	1,280,000					
Energy*Solutions*	238,000					
PFNW[a]	66,600					
Annual Total	**1,584,600**	**0.43**	**3.17**	**6.61**	**0.19**	**2,781**

CO = carbon monoxide; CO_2eq = carbon dioxide equivalent; HC = hydrocarbon; MT = metric ton; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns; TSD = treatment, storage, and disposal

Note: Blacked out cells indicate that the entries for each segment are not calculated.

a Shipment miles for PFNW include mileage from the Hanford Site to PFNW and from PFNW to WCS.

Table 3-4 Estimates of Emissions (MT per year) for Truck Transportation of Solidified Waste

TSD Facility	Round Trip Truck Miles/Year	Emission Pollutant (MT per year)				
		Total HC	Exhaust CO	Exhaust NOx	Total $PM_{2.5}$	Total GHG (CO_2eq)
WCS	3,696,000					
Energy*Solutions*	673,200					
Annual Total	**4,369,200**	**1.18**	**8.74**	**18.22**	**0.52**	**7,668**

CO = carbon monoxide; CO_2eq = carbon dioxide equivalent; HC = hydrocarbon; MT = metric ton; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns; TSD = treatment, storage, and disposal

Note: Blacked out cells indicate that the entries for each segment are not calculated.

As indicated in Table 3-4, GHG emissions could increase by about 7,668 MT per year for truck transportation of solidified waste. To put this into perspective, the estimated GHG emissions for Alternative 2B were 145,000 MT per year (DOE 2012, Appendix G, Table G-167). The incremental increase in annual GHG emissions from adding offsite truck transportation of solidified waste would be approximately 5.3 percent. Although there would be an increase in GHG emissions, the increase would be relatively small compared to the annual estimate of GHG emissions for Alternative 2B, especially considering that the total includes full operations of the WTP Pretreatment Facility.

Per PNNL (2013), the expansion factor for determining the volume of the solidified waste form could range from 1.5 to 1.8. If the upper end of the range were evaluated, the result would be an increase of as much as 20 percent in the volume to be disposed (for the 100 percent solidified waste scenario). For air emissions, this increase would not be substantial; most pollutants in Table

[29] Appendix G, Section G.2.1 of the TC&WM EIS states, "For the purpose of this analysis, emissions of PM_{10} and $PM_{2.5}$ from activities were assumed to be the same. Therefore, the concentrations estimated would also be the same, and $PM_{2.5}$ concentrations are not shown separately." As such, only PM_{10} emissions are reflected in the TC&WM EIS tables; however, $PM_{2.5}$ is discussed in the analysis in this SA.

3-4 would see a less-than-1-percent increase above that presented in the TC&WM EIS and the GHG emissions could be up to 6.6 percent higher. Since the WTP Pretreatment Facility is not currently operating, actual total emissions would likely be well below values in the TC&WM EIS.

Rail Transportation

Similar to the analysis for truck transportation, this section estimates locomotive emissions of total hydrocarbons, carbon monoxide, nitrogen oxides, particulate matter, and total GHGs (expressed as CO_2eq) associated with rail transportation of pretreated liquid and solidified waste. The EPA has published emission standards for locomotives that would be used for freight transportation from the Hanford Site to either WCS or Energy*Solutions* (40 CFR Part 1033). EPA (2009) provides emission rates that can be applied to meet these emission standards. This analysis uses emission rates associated with line-haul freight locomotives and assumes that the locomotives would meet Tier 4 requirements for equipment manufactured after 2015. Table 3-5 presents the emission factors used to develop the appropriate emission rates. These factors are presented in units of grams per brake-horsepower-hour. By applying a conversion factor of 20.8 brake-horsepower per gallon of diesel fuel, which is used by EPA (2009) for large line-haul freight locomotive applications, the factors are converted to grams per gallon emission rates.

Table 3-5 Emission Rate Information for Freight Locomotives

Emission Pollutant	Line-Haul Emission Factors (g/bhp-hr)
Total hydrocarbons	0.04
Exhaust carbon monoxide	1.28
Exhaust nitrogen oxides	1.00
Total particulate matter less than 10 microns	0.015

Source: EPA 2009
bhp = brake horsepower; g = gram; hr = hour

The USDOT provides annual reporting statistics that include energy intensity (or efficiency) for rail freight transportation. The most recent published data (2019) indicates that rail freight transportation had an energy intensity of 14,453 British thermal units (BTU)/freight car mile (USDOT 2024). By applying the energy conversion factor for diesel fuel (137,381 BTU/gallon), the analysis estimates the number of gallons per year required to transport the pretreated liquid or solidified waste (EIA 2024). For rail transportation of pretreated liquid, the locomotives would use approximately 22,000 gallons of diesel fuel annually (assuming 5 rail cars per train shipment). For the larger volume associated with solidified waste, the rail shipments would require approximately 41,000 gallons of diesel fuel per year. These emissions assume a round-trip mileage because DOE expects that the portable tanks would be returned to Hanford for re-use.

Based on the emissions factors in Table 3-5 and the conversion to the estimated gallons per year, Tables 3-6 and 3-7 present the annual emissions from rail transportation of pretreated liquid and solidified waste, respectively. The estimated annual locomotive emissions would represent a small addition to the projected emissions from the TC&WM EIS; smaller than those associated with truck transportation. Therefore, each of these entries would be less than the impacts discussed above and are not further evaluated.

Table 3-6 Estimates of Emissions (MT per year) for Rail Transportation of Pretreated Liquid Waste

TSD Facility	Freight Car Miles/Year	Emission Pollutant (MT per year)				
		Total HC	Exhaust CO	Exhaust NO_X	Total $PM_{2.5}$	Total GHG (CO2eq)
WCS [a]	178,800					
Energy*Solutions*	30,200					
Annual Total	**209,000**	**0.018**	**0.59**	**0.46**	**0.0069**	**346**

CO = carbon monoxide; CO_2eq = carbon dioxide equivalent; HC = hydrocarbon; MT = metric ton; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns; TSD = treatment, storage, and disposal

Note: Blacked out cells indicate that the entries for each segment are not calculated.

a Shipment miles for WCS include mileage from the Hanford Site to WCS and from PFNW to WCS.

Table 3-7 Estimates of Emissions (MT per year) for Rail Transportation of Solidified Waste

TSD Facility	Freight Car Miles/Year	Emission Pollutant (MT per year)				
		Total HC	Exhaust CO	Exhaust NO_X	Total $PM_{2.5}$	Total GHG (CO2eq)
WCS	331,800					
Energy*Solutions*	55,200					
Annual Total	**387,000**	**0.034**	**1.08**	**0.85**	**0.013**	**641**

CO = carbon monoxide; CO_2eq = carbon dioxide equivalent; HC = hydrocarbon; MT = metric ton; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns; TSD = treatment, storage, and disposal

Note: Blacked out cells indicate that the entries for each segment are not calculated.

3.3.2 Public and Occupational Health and Safety (Normal Operations)

The TC&WM EIS evaluated the potential health and safety impacts associated with the management, treatment, and disposal of hundreds of thousands of canisters/packages of radioactive waste (e.g., HLW, LLW, MLLW, and transuranic [TRU] waste) that would result from the operations of all facilities needed to support treatment of tank waste (DOE 2012*,* Tables 4-23 and 4-142). This included both contact- and remote-handled waste canisters/packages. The loaded IXCs would represent a very small increase in the number of the canisters/packages that were analyzed in the TC&WM EIS. The IXCs would be contact-handled with estimated dose rates of less than 1 millirem per hour (mrem/hour) at a distance of 30 centimeters (approximately 1 foot) and stored on a new IXC storage pad within a fenced area in 200W.

The DFLAW SA-02 evaluated potential operational impacts to workers and members of the public for a modular pretreatment capability and IXC storage in 200E. Most of the impacts were estimated to come from the exposure to IXCs on the storage pad. Per DOE (2019), the expected dose rate at the fence line of the IXC storage pad would be below 0.01 mrem/hour; therefore, the area outside the fence of the IXC storage pad would not be considered a radiation area in accordance with 10 CFR Part 835. Considering that operations of the modular pretreatment capability in 200W are similar to those evaluated in SA-02 and the proposed location for the 200W facilities are farther from the analyzed location of the maximally exposed member of the public, site potential impacts for the Proposed Action would be no greater than those estimated for DFLAW and therefore not substantively different than health impacts presented in the TC&WM EIS (DOE 2019). As presented above in Table 3-1, the TC&WM EIS projected an average annual worker dose of 160 mrem and an average dose to a member of the offsite public of 10 mrem (DOE 2012).

If the final design for the PWST capability includes aboveground tanks, there would be a potential for increased worker exposure during normal operations because the shielding provided by the soil around an underground tank would not be present. This would be addressed during the design of the shielding for the tank construction to ensure that as low as reasonably achievable (ALARA) principles are implemented. Similarly, the staging laydown area would contain a number of filled portable tanks that could range as high as 60 at any one time. The external exposure rates for these filled tanks would be much less than loaded IXCs, however, DOE would manage the access to the staging area to keep worker doses to a minimum. Additionally, normal worker exposure at the Hanford Site would continue to be monitored and administratively controlled.

Transportation of pretreated or solidified waste off site for treatment and/or out-of-state for disposal, as opposed to the onsite treatment and disposal evaluated in the TC&WM EIS, would essentially transfer a portion of the potential normal operational health impacts from the Hanford Site workforce to workers at commercial treatment and disposal facilities. Accordingly, radiological impacts resulting from this work would be comparable to those presented in the TC&WM EIS for treatment/disposal activities originally proposed for the Hanford Site.

For all workers at offsite treatment/disposal locations, under the requirements of 10 CFR Part 20 and 29 CFR Part 1910, as well as applicable state regulatory guidance, it is expected that radiation protection programs would maintain doses that adhere to ALARA principles and stay within compliance limits set by their respective governing authorities (e.g., U.S. Nuclear Regulatory Commission [NRC], Occupational Safety and Health Administration, WDOH, Texas Commission on Environmental Quality, UDEQ, or governing state equivalent).

Operations at the commercial treatment and disposal facilities would be conducted in accordance with licenses and permits issued by their respective states (i.e., Washington, Texas, and/or Utah). Because the pretreated waste volumes and constituents would be treated and disposed of in accordance with the existing licenses and permits of these facilities, impacts to facility workers are expected to fall within the range of potential health impacts considered during the licensing and permitting processes. Further, because there would be no new or additional radiological emissions or effluents at these commercial facilities beyond those evaluated as part of their permitting and licensing processes, there would be no additional doses to the public that have not previously been considered. As discussed earlier in this SA, the permitted operational throughput and disposal capacities of all analyzed offsite facilities would be expected to definitively accommodate the entire projected quantity of pretreated waste being sent from the Hanford Site over the analyzed period.

Based on the above considerations regarding both workers and the public, there would be no substantive difference in normal operational radiological health impacts to workers or the public from those originally estimated in the TC&WM EIS associated with the treatment and disposal of pretreated or solidified waste. Potential health impacts associated with transportation activities are addressed in Section 3.3.4.

3.3.3 Public and Occupational Health and Safety (Facility Accidents)

The TC&WM EIS analyzed a spectrum of accidents for operations associated with Alternatives 2B and 3B and Waste Management Alternative 2 (DOE 2012, Tables 4-50, 4-54, and 4-149). The accidents analyzed include leaks, fires, and design-basis seismic events. The accident with the highest consequence and risk was a seismic-induced collapse and failure of the WTP. Under that bounding scenario, DOE estimated that the hypothetical maximally exposed individual at the nearest offsite location could receive a dose of 4.3 rem, and the population surrounding the Hanford Site within a 50-mile radius could receive a collective dose of 75,000 person-rem. That accident was estimated to have a probability of occurrence of 5×10^{-4} per year, or once in 2,000 years.

For the DFLAW SA-02, DOE evaluated additional accident scenarios involving the IXC storage pad in 200E, including: (1) an IXC drop and spill event, (2) an IXC high-energy impact event (vehicular crash), and (3) a fire (unspecified source) involving all stored IXCs (DOE 2019). The IXCs installed in the TSCR were IXC-150, which indicates that they have a loading capacity of 150,000 curies. The larger IXCs planned for the LAWPS facility would be capable of loading up to 300,000 curies. The IXCs planned for the 200 WARM Project are the smaller, IXC-150.

The IXC drop and high-energy impact events evaluated in DOE (2019) were assumed to involve a single IXC and the analysis assumed that the columns were the larger IXCs at their maximum loading, 300,000 curies. Analysis of the fire event, assumed to involve all IXCs on the pad, assumed that there would be 120 columns loaded with an average 192,000 curies per IXC (DOE 2019).

The analysis in the DFLAW SA-02 indicates that the maximum potential offsite dose from an event at the 200E location would be about 31 millirem, or less than 1 percent of the maximally exposed individual dose estimated in the TC&WM EIS for the highest consequence and risk scenario. The loading of the IXCs in 200W with a combination of cesium and strontium would remain less than the curie loading of the IXCs evaluated for DOE (2019) and would not increase the overall accident hazard. Considering that the 200W IXC storage pad would be smaller than that analyzed in DOE (2019) and be located even farther from the site boundary, the potential impacts of the maximum reasonably foreseeable accident associated with the Proposed Action in this SA would be less than those presented in the SA-02.

Because the USDOT-approved portable tanks would be LSA-II packages, they would meet NRC requirements for *Packaging and Transportation of Radioactive Material* (10 CFR 71.71), which require the package to survive drop tests based on its weight. Therefore, any accidents involving staged tanks would be bounded by the accident scenarios presented in the TC&WM EIS (DOE 2012).

The TC&WM EIS analyzed accident scenarios in Alternative 3B for events involving the Cast Stone Facility (similar to the proposed onsite treatment facility). The estimated doses and LCF risks to the various receptors are shown in Table 3-8.

Table 3-8 Consequences of Potential Accidents Related to the Cast Stone Facility

Accident	Maximally Exposed Individual		Offsite Population[a]		Non-Involved Worker	
	Dose (rem)	LCF	Dose (person-rem)	LCF	Dose (rem)	LCF
Cast Stone feed receipt tank failure – unmitigated (200W)	0.0000035	2×10^{-9}	0.021	1×10^{-5}	0.0032	2×10^{-6}

Source: DOE 2012 (Table 4-54)

a Based on a population within 50 miles of the 200W as of the date of the TC&WM EIS (589,668 persons).

Proposed treatment and/or disposal of the pretreated or solidified waste at WCS or Energy*Solutions* would not change the types of accidents that could occur at those facilities or the potential impacts that could occur from presently ongoing MLLW treatment and disposal operations at such locations because the pretreated or solidified waste would meet the existing waste acceptance criteria and would be within the volumes stipulated in the facilities' state permit(s) or license(s).

3.3.4 Public and Occupational Health and Safety (Transportation)

There would be a separate (i.e., new) set of incident-free and accident risks associated with the transportation of pretreated or solidified waste to offsite treatment and/or disposal facilities not considered in the TC&WM EIS. The TC&WM EIS evaluated the potential transportation health risk impacts from the management, treatment, and disposal of numerous packages of radioactive waste (e.g., HLW, LLW, MLLW, and transuranic [TRU] waste) that would result from Hanford Site operations of all facilities supporting the treatment of tank waste and secondary waste streams. This included both contact- and remote-handed TRU waste canisters and packages over a wide array of radiological concentrations and intensities. The TC&WM EIS Waste Management Alternative 2 included the evaluation of offsite shipments of LLW and MLLW to the Hanford Site for treatment and disposal at the IDF (DOE 2012).

Offsite transportation of LLW and MLLW is strictly regulated. In accordance with 49 CFR, Subtitle B, Subchapter C, USDOT regulates packaging, labeling, preparation of shipping papers, handling, marking, and placarding of shipments and establishes standards for personnel as well as conveyance (e.g., truck and train) performance and maintenance (49 CFR 173.401). USDOT and the NRC set radioactive material packaging standards (10 CFR Part 71). In addition, DOE LLW and MLLW shipments must comply with DOE Orders 460.2A and 460.1D.

Proper packaging is a key element in transportation safety, and the selection of appropriate packaging typically is based on the level and form of radioactivity inherent to the materials that are being shipped. LLW and MLLW must be packaged to protect workers and the public (as well as the environment) during transport due to potential radiological exposures to truck or rail crews and the public being directly dependent upon external dose rates associated with the waste packages.[30]

[30] USDOT regulations (49 CFR Part 173) limit the external dose rates for LLW/MLLW packages to 200 mrem per hour at the contact surface of the package and 10 mrem per hour at 2 meters from the surface of the transport vehicle.

Pretreated liquid (or solidified) LLW and MLLW to be shipped off site for treatment are expected to have low levels of radioactivity. This is substantiated by the following considerations: (1) as identified in Section 2.4.3, the pretreated liquids would all qualify to be transported in LSA-II tankers or portable tanks;[31] (2) the radionuclide inventories of the solidified waste would be the same as the pretreated liquid waste with 50-percent more volume, therefore achieving an even lower radionuclide concentration per package; and (3) the WM PEIS (from which this SA's dose-rate estimates are scaled) conservatively assumed a *generically representative* dose rate of 1 mrem per hour at 1 meter for all LLW and MLLW packages (DOE 1997).

Under the Proposed Action, the pretreated liquid waste could be transported off site by truck or rail. DOE (and state inspectors, where required) would inspect vehicles and loads for shipments leaving the Hanford Site. States may inspect shipments to confirm regulatory compliance. The shipments would be expected to use the most direct routes that minimize radiological risk (DOE 1999). Shipments leaving the Hanford Site area for out-of-state destinations (e.g., Texas or Utah) would be transported over federal highways for the majority of their routes. For rail shipments, DOE would transport the portable tanks or solidified waste disposal containers to a rail spur in the southern portion of the Hanford Site or in a suitable location in the surrounding Tri-Cities, Washington, area and transfer these containers to a suitable railcar for shipping.

For truck shipments, data from the Federal Motor Carrier Safety Administration (FMCSA) for 2021 indicates that large trucks are involved in 35.2 accidents involving an injury or fatality per 100 million miles traveled (FMCSA 2024).[32] For rail shipments, the Federal Railroad Administration, an agency within the USDOT, annually prepares a safety analysis report that includes a 10-year overview and statistics regarding accident safety. The latest 10-year overview (2015−2024) indicates that freight trains travel an average of about 460 million miles each year and have an average of about 7.65 accidents or events either at highway crossings or along the rail line per 1 million train miles. From those accidents, the average number of fatalities that occur per year is about 0.37 fatality per 1 million train miles; 98.5 percent of which occur at highway intersections (FRA 2024).

DOE has an outstanding transportation safety record. During fiscal year 2022, DOE transported more than 3,800 hazardous materials shipments for more than 7.5 million miles without a single USDOT-recordable transportation accident.[33] DOE's transportation contractors would follow the same USDOT and NRC regulations for transporting hazardous material. DOE has response systems in place for accidents involving shipments of LLW or MLLW. Further, DOE supports training and emergency planning through its Transportation Emergency Preparedness Program. State, tribal, and local government officials respond to any such accident within their jurisdiction. DOE also responds to transport emergencies at the request of states and tribes.

[31] Per 49 CFR 173.427(a)(1), the external dose rate of an LSA package may not exceed an external radiation level of 1 rem per hour at 3 meters from the unshielded material.
[32] FMCSA (2024) reports that 33.6 accidents involving injury and 1.57 accidents involving a fatality occurred in 2021 per 100 million miles of large truck transportation.
[33] https://www.hanford.gov/files.cfm/TBI_Transportation_Fact_Sheet.pdf

Impact Assessment

The analysis in this SA evaluates four transportation scenarios to ship the inventory associated with 32 million gallons of 200W pretreated liquid waste, which include (1) pretreated liquid waste shipped in 5,000-gallon, USDOT-compliant tanker trucks or portable tanks to either the WCS FWF (approximately 1,600 roadway miles) or the Energy*Solutions* site (approximately 680 roadway miles); (2) solidified waste shipped in approximately 13.1-cubic yard disposal containers (one per legal-weight truck) from the Hanford Site to either the WCS FWF (approximately 1,600 roadway miles) or the Energy*Solutions* site (approximately 680 roadway miles); (3) pretreated liquid waste shipped via railroad with two, 5,000-gallon portable tanks on each railcar to either the WCS FWF (approximately 2,155 rail miles) or the Energy*Solutions* site (approximately 837 rail miles); or (4) solidified waste shipped in approximately 13.1-cubic yard disposal containers (three containers per railcar) shipped from the Hanford Site to either the WCS FWF (approximately 2,155 rail miles) or the Energy*Solutions* site (approximately 837 rail miles). Tables 2-2 through 2-4 provide the specific analytical parameters for each of these scenarios, which includes the assumption of an annual average of 5 railcars per train shipment. The Proposed Action is assumed to operate at this rate for about 11 years (2030−2040).

The WM PEIS includes a comprehensive analysis of LLW and MLLW transportation impacts and found that transporting LLW and MLLW has the potential to affect the health of truck crews and the public along transportation routes (DOE 1997). These health effects include both radiological and nonradiological impacts. The radiological impacts are the result of radiation received during incident-free transport, as well as accidents in which the waste containers are assumed to fail. Nonradiological impacts could occur as a result of exposure to vehicle exhaust and physical injury from vehicle accidents. In the WM PEIS, DOE evaluated multiple alternatives for decentralization, centralization, and regionalization of LLW/MLLW. Under a few of the truck alternatives for decentralization and regionalization, DOE determined that the impacts of transporting approximately 25,000 truck shipments of LLW and MLLW (over approximately 9 million miles) would be as follows (DOE 1997, Section 7.4.2 and Table E-15):

- Between 0.1 and 0.2 LCFs from radiological doses to either the truck crews or the public along the transportation routes;[34]
- About 0.1 fatality from vehicle emissions; and
- About 0.5 fatality resulting from physical injuries from traffic accidents.

Similarly, the WM PEIS also demonstrated that rail transportation has slightly lower risks than truck transportation. For the same decentralization and regionalization alternatives as above but using rail transport, there would be about 9,600 shipments of LLW and MLLW (over approximately 3.75 million rail miles) that would result in the following impacts (DOE 1997, Section 7.4.2 and Table E-16):

[34] The WM PEIS (DOE 1997) analyses reflect a lower dose-to-LCF risk factor (5×10^{-4} LCFs per person-rem) than DOE uses present-day (6×10^{-4} LCFs per person-rem). The updated factor reflects an increase of approximately 20 percent over the impacts calculated in 1997. The results presented in this SA reflect the current dose-to-LCF risk factor. The comparison to the WM PEIS to obtain potential impacts in this SA also reflects national population increases and updated truck accident rates since publication of the WM PEIS.

- Between 0.02 and 0.07 LCFs from radiological doses to either the rail crews or the public along the transportation routes;[35]
- About 0.12 fatality from locomotive emissions; and
- About 0.0075 fatality resulting from physical injuries from rail accidents.

DOE determines the appropriate level of detail of impact analysis, including transportation impact analysis, on a case-by-case basis. This determination is based on the nature of the proposed action and the potential significance of potential impacts. DOE transportation analyses have consistently shown that the impacts of the transportation of radioactive materials are generally small and are occasionally even overwhelmed by nonradiological impacts associated with the same shipments.[36] Accordingly, for DOE actions where only minimal radiological impacts would be expected from the transportation of certain radioactive materials (e.g., LLW, MLLW), completely new quantitative analyses are often not deemed necessary to assess potential impacts of newly proposed actions. Instead, DOE often endorses the approach of a simple screening analysis (with appropriately conservative inputs) to identify an upper bound on potential impacts, which would be expected to show whether potential new impacts could be of a significant magnitude and whether the need for further analysis is warranted.

As such, analytical tools that have built in assumptions, such as similar materials being transported, similar packaging, similar origination and destination locations, similar travel routes, similar population densities, and similar modes of transport, may be incorporated by reference into an SA and used to develop estimates for use in a screening analysis. This SA uses an analytical comparison based on the impact results presented in the WM PEIS as a primary mechanism for determining dose estimates to the public and truck or rail crews for the proposed offsite shipment of Hanford Site pretreated or solidified waste to one or more appropriately licensed and permitted commercial TSD facilities. The associated findings from this screening assessment are presented below in Table 3-9 (for truck and rail transportation of pretreated liquid and solidified waste), which provide both annual and total LCF estimates resulting from the anticipated 11-year (approximate) period to crews and the public for incident-free transport, as well as the projected public consequences from a maximum reasonably foreseeable transportation accident occurring during the 11-year Proposed Action period. For comparison perspective, the estimated number of nonradiological accident fatalities is also shown for the entire duration of the Proposed Action's transportation activities.

Incident-free impacts are those associated with routine transportation if no accidents occurred to affect the shipment. These impacts could be from the radiation emitted from the transportation cask or they could be from the exhaust and fugitive dust emitted by the truck or train. Of the four scenarios, annual incident-free impacts to the public would range between 0.0025 and 0.076 LCF; the largest of which would be associated with truck transportation of solidified waste. Similarly, the annual incident-free impacts to truck and rail workers would range between 0.00096 and 0.050 LCF; the largest of which would also be associated with truck transportation of solidified waste.

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[35] See Footnote 34.

[36] Examples include (1) 46,000 truck shipments of LLW from Paducah to WCS would result in 0.1 LCFs to the public and about 6 nonradiological traffic fatalities (DOE 2020, Table 4-38) and (2) 33,700 shipments of greater than Class C waste across the US would result in 0.04 LCFs and about 2 nonradiological traffic fatalities (DOE 2016, Table 4.3.9-1).

The potential consequences for a maximally foreseeable truck accident would be about 2.6 LCF, but combining this consequence with the annual probability of a maximally foreseeable truck accident, which varies by the number of shipments involved, the annual risk of a maximally foreseeable truck accident ranges from 0.000048 to 0.00013 LCF for shipping pretreated liquid or solidified waste, respectively. The potential consequences for a maximally foreseeable rail accident would be about 7.9 LCF, but combining this consequence with the annual probability of a maximally foreseeable rail accident, which varies by the number of shipments involved, the annual risk of a maximally foreseeable rail accident ranges from 0.00005 to 0.000092 LCF for shipping pretreated liquid or solidified waste, respectively. These estimates are all scaled from the WM PEIS, which assumed that 100 percent of the MLLW would be released from its packaging, 10 percent of that release would be entrained in an aerosol, and 5 percent of the aerosolized release would be respirable. Such aerosolized fraction and respirable fraction are attributed, in the analysis, to both heterogeneous MLLW solids (i.e., a powder) and nonvolatile MLLW liquids. Therefore, both fractions would be applicable to the analysis of an accident scenario involving pretreated liquid waste but would be overly conservative for an accident involving solidified waste, which would have a much lower airborne release fraction and respirable fraction than a liquid or a powder.

Table 3-9 Estimated Radiological Impacts to the Public and Truck Crews for Offsite Waste Transportation

Analytical Parameter	Truck Transportation		Rail Transportation [a]	
	Pretreated Liquid	Solidified [b]	Pretreated Liquid	Solidified [b]
Total miles/year	792,300	2,184,600	14,550/104,500	41,250/193,550
Total miles over 11-year Proposed Action period	8,715,300	24,030,600	160,050/1,149,500	453,750/2,129,050
Total shipments/year	604	1,650	582/60	1,650/110
Total shipments over 11-year Proposed Action period	6,644	18,150	6,402/660	18,150/1,210
Public LCFs from 1 year of shipping	2.8×10^{-2}	7.6×10^{-2}	2.5×10^{-3}	6.0×10^{-3}
Public LCFs from 11-year Proposed Action period	3.1×10^{-1}	8.4×10^{-1}	2.8×10^{-2}	6.6×10^{-2}
Crew LCFs from 1 year of shipping	1.7×10^{-2}	5.0×10^{-2}	9.6×10^{-4}	1.3×10^{-3}
Crew LCFs from 11-year Proposed Action period	1.9×10^{-1}	5.5×10^{-1}	1.1×10^{-2}	1.4×10^{-2}
Accident fatalities (nonrad) per year	132×10^{-2}	4.1×10^{-2}	1.5×10^{-1}	2.7×10^{-1}
Accident fatalities (nonrad) over 11-year Proposed Action period	1.4×10^{-1}	4.5×10^{-1}	1.6	3.0
Maximum reasonably foreseeable accident probability per year	1.8×10^{-5}	5.0×10^{-5}	6.6×10^{-6}	1.6×10^{-5}
Maximum reasonably foreseeable accident cumulative probability over 11-year Proposed Action period	2.0×10^{-4}	5.5×10^{-4}	7.3×10^{-5}	1.8×10^{-4}

Analytical Parameter	Truck Transportation		Rail Transportation [a]	
	Pretreated Liquid	Solidified [b]	Pretreated Liquid	Solidified [b]
Maximum reasonably foreseeable accident consequences (LCFs)	2.6	2.6	7.9	7.9
Maximum reasonably foreseeable accident risk from 1 year of Proposed Action (LCF/year)	4.8×10^{-5}	1.3×10^{-4}	5.0×10^{-5}	9.2×10^{-5}
Maximum reasonably foreseeable accident cumulative risk from 11-year Proposed Action period (LCFs)	5.3×10^{-4}	1.4×10^{-3}	5.5×10^{-4}	1.0×10^{-3}

LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste.

a For the rail mode scenario, the portable tanks or solidified waste disposal containers must first be transported from the Hanford Site to a nearby rail spur by truck. Therefore, the values for shipments and miles report two values (X/Y), where X is the value for truck and Y is the value for rail (i.e., numbers of shipments and shipment miles).

b The reported impacts for solidified waste are based on miles traveled. Since the solidification (e.g., grouting) process increases the total waste volume, the required transportation distance increases, resulting in higher risk values presented in the table. However, as these risk estimates are based on total shipments and mileage, they are inherently conservative for an accident involving solidified waste. Compared to liquid or powdered waste forms, solidified waste has a significantly lower airborne release fraction and respirable fraction, reducing the potential radiological consequences in the event of an incident.

To provide additional perspective on the incident-free radiological impact to the population from these shipments, the increased annual risk (associated with truck shipments of solidified waste) of 0.076 LCF is equivalent to a collective population exposure of about 127 person-rem in the exposed population (when applying the standard 6×10^{-4} dose-to-LCF risk conversion factor). This would be equivalent to a hypothetical total population of 100,000 people being exposed to an *average* individual dose of 1.27 millirem per year (0.2 percent of that incurred annually from natural background radiation).

DOE has also prepared Appendix B to provide an additional scaling comparison to another recent NEPA document. In 2020, DOE prepared the *Savannah River Site Defense Waste Processing Facility Recycle Wastewater Final EA* (SRS EA) and FONSI (DOE 2020). The SRS EA evaluated the transportation, stabilization, and disposal of up to 10,000 gallons of liquid DWPF recycle wastewater from the SRS H-Area Tank Farm to WCS and/or Energy*Solutions* and included a conservative accident analysis for a potential severe transportation accident for a maximum liquid release. As reported in Appendix B, dependent on the weather conditions and population density at the location of an accident, the long-term accident risk could range between 0.000164 and 0.00527 LCF per year. The value presented in Table 3-9 for cumulative risk for the 11-year period (0.00047 LCF) falls within that range and demonstrates good correlation.

Per the PNNL (2013), the expansion factor for determining the volume of the solidified waste form could range from 1.5 to 1.8. If the upper end of the range were evaluated, the result would be an increase of as much as 20 percent in the volume to be disposed of (for the 100 percent solidified waste scenario). This could result in a corresponding increase in the number of truck or rail shipments. For perspective, the increase in shipments for the 100 percent truck scenario would cause the annual incident-free impacts to the public to increase from 0.076 LCF to 0.091 LCF, and the annual incident-free impacts to truck workers to increase from 0.05 LCF to 0.055 LCF. Incident-free rail shipments would be bounded by the impacts from truck shipments. The increase of the accident risk by 20 percent would be more than offset by the fact that the solidified waste form is not in a dispersible configuration, as compared to the analysis assumption that it was either a liquid or powder.

As mentioned above, the TC&WM EIS Alternative 2B did not include offsite transportation of tank waste; however, the Secondary Waste Management SA-03 did evaluate and provide the basis for a decision to transport liquid and solid secondary waste to offsite treatment and disposal facilities (*see* Section 1.4). Although Energy*Solutions* was not a specific destination evaluated in SA-03, the SA evaluated transportation impacts based on the number of shipment miles, including those to Texas or Tennessee (DOE 2023b).

3.3.5 Waste Management

The TC&WM EIS evaluated management of several radiological waste streams, including LLW, MLLW, TRU waste, and HLW. There are four key differences to the proposed waste management in this 200W Tank Waste Treatment SA and that evaluated in the TC&WM EIS: (1) onsite management of pretreated waste, (2) onsite management of loaded IXCs that would be managed as HLW, (3) potential onsite treatment of pretreated waste, and (4) the transportation of pretreated tank waste for treatment and out-of-state disposal at appropriately licensed and permitted commercial TSD facilities.

3.3.5.1 Onsite Waste Management

The DFLAW SA-02 evaluated the removal of key radionuclides from tank waste and the onsite handling of the LAW by sending the LAW directly to the LAW Vitrification Facility (DOE 2019). SA-02 also evaluated the management and storage of loaded IXCs on a storage pad in 200E until their disposition as HLW in the future. SA-02 determined that under the DFLAW approach, the potential waste management impacts were not significantly different from those analyzed in the TC&WM EIS.

Under the Proposed Action, all of the SY tank farm and SST retrieval waste from the 200 Area waste tanks would not be processed through 200E, as assumed in the TC&WM EIS and the DFLAW SA-02. Instead, DOE would construct similar facilities adjacent to the SY tank farm in 200W to facilitate key radionuclide removal from approximately 32 million gallons of tank waste and offsite transportation for treatment and disposal of that pretreated waste. Ultimately, under the Proposed Action, there would not be an increase in the volume of supernate to be processed for removal of key radionuclides; however, DOE would use appropriately licensed and permitted commercial TSD facilities in parallel with the LAW Vitrification Facility to comply with the HFFACO/TPA.

As noted in Section 2.3, DOE is also proposing construction and operation of an onsite treatment facility. These actions were evaluated in Alternative 3B in the TC&WM EIS. The only key difference between the current proposal for onsite treatment is that the solidified waste is proposed to be shipped offsite to an appropriately licensed and permitted disposal facility instead of being disposed of at the Hanford Site IDF. Out-of-state disposal is discussed in Section 3.3.5.2.

As noted in Section 2.2.4, DOE would prepare a staging laydown area in 200W to facilitate onsite management of the empty and filled portable tanks (when shipping pretreated liquid) and/or disposal container overpacks (if operating an onsite treatment facility). This area would be the largest under the rail shipment scenario because train shipments would include 5-30 loaded railcars, each with 2 portable tanks onboard (or 3 disposal container overpacks); therefore, necessitating a staging capacity of between 10 and 60 filled tanks. The estimated 2-acre laydown area would allow DOE to stage about 90 containers at any one time; about 30 of which would be empty (either new or returned from the TSD). Having an adequate supply of empty portable tanks or overpacks would be necessary to provide efficient use of processing capacity and maximize the shipment of the pretreated or solidified waste to its offsite destination.

3.3.5.2 Out-of-State, Commercial Waste Management

As reported in Section 2.4 of this SA, some of the differences evaluated in this SA are related to the transportation, treatment, and disposal of approximately 32 million gallons of pretreated waste. As noted in Section 1.1, DOE is performing a WIR Evaluation to assess whether the retrieved tank waste may be managed as MLLW. Final issuance of the WIR Evaluation and a WIR Determination would be required treated and disposed of in an appropriately licensed and permitted commercial TSD facility.

The TC&WM EIS did not anticipate offsite treatment or disposal of pretreated or solidified tank waste because all tank wastes would be processed through either the LAW Vitrification Facility or the HLW Facility. As discussed above, offsite treatment and disposal of pretreated tank waste (after a WIR determination) would facilitate compliance with the HFFACO/TPA.

Offsite Solidification/Treatment

Potential impacts related to treatment of pretreated liquid waste at the offsite, appropriately licensed and permitted commercial TSD facilities would be minimal under the Proposed Action. Each potential facility is discussed below.

As identified in Section 2.4.2, WCS is permitted, licensed, and authorized to receive, treat, and dispose of Class A, Class B, and Class C LLW and MLLW. Waste would be treated at WCS and disposed of in the FWF. DOE would ensure that pretreated wastes meet the *FWF Federal Generator Handbook* (WCS 2015) prior to preparing any shipment from the LILO station. WCS has capacity to treat and dispose of up to 2 million gallons per year of liquid pretreated waste from the Hanford Site without impacting other waste treatment or disposal commitments (WCS 2024a). Per the assumption in Table 2-2, after a ramp up, this analysis assumes that DOE would send approximately 2 million gallons of pretreated waste per year to WCS.

Also described in Section 2.4.2, Energy*Solutions* operates a MLLW treatment and disposal facility in Clive, Utah. The Clive LLW facility is licensed by UDEQ for the treatment and disposal of Class A MLLW that meets specified waste acceptance criteria (Energy*Solutions* 2015). Energy*Solutions* has indicated that it has capacity to treat and dispose of 1 million gallons per year of liquid pretreated waste from the Hanford Site without impacting its current operations or commitments (Energy*Solutions* 2024). Per the assumption in Table 2-2, after a ramp up, this analysis assumes that DOE would send approximately 837,000 gallons of pretreated waste per year to Energy*Solutions*.

Per the discussion in Section 2.4.2, PFNW could be used for treatment; however, the solidified waste form was assumed to be sent to WCS for disposal. If PFNW were used as an option for treatment, DOE would ensure that pretreated wastes meet the PFNW waste acceptance criteria prior to preparing any shipment from the LILO station. PFNW has indicated that it has capacity to treat and disposition about 360,000 gallons per year of liquid pretreated waste from the Hanford Site without impacting its current operations or commitments (Perma-Fix 2024). Per the assumption in Table 2-2, DOE analyzed sending approximately 37,000 gallons per year to PFNW.

Although the TC&WM EIS did not anticipate or evaluate offsite treatment of tank waste, any pretreated wastes would meet the appropriate waste acceptance criteria of the proposed commercial TSD, and the proposed volumes would not impact these facilities' current commitments or licensed capacities.

Out-of-State Disposal

Waste Control Specialists Federal Waste Facility

DOE considers any license limits on specific radionuclides when identifying key radionuclides. WCS is licensed for disposal of LLW and MLLW in the WCS FWF under *Radioactive Material License No. R04100 Amendment 40* issued by the Texas Commission on Environmental Quality (TCEQ) in January 2024.[37] The license for the WCS FWF currently contains a total volume limit of 300,000 cubic yards and total activity limit (total decay corrected radioactivity) of 5,500,000 curies for containerized Class A, Class B, and Class C LLW, collectively. As of December 2024, approximately 97 percent of the current license limit remains available at the WCS FWF (WCS 2024b).

As noted in Section 2.4.1, based on preliminary data from H2C (2025), DOE expects that about 70 percent of the tank waste volume would be sent to WCS for disposal. This would correlate to about 166,408 cubic yards of solidified waste, which would represent about 55 percent of the current license total volume limit.[38][39] It would also represent about 57 percent of the remaining available capacity as of December 2024 (WCS 2024b).

The total activity in the 32 million gallons of pretreated liquid waste can be estimated by applying the average curies per shipment for the four groups identified in Section 2.4.1 to the shipments of liquid. This total results in about 102,500 total curies of containerized LLW. Of the waste that would be expected to be sent to WCS, the total activity corresponds to about 66,000 curies. Even

[37] The current license expired in September 2024 but is in "timely renewal status" based on the timely renewal request letter submitted by WCS in September 2023. This status allows the facility to operate under the current license until TCEQ reviews and issues a renewal amendment or the request is denied.

[38] If the full inventory of waste were sent to WCS (about 237,700 cubic yards of solidified waste), it would represent about 79 percent of the current license total volume limit and about 82 percent of the remaining available capacity as of December 2024 (WCS 2024).

[39] For the purposes of this SA, the waste volume expands by a factor of 1.5 when the pretreated liquid is solidified into a solidified matrix. See Footnote 23 for more information on the expansion factor, which could range from 1.5 to 1.8. Conservatively, if the upper end of the range were used, 70 percent of the solidified waste would represent about 67 percent of the current license total volume limit and about 70 percent of the remaining available capacity as of December 2024 (WCS 2024). If the full inventory was assumed to go to WCS and the higher expansion factor was used, the projected volume would represent about 95 percent of the current license total volume limit and about 98 percent of the remaining available capacity as of December 2024 (WCS 2024).. DOE would not send any waste to WCS that did not meet its waste acceptance criteria, including the license total volume limit.

if all of the waste was sent to WCS, this maximum radionuclide inventory would represent only about 1.9 percent of the activity limit for the WCS FWF.

EnergySolutions Clive Disposal Facility

Energy*Solutions* (Clive Disposal Facility) is licensed under *Radioactive Material License UT 2300249* (UDEQ 2023), issued by the State of Utah to receive Class A LLW. The license contains a volume limit for the mixed waste landfill cell of 1,354,092 cubic yards.

As noted in Section 2.4.1, based on preliminary data from H2C (2025), DOE expects that about 30 percent of the tank waste volume would be sent to Energy*Solutions*. This would correlate to as much as 71,324 cubic yards of solidified waste, which would represent about 5.3 percent of the current license total volume limit.[40][41] There is no activity limit specified in the license for disposal of waste in the mixed waste landfill cell as long as the Class A waste meets the waste acceptance criteria.

Perma-Fix Northwest

PFNW does not have disposal capability and accepts and solidifies MLLW within the limits of its radioactive materials license (WDOH 2024). Therefore, any waste solidified at PFNW would be disposed of at either Energy*Solutions* (for Class A LLW and MLLW only) or WCS FWF (for Class A, B, and C LLW and MLLW).

[40] For the purposes of this SA, the waste volume expands by a factor of 1.5 when the pretreated liquid is solidified into a solidified matrix. See Footnote 23 for more information on the expansion factor, which could range from 1.5 to 1.8.

[41] If the full inventory of waste were sent to Energy*Solutions*, the total volume (assuming an expansion factor of 1.5 - about 237,700 cubic yards of solidified waste) would represent about 18 percent of the current license total volume limit. Conservatively, if the upper end of the range were used, 30 percent of the solidified waste would represent about 6.8 percent of the current license total volume limit. If the full inventory could meet Class A concentration limits and was sent to Energy*Solutions* and the higher expansion factor was used, the volume would represent about 21 percent of the current license total volume limit.

4 CUMULATIVE IMPACTS

This chapter presents an analysis of the potential cumulative impacts (or effects) resulting from the Proposed Action. The TC & WM EIS defined cumulative impacts as "impacts that can result from individually minor, but collectively significant, actions taking place over a period of time." This analysis includes impacts from other past, present, and reasonably foreseeable future actions.

The TC&WM EIS presented the cumulative impacts analysis in Chapter 6, specifically identifying the past, present, and reasonably foreseeable future actions relative to that Proposed Action. This chapter evaluates the incremental impacts of implementing the Proposed Action and those evaluated in the TC&WM EIS. The chapter also evaluates if there are any new present or reasonably foreseeable future actions that were not considered in the TC&WM EIS that could contribute to cumulative impacts with the incremental impacts of the Proposed Action.

4.1 Incremental Impacts of the 200W Tank Waste Treatment

As noted in Chapter 3 of this SA, implementation of the Proposed Action has the potential for impacts to air quality, occupational and public health and safety (normal operations, facility accidents, and transportation), and waste management. These impacts are discussed in the following section in combination with potential impacts from new present and reasonably foreseeable future actions that were not previously included in the TC&WM EIS.

4.2 Evaluation of New Present and Reasonably Foreseeable Future Actions

As part of the analysis of cumulative impacts for this SA, DOE considered both the timing and the Region of Influence for each environmental resource area that could be affected during the period from present to the year 2040. Ongoing and reasonably foreseeable future actions that are considered in this SA include the following:

- Implementation of the **TBI Demonstration** project to separate and pretreat approximately 2,000 gallons of supernate tank waste from DST SY-101 (in 200W) through in-tank settling, decanting, filtration, and IX media. As discussed in Section 1.4, the TBI EA (DOE 2023c) evaluated this action. Following pretreatment, the pretreated waste is being managed as MLLW and will be sent to WCS and Energy*Solutions* for treatment and disposal. Because this action is forecast to be completed in 2025, it would not have cumulative impacts with the Proposed Action, which is not expected to begin for another five years. Therefore, the TBI Demonstration action is not discussed further in this SA.

- As identified in Section 2.2.1, under the **DFLAW approach**, DOE will separate the LAW from other waste in the Hanford Site tanks and vitrify a portion of the LAW. During DFLAW, the supernate portion of the radioactive waste in 200E is transferred and pretreated in the LAWPS to remove Cs-137 and solids. The pretreated waste is then fed to the WTP LAW Vitrification Facility. The vitrified waste will be disposed of on site at the IDF in 200E. An integral element of the DFLAW approach is the construction of an IXC storage pad in 200E for the loaded IXCs.

DOE decided to implement DFLAW in an AROD, which was based on the DFLAW SA (SA-02) (*see* Section 1.4 of this SA). The activities evaluated in this SA would be similar to those evaluated in the DFLAW SA-02; however, activities in this SA would occur in 200W and would also include offsite transportation, onsite or offsite treatment, and out-of-state disposal of the pretreated or solidified waste.

- Implementation of the **DFHLW approach** (*see* Section 1.1 of this SA) would occur primarily in 200E and would involve bypassing the planned WTP Pretreatment Facility to send HLW directly to the HLW Vitrification Facility. The potential impacts of implementing the DFHLW approach will be presented in a separate and independent SA to the TC&WM EIS (SA-04) to evaluate whether that proposal would represent a substantial change to the proposal evaluated in the TC&WM EIS or present significant new circumstances or information relevant to environmental concerns. The primary elements of the DFHLW approach include the addition of a waste transfer vault in 200E, the construction and operation of a HLW effluent treatment system adjacent to the HLW Vitrification Facility in WTP, construction of Hanford Site interim storage modules for storage of immobilized HLW until a federal repository becomes available, and the potential construction of multi-use storage tanks with a total 1-million gallon capacity in 200W. This potential 1 million gallons of additional tank storage would add DST storage capacity to 200W to be able to store untreated tank waste and to manage solids and slurries that accumulate as a result of retrievals associated with the 200W tank waste treatment.

- As addressed in the **Secondary Waste Management SA** (SA-03) and detailed in Section 1.4 of this SA, DOE plans to transport and treat certain solid and liquid secondary wastes at licensed and permitted commercial treatment facilities off the Hanford Site. DOE also plans to dispose of some of these secondary wastes (after treatment) off site at a licensed and permitted commercial disposal facility. This action would be implemented on an interim basis until such time as enhanced onsite treatment capability is available for DFLAW operations (estimated to be in approximately 10 years). Therefore, much of this action would occur in parallel with the Proposed Action.

  DOE (2023b) presents the potential impacts of this secondary waste management and describes the potentially affected resource areas in addition to those analyzed in the TC&WM EIS. Primarily, the increases in potential impacts were associated with the offsite transportation of secondary waste and included potential impacts to air quality (vehicle emissions), transportation health and safety (incident-free and accident risks), and waste management (TSD facility capacity).

- As mentioned in Section 1.1 of this SA, DOE would retrieve approximately 32 million gallons of the approximately 39 million gallons of tank waste in 200W by 2040 consistent with the HFFACO/TPA. Retrieval and management of the balance of the 200W tank waste is a reasonably foreseeable action that could occur after 2040. Because this action would likely occur after completion of the Proposed Action, the potential impacts would not be cumulative; however, in the event that waste retrieval, transportation, treatment, and disposal of the 7 million gallons could be accelerated, this SA evaluates the potential impacts of the actions taken to manage this additional volume of tank waste. For the purpose of this SA, retrieval and pretreatment of the 7 million gallons is assumed to continue at the same rate as evaluated for the Proposed Action (2.91 million gallons per year).

4.2.1 Air Quality

The cumulative impacts to air quality primarily would be driven by the vehicle emissions associated with 10−11 years of offsite truck transportation of solidified waste (from the proposal evaluated in Section 3.3.1 of this SA) and secondary waste (evaluated under the Secondary Waste Management SA-03) (DOE 2023b). The potential air quality impacts of truck transportation were shown in Section 3.3.1 to bound those associated with rail transportation; therefore, only truck transportation is included here. Because implementation of the DFLAW and DFHLW approaches would not notably add radiological or nonradiological emissions to that already analyzed as part of the TC&WM EIS, these actions are not further evaluated in this SA. The combined annual vehicle emissions are presented in Table 4-1.

Table 4-1 Estimated Vehicle Emissions Associated with Cumulative Hanford Waste Transportation

Waste Stream	Emission Pollutant (MT per year)				
	Total HC	Exhaust CO	Exhaust NO_X	Total $PM_{2.5}$	Total GHG (CO_2eq)
Solidified 200W Waste	1.18	8.74	18.22	0.52	7,668
Secondary Waste	0.03	0.24	0.51	0.01	215
Totals	**1.21**	**8.98**	**18.73**	**0.53**	**7,883**

Source: Section 3.3.1 and DOE (2023b)
CO = carbon monoxide; CO_2eq = carbon dioxide equivalent; HC = hydrocarbon; MT = metric tons; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns

Per the discussion provided in Section 3.3.1, these small additions to air emissions would represent less than a 1-percent increase in hydrocarbons, carbon monoxide, nitrogen oxides, and $PM_{2.5}$. The potential GHG emissions would represent a 5.4-percent increase from those projected in the TC&WM EIS; however, because the Pretreatment Facility would not be operating, these small increases likely would still be within the projected air emissions from the TC&WM EIS.

If the additional 200W tank waste (great than 32 million gallons) was transported for offsite treatment and disposal, DOE expects that the annual vehicle emissions would be similar to those presented in Table 4-1; however, the emissions likely would continue beyond the 2040 Proposed Action end date.

4.2.2 Public and Occupational Health and Safety (Normal Operations)

The cumulative impacts to health and safety of workers and the public at or near the Hanford Site would not be notably different than those presented in the TC&WM EIS. Implementation of the DFLAW and DFHLW approaches would not be expected to increase the radiological doses to either the workforce or members of the public beyond those projected in the TC&WM EIS. The addition of 1 million gallons of multi-use storage capacity in 200W would be similar to the addition of four WRFs (equal to about 1.8 million gallons) evaluated under each of the TC&WM alternatives (DOE 2012, Section E.1.2.2.8.4).

As stated in the Secondary Waste Management SA-03, transportation of secondary waste off site for treatment (and potential subsequent disposal), as opposed to the onsite treatment options evaluated in the TC&WM EIS, would essentially transfer the potential normal operational health impacts from the Hanford Site workforce to workers at commercial treatment and disposal facilities, given that the scopes of work would be similar in nature regardless of location (DOE 2023b). Accordingly, radiological impacts resulting from this work would be comparable to those presented in the TC&WM EIS for treatment/disposal activities originally proposed for the Hanford Site.

The cumulative impacts at the TSD facilities would be within their existing operating envelopes. Operations at these facilities would be conducted in accordance with licenses and permits issued by their respective states (i.e., Washington, Utah, and/or Texas). Because the pretreated, solidified, and secondary waste volumes and constituents would be treated and disposed of in accordance with the existing licenses and permits of these facilities, impacts to facility workers are expected to fall within the range of potential health impacts considered during the licensing and permitting processes. Further, because there would be no new or additional radiological emissions or effluents at these commercial facilities beyond those evaluated as part of their permitting and licensing processes, there would be no additional doses to the public that have not previously been considered. As discussed earlier in this SA, the licensed operational throughput and disposal capacities of all analyzed offsite facilities would be expected to accommodate the entire projected quantity of pretreated and secondary waste being sent from the Hanford Site over the analyzed period (i.e., 2030–2040).

If the additional 200W tank waste (greater than 32 million gallons) was transported for offsite treatment and/or out-of-state disposal, DOE expects that the potential health and safety impacts of workers and the public at or near the Hanford Site would be similar to that discussed above. The workers and public at the TSD facilities would continue to experience potential annual health impacts; however, there would be no additional impacts from new or additional radiological emissions or effluents at these commercial facilities beyond those evaluated as part of their permitting and licensing processes. There would be no additional doses to the public that have not previously been considered. All wastes would still be required to meet the TSD facilities' waste acceptance criteria.

4.2.3 Public and Occupational Health and Safety (Facility Accidents)

The cumulative impacts associated with facility accidents at or near the Hanford Site would not be notably different that those presented in the TC&WM EIS. Implementation of the DFLAW and DFHLW approaches would not be expected to increase the potential accident consequences or risks beyond those that were projected in the TC&WM EIS (DOE 2019).

Treatment and stabilization of pretreated or secondary waste at any of the proposed TSD facilities would not change the types of accidents that could occur at the facility or the potential impacts from accidents compared to operations that were evaluated as part of the licensing or permitting processes with the respective states (DOE 2023b). DOE would ensure that the wastes met the respective Waste Acceptance Criteria before transporting the waste for treatment and disposal.

If the additional 200W tank waste (greater than 32 million gallons) was transported for offsite treatment and out-of-state disposal, DOE expects that the potential health and safety impacts from facility accidents would be similar to that discussed above. All wastes would still be required to meet the TSD facilities' waste acceptance criteria.

4.2.4 Public and Occupational Health and Safety (Transportation)

The cumulative impacts associated with radiological transportation would add to the potential impacts presented in the TC&WM EIS. Transportation of radiological materials was evaluated in this SA (*see* Section 3.3.4) and the Secondary Waste Management SA.

The Secondary Waste Management SA (and the TBI EA) used the same screening analysis (based on the 1997 WM PEIS) as presented in Section 3.3.4 of this SA. The Secondary Waste Management SA-03 evaluated transportation of an average of 8,650 cubic meters per year of solid and liquid LLW/MLLW from the Hanford Site to permitted TSD facilities (DOE 2023b). When the potential transportation impacts from the Secondary Waste Management SA (DOE 2023b) and the Proposed Action are combined (Table 4-2), the potential cumulative impacts to the public and the crew remain quite small.

If the additional 200W tank waste (greater than 32 million gallons) were managed, DOE expects that the potential annual transportation impacts to workers (crew) and the public along the routes would be similar to that presented in Table 3-4. The increased cumulative impacts would be associated with the additional years of potential shipments. Considering that the shipments of secondary waste would be completed by 2040, the additional impacts would be an increased scaling of the annual results from Table 3-9 for a little over 2 years (which is derived from about 7 million gallons [39 million minus 32 million] divided by 2.91 million per year [current processing rate assumption in Table 2-2]). Table 4-2 includes the potential contribution of shipping the solidified waste (because this scenario bounds the shipment of pretreated liquid), the additional solidified waste (greater than 32 million gallons), and the secondary waste from SA-03. Table 4-2 assumes the use of trucks for transportation because it provides the higher potential impacts for incident-free transportation. The potential accident risks (radiological and nonradiological) are provided later in this section.

Table 4-2 Cumulative Radiological Impacts to the Public and Truck Crews for Hanford-Related Waste Transportation

Analytical Parameter	200W Solidified Waste	Secondary Waste	Total
Total miles/year (public)	2,184,600	51,100	2,235,700
Total miles over multi-year Proposed Action period (public)[b]	24,030,600 (29,273,640)	510,700	24,541,300 (29,784,340)
Total miles/year (crews)	2,184,600	103,800	2,288,400
Total miles over multi-year Proposed Action period (crews)[b]	24,030,600 (29,273,640)	1,038,000	25,068,600 (30,311,640)
Total shipments/year	1,650	2,156–2,200	3,806–3,850
Total shipments over multi-year Proposed Action period[b]	18,150 (22,110)	21,560–22,000	39,710–40,150 (43,670–44,110)
Public LCFs from 1 year of shipping	0.076	0.0021	0.078
Public LCFs from multi-year Proposed Action period[b]	0.86 (0.95)	0.021	0.88 (0.97)
Crew LCFs from 1 year of shipping	0.050	0.0019	0.052
Crew LCFs from multi-year Proposed Action period[b]	0.55 (0.67)	0.019	0.57 (0.69)
Accident fatalities (nonrad) per year	0.037	0.0017	0.039
Accident fatalities (nonrad) over multi-year Proposed Action period[b]	0.41 (0.50)	0.017	0.43 (0.52)
Maximum reasonably foreseeable accident probability per year	5.0×10^{-5}	1×10^{-6}	(a)
Maximum reasonably foreseeable accident cumulative probability over multi-year Proposed Action period[b]	5.5×10^{-4} (6.7×10^{-4})	1×10^{-5}	(a)
Maximum reasonably foreseeable accident consequences (LCFs)	2.6	2.6	(a)
Maximum reasonably foreseeable accident risk from 1 year of Proposed Action (LCF/year)[b]	1.3×10^{-4}	4×10^{-6}	(a)
Maximum reasonably foreseeable accident cumulative risk from multi-year Proposed Action period (LCFs)[b]	1.4×10^{-3} (1.7×10^{-3})	4×10^{-5}	(a)

Source: Section 3.3.4 and DOE (2023b)

LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste.

a The probabilities and consequences of maximum reasonably foreseeable accident scenarios involving different waste forms are not additive. Additionally, the potential risks of these scenarios represent the consequence times the probability of the scenario and are likewise not additive.

b The values in parentheses () for the multi-year estimates reflect the additional 2.4 years of processing at the same rate used for the Proposed Action (2.91M gallons per year) to reflect the offsite transportation of up to 39M gallons of solidified waste.

As shown in Table 3-9, the Proposed Action could statistically result in as many as 3 fatalities associated with nonradiological traffic accidents under the scenario involving rail transportation of solidified waste. This is a highly conservative result that is based on the scaling of data presented in the WM PEIS (DOE 1997). If the analysis considers the more recent data on fatalities from rail accidents presented in Section 3.3.4 (the average number of fatalities equals 0.37 fatality per 1 million train miles), the expected result would be closer to 0.79 fatalities over the 11-year period.

As presented as a footnote to Table 3-9, the nonradiological accident fatality results assume that a train shipment includes a single railcar loaded with three disposal containers. A more realistic scenario would be that at least five loaded railcars would be included in a train shipment. This would reduce these potential impacts by 80 percent.

For radiological accident risk, from Table 3-9, the maximum reasonably foreseeable accident cumulative risk for the 11-year analysis period for rail transportation of liquid pretreated waste would be about 0.00055 LCF. The result reported for rail transportation of solidified waste is 0.001 LCF; however, as these risk estimates are based on total shipments and mileage, they are inherently conservative for an accident involving solidified waste. Compared to liquid or powdered waste forms, solidified waste has a significantly lower airborne release fraction and respirable fraction, reducing the potential radiological consequences in the event of an incident.

4.2.5 Waste Management

The cumulative impacts to waste management would include contributions from the current and reasonably foreseeable future actions identified in the preceding discussion.

- Under the DFLAW approach, DOE does not plan to send any waste off site for treatment or disposal but would manage loaded IXCs on site in 200E. Per DOE (2019), these waste management actions would not be substantively different than the proposed action evaluated in the TC&WM EIS.

- Under the DFHLW approach, DOE would not send any waste off site for treatment or disposal. There would be no substantive differences in impacts related to onsite waste management from this approach compared to the management of HLW in the TC&WM EIS. This would include the addition of up to 1 million gallons of multi-use tank storage in 200W.

  Like the Proposed Action, the current plan for secondary waste management (as analyzed in SA-03 [DOE 2023b]) would result in a reduction of onsite waste management (including onsite disposal) of solid and liquid LLW/MLLW because waste would be sent to out-of-state, appropriately licensed and permitted commercial TSD facilities for treatment and disposal. However, there would be a potential cumulative impact of sending additional waste to the same commercial TSD facilities under both proposals. In SA-03, secondary waste was separated into three groups for management: Group 1 is the largest projected annual volume (7,700 cubic meters of solid LLW/MLLW and 590 cubic meters of liquid MLLW) and would be sent to PFNW for treatment and returned to the IDF on the Hanford Site for disposal; Group 2 is a much smaller annual volume (15 cubic meters of solid MLLW and 3 cubic meters of liquid MLLW) and would be sent to a facility in Kingston, Tennessee, for treatment and ultimate disposal at WCS; and Group 3 (annual volumes of 6 cubic meters of solid MLLW and 326 cubic meters of liquid MLLW) would be sent to WCS for treatment and disposal. No secondary waste was assumed to be sent to Energy*Solutions* in Utah.

Table 4-3 provides a combination of potential waste streams sent from the Hanford Site to WCS under these proposals. For Table 4-3, the waste associated with the Proposed Action is presented as both pretreated liquid and solidified MLLW. The actual combination of liquid and solidified waste would be somewhere within these values.

Table 4-3 Cumulative Hanford Waste Volumes Projected for Treatment and Disposal at WCS (MLLW, cubic meters)

Waste Type	200W Tank Waste	Secondary Waste[a]	Total
100-percent Pretreated Liquid[b]			
Solid (annual)	210	6	216
Solid (multi-year)[c]	2,815	60	2,875
Liquid (annual)	10,875	326	11,201
Liquid (multi-year)[c]	145,725	3,260	148,985
100-percent Solidified Waste			
Solid (annual)	16,523	6	16,529
Solid (multi-year)[c]	221,408	60	221,468
Liquid (annual)	0	326	326
Liquid (multi-year)[c]	0	3,260	3,260

Source: Section 3.3.4 and DOE (2023b)

MLLW = mixed low-level radioactive waste

a MLLW secondary waste was identified as Group 3 in DOE (2023b) and was assumed to be treated and disposed of at WCS.

b This scenario assumes that 37,000 gallons per year would be sent to PFNW for treatment, and the resultant solidified waste would be sent to WCS.

c For cumulative impacts, the multi-year value for 200W tank waste includes about 13.4 years, which would assume treatment of the full approximately 39-million gallon inventory.

As identified in Section 3.3.5, WCS has the capacity to treat up to 2 million gallons per year of waste from the Hanford Site without impacting other waste treatment or disposal commitments. By including the planned secondary waste (solid and liquid), the total potential annual volume over the next 10 years would be within the Hanford Site's existing capacity. Section 3.3.5 also presents the current, permitted volume limit. The additional 2-plus years of volume from 200W tank waste treatment plus the projected volume of secondary waste from SA-03 would bring the total expected volume up to 68 percent of the current permitted limit of 300,000 cubic yards.[42]

[42] If the additional 200W tank waste (greater than 32 million gallons) were transported for offsite treatment and disposal, DOE would ensure that the additional waste shipments (during 2+ additional years) would remain within the permitted and available capacity for the TSD facility at that time. Currently, DOE is not aware of any constraints that would affect WCS' or Energy*Solutions*' available capacity in the post-2040 timeframe; however, these facilities could apply for permit modifications within the next 15–20 years to increase their capacity should the need arise.

5 PRELIMINARY CONCLUSIONS

DOE prepared this SA in accordance with 10 CFR 1021.314. The Proposed Action evaluated in this SA is to construct and operate pretreatment and treatment facilities in 200W to support the 200W tank waste treatment and offsite transport, treatment, and disposal of approximately 32 million gallons of pretreated tank waste (or as solidified waste) at appropriately licensed and permitted commercial TSD facilities. The 200W onsite facilities would be similar to the facilities implemented under the DFLAW SA-02 in 200E but would also include an onsite treatment facility as analyzed in Alternative 3B of the TC&WM EIS. The offsite transport, treatment, and disposal of tank waste would be similar to, albeit at a larger scale than. the actions evaluated under the Secondary Waste Management SA-03 and the TBI EA. While the TC&WM EIS did not originally anticipate offsite treatment and disposal of tank waste, the volume of projected pretreated waste would be within the existing permitted capacity of the commercial TSD facilities and would not result in significant impacts. Implementation of the Proposed Action of this SA would facilitate compliance with the HFFACO/TPA without a significant increase in environmental impacts.

The TC&WM EIS evaluated potential environmental impacts from the emission of criteria pollutants, toxic pollutants, and carbon dioxide. The incremental increase in emissions related to the transportation of pretreated waste for treatment and out-of-state disposal would add less than 1 percent to the nonradiological emissions analyzed in the TC&WM EIS and up to 5.3 percent to the projected GHG emissions from the TC&WM EIS.

Transportation of pretreated liquid or solidified waste off site for treatment and/or disposal, as opposed to the onsite treatment and disposal evaluated in the TC&WM EIS, would transfer a portion of the potential normal operational health impacts from the Hanford Site workforce to workers at commercial TSD facilities. Additionally, the Proposed Action would not introduce any unique facility accidents that had not been evaluated either in the TC&WM EIS (including previous SAs) or in the commercial facility permitting or licensing process. Accordingly, radiological impacts and accident risk resulting from the Proposed Action would be comparable to those presented in the TC&WM EIS for treatment/disposal activities originally proposed for the Hanford Site.

The estimated radiological health risks to the public and transportation crews from transportation of solidified waste are low (0.84 and 0.55 LCF, respectively, for the truck scenario) for the approximate 11-year Proposed Action period. Potential radiological health risks for rail transport of the pretreated or solidified waste would be even smaller.

The volumes of pretreated waste to be treated and/or disposed of at the appropriately licensed and permitted commercial TSD facilities would be within their existing permitted capacity and would not impact their current operations or commitments.

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Appendix A: Project Background Details

A.1 LAWPS Phase 1: Tank Side Cesium Removal

The LAWPS Phase 1 TSCR system supports DOE's initial strategy for DFLAW and separates cesium and undissolved solids from tank waste, resulting in pretreated waste that will provide initial feed to the WTP LAW Facility. The TSCR system is located adjacent to the Hanford Site's AP Tank Farm on a 3,000-square-foot site and comprises three enclosures: a Process Enclosure, a Control Enclosure, and an Ancillary Enclosure containing supporting equipment and chemicals. The TSCR system began operating in January 2022. Waste is staged in a DST from which the waste is transferred to the TSCR system. The waste first passes through a pair of parallel filters that removes undissolved solids. From there, the filtered waste proceeds to a series of three IXCs where the cesium is removed. The pretreated waste then passes through a delay tank and gamma detectors before leaving the system, after which it is transferred into a second DST that will act as the feed tank for the WTP LAW Facility. The solids removed by filtration are returned to a DST and the spent IXCs are transferred to an interim storage pad for eventual disposal. At the end of the mission, the current baseline plan includes sending the IXCs to a future CST Processing Facility to remove the resin and feed it to the WTP HLW Facility. The TSCR system is planned to eventually be replaced in LAWPS Phase 2 by a system that will provide higher-capacity pretreatment better matched to the capacity of the WTP LAW Facility. The term "Advanced Modular Pretreatment System" is being used to describe this additional pretreatment capability which is currently undergoing detailed design. Figures A-1 and A-2 provide an overview of the TSCR and the Process Enclosure.

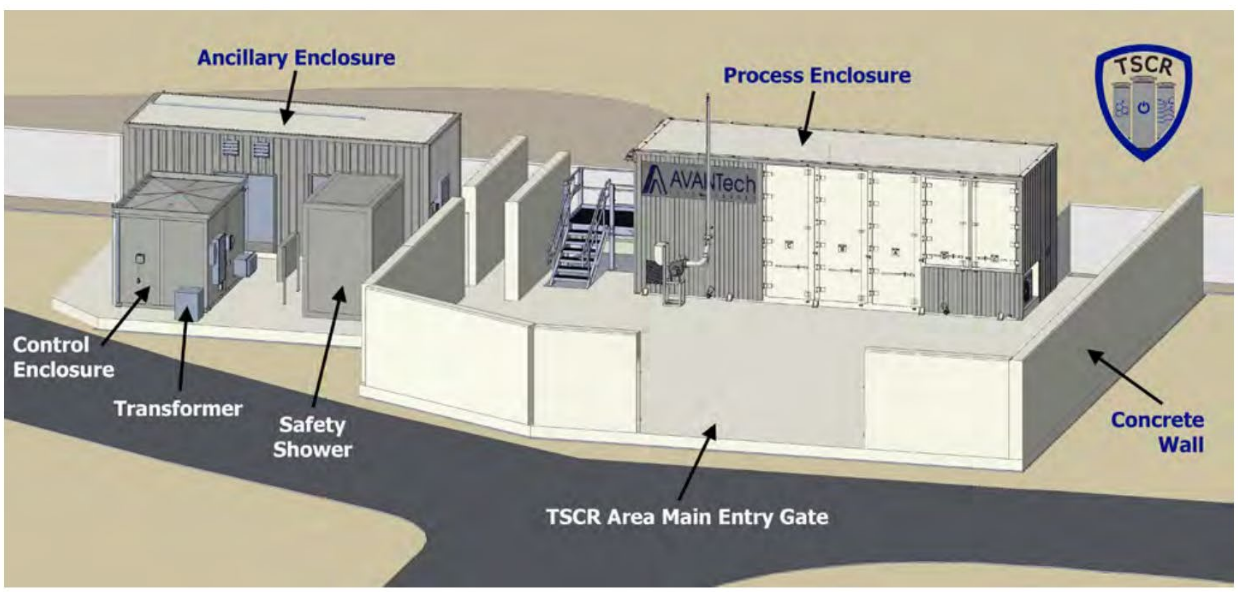

Figure A-1 TSCR Overview

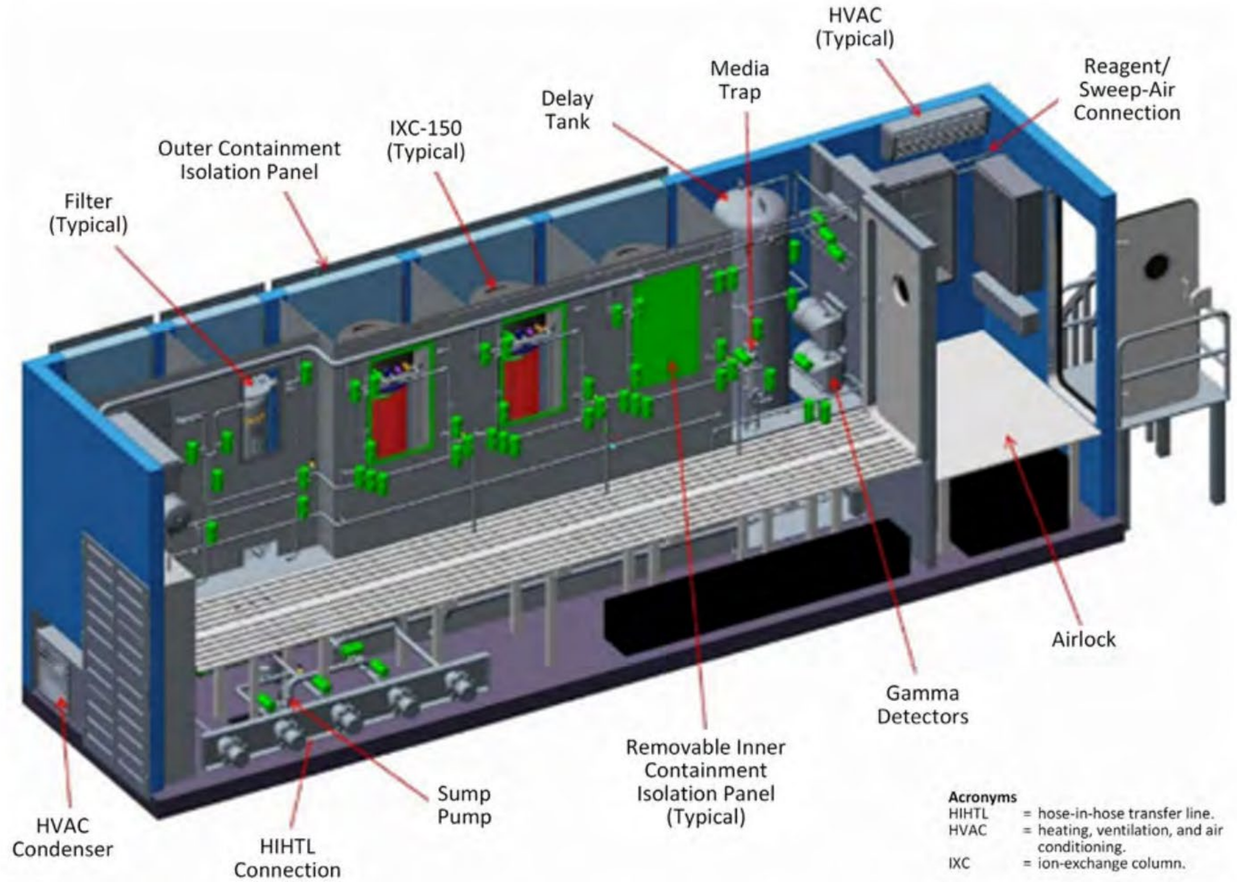

Figure A-2 TSCR Process Enclosure

Appendix B: Additional Transportation Accident Analysis for Liquid Pretreated Waste

Section 3.3.4 of this SA projects potential impacts from the Proposed Action by using a scaling approach based on information from the analysis of potential transportation impacts presented in the 1997 WM PEIS (DOE 1997). The WM PEIS evaluated the potential health risks of at least more than 25,000 shipments of LLW/MLLW. Section 3.3.4 includes an evaluation of impacts for four scenarios including truck and rail transportation of liquid pretreated waste and solidified waste. This SA includes additional analysis of the potential shipment of pretreated liquid. Because of the lower accident risk associated with release of solidified waste during a severe accident, this appendix is limited to a comparative analysis for truck transportation of pretreated liquid waste, which would result in the highest number of shipments of liquid waste.

In 2020, DOE prepared the *Savannah River Site Defense Waste Processing Facility Recycle Wastewater Final EA* (SRS EA) and FONSI (DOE 2020). The SRS EA evaluated the transportation, stabilization, and disposal of up to 10,000 gallons of liquid DWPF recycle wastewater from SRS to WCS and/or Energy*Solutions*. In Appendix B of the SRS EA, DOE prepared a conservative analysis of potential consequences of a severe transportation accident that assumed a total release of liquid MLLW to the environment. The analysis that follows provides a representative assessment of the potential human health consequences associated with a severe transportation accident involving a single truck shipment of pretreated liquid waste from the Proposed Action. The SRS EA information used in this appendix is for transportation analysis reference only. The TBI Demonstration EA also used the same approach to evaluate the relative accident risks of a shipment of 2,000 gallons of pretreated waste from the Hanford Site to WCS (DOE 2023).

B.1 200W Tank Waste Treatment Inventory

Section 2.4.1 provides the estimated radionuclide inventory concentration (curies per shipment) of the pretreated waste that would be shipped in the tankers or portable tanks. As presented in that section, there are approximately 39 million gallons of waste from which the approximately 32 million gallons of pretreated waste would come under the Proposed Action. The distribution of volumes among the four groups defined in Section 2.4.1 is relatively consistent. There are about 9 million gallons in Group A and Group D and about 10 million gallons each in Groups B and C. Therefore, this SA assumes that about 25 percent of the shipments would come from each group.

The NRC regulations at 10 CFR Part 71 include requirements and limits for the transportation of radiological materials. Appendix A of Part 71 includes A2 values for each radionuclide, which is the limit (in curies) of the specific activity of each radionuclide that can be shipped in a Type A package. Even though the pretreated waste does not require a Type A package and will be transported in an LSA-II tanker or portable tank, the comparisons of these A2 values gives a sense of the relative hazard associated with each radionuclide; the lower the activity limit, the higher the potential hazard on a curie-per-shipment basis. The A2 values for each radionuclide expected in the pretreated waste are presented in Table B-1.

Table B-1 Specific Activity Limits (A2 Values) for Key Radionuclides

Radionuclide	A2 Value from 10 CFR Part 71
Carbon-14	8.05E-06
Cobalt-60	3.25E-04
Nickel-63	8.68E-07
Strontium-90	1.13E-03
Technetium-99	1.37E-03
Iodine-129	0.00E+00
Cesium-137	1.60E+01
Neptunium-237	5.40E-02
Plutonium-238	2.70E-02
Plutonium-239	2.70E-02
Plutonium-240	2.70E-02
Americium-241	2.17E-03
Plutonium-241	1.60E+00
Curium-242	3.08E-08
Plutonium-242	2.70E-02
Americium-243	1.26E-04
Curium-243	1.00E-07
Curium-244	1.00E-07

Source: 10 CFR Part 71, Appendix A.

The total inventory of radionuclides in the 5,000-gallon shipments would range from approximately 12 curies to about 23 curies (based on the averages for each of the four groups). Tables B-2 through B-5 provide the fraction of the A2 limit for each radionuclide contained in the 5,000-gallon tanker truck or portable tank. These tables assume that the shipment is at its maximum capacity (5,000 gallons). The sum of fractions at the bottom of each table indicates that the total loading of a tanker would be about 2.14 to 6.96 times the allowable radionuclide loading for a 333-gallon USDOT Type A package. This higher value (greater than 1.0) is only used for comparison to the previous evaluation in the SRS EA (as discussed at the beginning of this appendix). With the assumption identified earlier (equal distribution among waste tank groups), DOE expects that each group would transport about 146 shipments per year.

Table B-2 Group A Comparison to A2 Values

Radionuclide	Activity (curies)	A2 (curies)	Ci/A2
Carbon-14	1.61E-02	8.10E+01	1.98E-04
Cobalt-60	5.96E-04	1.10E+01	5.42E-05
Nickel 63	1.08E-01	8.10E+02	1.34E-04
Strontium-90	2.14E+01	8.10E+00	2.64E+00
Technetium-99	5.88E-01	2.40E+01	2.45E-02
Iodine-129	5.19E-04	0.00E+00	0.00E+00
Cesium-137	2.81E-01	1.60E+01	1.76E-02
Neptunium-237	4.85E-04	5.40E-02	8.98E-03
Plutonium-238	8.45E-04	2.70E-02	3.13E-02
Plutonium-239	3.64E-02	2.70E-02	1.35E+00
Plutonium-240	7.44E-03	2.70E-02	2.76E-01
Americium-241	6.99E-02	2.70E-02	2.59E+00
Plutonium-241	1.05E-02	1.60E+00	6.56E-03
Curium-242	8.66E-04	2.70E-01	3.21E-03
Plutonium-242	3.64E-07	2.70E-02	1.35E-05
Americium-243	4.54E-05	2.70E-02	1.68E-03
Curium-243	2.54E-05	2.70E-02	9.42E-04
Curium-244	4.00E-04	5.40E-02	7.41E-03
Group A Sum of Fractions			**6.96**

Table B-3 Group B Comparison to A2 Values

Radionuclide	Activity (curies)	A2 (curies)	Ci/A2
Carbon-14	1.75E-02	8.10E+01	2.16E-04
Cobalt-60	3.78E-04	1.10E+01	3.44E-05
Nickel 63	1.74E-01	8.10E+02	2.15E-04
Strontium-90	1.46E+01	8.10E+00	1.81E+00
Technetium-99	9.19E-01	2.40E+01	3.83E-02
Iodine-129	8.51E-04	0.00E+00	0.00E+00
Cesium-137	4.38E-01	1.60E+01	2.74E-02
Neptunium-237	7.95E-04	5.40E-02	1.47E-02
Plutonium-238	5.58E-04	2.70E-02	2.07E-02
Plutonium-239	1.99E-02	2.70E-02	7.38E-01
Plutonium-240	4.06E-03	2.70E-02	1.50E-01
Americium-241	3.55E-02	2.70E-02	1.32E+00
Plutonium-241	5.36E-03	1.60E+00	3.35E-03
Curium-242	5.86E-04	2.70E-01	2.17E-03
Plutonium-242	2.83E-07	2.70E-02	1.05E-05
Americium-243	2.08E-05	2.70E-02	7.70E-04
Curium-243	4.70E-05	2.70E-02	1.74E-03
Curium-244	7.55E-04	5.40E-02	1.40E-02
Group B Sum of Fractions			**4.13**

Table B-4 Group C Comparison to A2 Values

Radionuclide	Activity (curies)	A2 (curies)	Ci/A2
Carbon-14	2.29E-02	8.10E+01	2.83E-04
Cobalt-60	3.63E-04	1.10E+01	3.30E-05
Nickel 63	1.91E-01	8.10E+02	2.36E-04
Strontium-90	1.22E+01	8.10E+00	1.50E+00
Technetium-99	7.59E-01	2.40E+01	3.16E-02
Iodine-129	7.51E-04	0.00E+00	0.00E+00
Cesium-137	4.83E-01	1.60E+01	3.02E-02
Neptunium-237	7.90E-04	5.40E-02	1.46E-02
Plutonium-238	4.27E-04	2.70E-02	1.58E-02
Plutonium-239	1.85E-02	2.70E-02	6.87E-01
Plutonium-240	3.89E-03	2.70E-02	1.44E-01
Americium-241	2.00E-02	2.70E-02	7.42E-01
Plutonium-241	6.14E-03	1.60E+00	3.84E-03
Curium-242	3.68E-04	2.70E-01	1.36E-03
Plutonium-242	2.03E-07	2.70E-02	7.50E-06
Americium-243	1.14E-05	2.70E-02	4.22E-04
Curium-243	8.70E-06	2.70E-02	3.22E-04
Curium-244	1.39E-04	5.40E-02	2.57E-03
Group C Sum of Fractions			**3.18**

Table B-5 Group D Comparison to A2 Values

Radionuclide	Activity (curies)	A2 (curies)	Ci/A2
Carbon-14	1.56E-02	8.10E+01	1.93E-04
Cobalt-60	1.72E-04	1.10E+01	1.56E-05
Nickel 63	7.90E-02	8.10E+02	9.75E-05
Strontium-90	1.06E+01	8.10E+00	1.31E+00
Technetium-99	5.13E-01	2.40E+01	2.14E-02
Iodine-129	5.11E-04	0.00E+00	0.00E+00
Cesium-137	2.18E-01	1.60E+01	1.36E-02
Neptunium-237	6.37E-04	5.40E-02	1.18E-02
Plutonium-238	2.49E-04	2.70E-02	9.22E-03
Plutonium-239	9.89E-03	2.70E-02	3.66E-01
Plutonium-240	2.07E-03	2.70E-02	7.67E-02
Americium-241	8.72E-03	2.70E-02	3.23E-01
Plutonium-241	3.44E-03	1.60E+00	2.15E-03
Curium-242	2.08E-04	2.70E-01	7.69E-04
Plutonium-242	1.14E-07	2.70E-02	4.22E-06
Americium-243	5.25E-06	2.70E-02	1.94E-04
Curium-243	4.56E-06	2.70E-02	1.69E-04
Curium-244	7.22E-05	5.40E-02	1.34E-03
Group D Sum of Fractions			**2.14**

B.2 Comparison of SRS DWPF Recycle Wastewater EA Inventory for Transportation Purposes

Table B-6 presents the estimated inventory of a single Type A package analyzed in the *SRS DWPF Recycle Wastewater Final EA* (DOE 2020, Appendix A). As a point of comparison, the analyzed volume of the Type A packages was 230 gallons. This is the inventory that was used in the analysis of potential consequences of a severe transportation accident. As indicated at the bottom of Table B-6, the sum of fractions for the SRS DWPF recycled wastewater was 72 percent of the allowable radionuclide loading for the proposed package. A summarization of the consequence analysis for the *DWPF Recycle Wastewater Final EA* is presented in Section B.3 below the tables.

Table B-6 Estimated Radionuclide Inventory of One Shipping Container Filled with 230 Gallons of DWPF Recycle Wastewater in Liquid Form

Radionuclide	Activity (curies)	A2 (curies)	Ci/A2
Americium-241	5.61E-06	2.70E-02	2.08E-04
Americium-242M	4.24E-08	2.70E-02	1.57E-06
Americium-243	1.22E-06	2.70E-02	4.52E-05
Carbon-14	6.31E-05	8.10E+01	7.79E-07
Curium-242	7.77E-07	2.70E-01	2.88E-06
Curium-243	3.55E-06	2.70E-02	1.31E-04
Curium-244	5.26E-05	5.40E-02	9.74E-04
Curium-245	2.90E-06	2.40E-02	1.21E-04
Curium-247	3.58E-06	2.70E-02	1.33E-04
Curium-248	4.75E-06	8.10E-03	5.86E-04
Cesium-137	1.14E+01	1.60E+01	7.13E-01
Iodine-129	9.53E-07	0.00E+00	0
Niobium-94	6.35E-07	1.90E+01	3.34E-08
Nickel 59	2.64E-05	0.00E+00	0
Nickel 63	3.01E-05	8.10E+02	3.72E-08
Neptunium-237	6.87E-06	5.40E-02	1.27E-04
Plutonium-238	4.75E-05	2.70E-02	1.76E-03
Plutonium-239	3.66E-05	2.70E-02	1.36E-03
Plutonium-240	3.66E-05	2.70E-02	1.36E-03
Plutonium-241	6.75E-05	1.60E+00	4.22E-05
Plutonium-242	3.72E-05	2.70E-02	1.38E-03
Plutonium-244	1.73E-07	2.70E-02	6.41E-06
Strontium-90	9.61E-03	8.10E+00	1.19E-03
Technetium-99	2.66E-03	2.40E+01	1.11E-04
Uranium-233	9.40E-05	1.60E-01	5.88E-04
Uranium-234	6.08E-05	1.60E-01	3.80E-04
Uranium-235	6.51E-08	0.00E+00	0
Uranium-236	6.31E-07	1.60E-01	3.95E-06
Uranium-238	1.46E-06	0.00E+00	0
Sum of Fractions			**0.722**

Sources: DOE 2020, Appendix B; 10 CFR Part 71, Appendix A

B.3 Summarization of Impacts Analysis of SRS DWPF Recycle Wastewater for Comparison Purposes

In the *SRS DWPF Recycle Wastewater Final EA* (DOE 2020, Appendix B), DOE performed a conservative analysis to estimate the potential impacts from the release of the liquid DWPF recycle wastewater to the atmosphere (exposure to downwind receptors) should a worst-case-type accident occur during transport. The severe accident considered in the consequence assessment was characterized by extreme mechanical (impact) and thermal (fire) forces. The accident represented any low-probability, high-consequence event that could lead to the release of the entire liquid cargo of one package to the environment. Therefore, accidents of this severity are expected to be extremely rare. However, the overall probability that such an accident could occur depends on the potential accident rates for such a severe accident and the shipping distance for each case.

Important for the purposes of risk assessment are the fraction of the released material that can be entrained in an aerosol (part of an airborne contaminant plume) and the fraction of the aerosolized material that is also respirable (of a size that can be inhaled into the lungs). These fractions depend on the physical form of the material. Compared to solid materials, liquid materials are relatively easy to release if the container is breached in an accident. Once released, the liquid waste could become aerosolized and disperse downwind. Generally, aerosolized liquids are readily respirable (i.e., the respirable fraction is equal to one).

Because predicting the exact location of a severe transportation-related accident is impossible when estimating population impacts, separate accident consequences are calculated for accidents occurring in three population density zones: rural, suburban, and urban. Moreover, to address the effects of the atmospheric conditions existing at the time of an accident, two atmospheric conditions were considered: neutral and stable.[43]

RISKIND (Yuan et al. 1995) is a model used to calculate the accident consequences for local populations and for the highest-exposed individual. The population dose includes the population within 50 miles of the accident site. The analysis considered the following exposure pathways:

- External exposure to the passing radioactive cloud (plume),
- External exposure to contaminated ground,
- Internal exposure from inhalation of airborne contaminants, and
- Internal exposure from the ingestion of contaminated food (rural zone only).

Although remedial activities after the accident (e.g., evacuation or ground cleanup) would reduce the consequences, these activities were not considered in the consequence assessment with one exception. In a rural zone, crops contaminated immediately after an accident were assumed to be removed and not considered for ingestion. However, no remediation measures were assumed for subsequent growing seasons in the long term.

[43] Neutral-weather conditions constitute the most frequently occurring atmospheric stability condition in the United States. These conditions are represented by Pasquill stability Class D, with a wind speed of nine miles per hour in the air dispersion model used in this consequence assessment. Observations at National Weather Service surface meteorology stations at more than 300 U.S. locations indicate that on a yearly average, neutral conditions (Pasquill Classes C and D) occur about half (50%) of the time, stable conditions (Pasquill Classes E and F) occur about one-third (33%) of the time, and unstable conditions (Pasquill Classes A and B) occur about one-sixth (17%) of the time (Doty et al. 1976).

The highest-exposed individual for severe transportation accidents would be located at the point that would have the highest concentration of hazardous material that would be accessible to the general public. This location was assumed to be 100 feet or farther from the release point at the location of highest air concentration. For purposes of the analysis, the location of the highest-exposed individual was estimated to be at a downwind distance of approximately 500 feet for neutral-weather conditions and approximately 1,000 feet for stable-weather conditions.

The accident consequence assessment assumed that the entire contents of the Type A package would be released and aerosolized. For perspective, the release of a Type A container's entire contents could potentially occur approximately 0.4 percent of the time, given that a truck accident does occur, with about a 10-percent release of its contents estimated 1.6 percent of the time (NRC 1977). The aerosolized fraction of the released liquid contents under severe accident conditions could range from about 0.0001 to 0.1 (NRC 1998), depending on potential over-pressurization and/or explosive and thermal stresses that might result.

Table B-6 (above) lists the estimated radionuclide inventory released (assuming release of the full contents of the package); Table B-7 lists the resultant population doses over the short and long term under neutral- and stable-weather conditions for generic rural, suburban, and urban population zones. Table B-7 also provides a conservative estimate of the potential resultant LCFs that were presented in the *SRS DWPF Recycle Wastewater Final EA* (DOE 2020, Appendix B).

Table B-7 Potential Radiological Consequences to the Population from a Severe Transportation Accident Involving DWPF Recycle Wastewater[a]

Location	Neutral-Weather Conditions[b]		Stable Weather Conditions[b]	
	Short-Term[c]	Long-Term[c]	Short-Term	Long-term
Population Dose (person-rem)				
Rural	0.0534	592	0.0931	1,030
Suburban	6.40	1,360	11.2	2,360
Urban[d]	14.2	3,020	24.8	5,260
Dose Risk (LCF)[e]				
Rural	0.000032	0.36	0.000056	0.62
Suburban	0.0038	0.85	0.0067	1.4
Urban	0.0085	1.8	0.015	3.2

LCF = latent cancer fatality; km^2 = square kilometers.

a National average population densities were used for the accident consequence assessment, corresponding to densities of 6 persons/km^2, 719 persons/km^2, and 1,600 persons/km^2 for rural, suburban, and urban zones, respectively. Potential impacts were estimated for the population within a 50-mile radius, assuming a uniform population density for each zone.

b For the accident consequence assessment, doses were assessed under neutral atmospheric conditions (Pasquill Class D with winds at 9 miles per hour) and under stable conditions (Pasquill Class F with winds at 2.2 miles per hour). The results for neutral conditions represent the most likely consequences, given a severe accident occurs. The results for stable conditions represent weather in which the least amount of dilution is evident; the air has the highest concentrations of radioactive material, which leads to the highest doses.

c Short-term consequences are from exposure within the first 2 hours of an accident, including plume passage. Long-term consequences are from exposure over a 50-year period following an accident without consideration for decontamination or cleanup efforts.

d It is important to note that the urban population density generally applies to a relatively small, urbanized area; very few, if any, urban areas have a population density as high as 1,600 persons/km^2 extending as far as 50 miles (DOE 2002; Weiner et al. 2006). The urban population density corresponds to approximately 32 million people within the 50-mile radius—well in excess of the total populations along most of the routes considered in the assessment.

e LCFs were calculated by multiplying the dose by the health risk conversion factor of 0.0006 fatal cancer per person-rem (ISCORS 2002).

The highest potential doses for an individual under neutral- and stable-weather conditions were estimated at 45 and 143 mrem, respectively. The associated chances of contracting a fatal cancer in that maximally exposed individual's lifetime is approximately 0.00003 and 0.00009. The analysis in the *SRS DWPF Recycle Wastewater Final EA* conservatively assumed 100 percent of the release is aerosolized. The results presented in Table B-7 assume that the release would occur in any accident, no matter how severe.

In addition to identifying the radiological consequences of the hypothetical event, the *SRS DWPF Recycle Wastewater Final EA* identified the radiological risk by multiplying the potential consequences by the probability of a severe accident during the transportation campaign. Those probabilities were dependent on the number of shipments in the campaign and the distances involved. This SA applies a similar technical approach in Section B.4 to be able to compare the WM PEIS scaling results presented in Section 3.3.4.

B.4 Scaling of Potential Consequences to the 200W Tank Waste Treatment

As shown by comparing Tables B-2 through B-5 against Table B-6, the ratios of the sums of fractions are directly relatable to the ratios of potential consequences of an event. The A2 values provide a relative measure of the potential health impact of a transportation accident; the higher the health risk of a particular radionuclide, the lower the A2 radionuclide activity limit. As such, the estimated radiological health impacts of a severe transportation accident involving pretreated liquid waste (from Groups A through D) can be estimated by scaling the RISKIND results from the *SRS DWPF Recycle Wastewater Final EA* (DOE 2020, Appendix A) by the ratio of the sum of fractions of. The calculation is obtained by applying the following equation:

$$\mathbf{Conseq_{200TWT} = Conseq_{DWPF} \times SOF_{200TWT} \div SOF_{DWPF}}$$

Where:

- $Conseq_{200TWT}$ represents the calculated consequences in Table B-8 for a severe accident for a variety of population densities and meteorological conditions (Table B-8 provides this information for an accident involving each of the Groups A through D);
- $Conseq_{DWPF}$ represents the estimated consequences (in person-rem) from Table B-7 for a variety of population densities and meteorological conditions;
- SOF_{200TWT} represents the sum of fractions of the Proposed Action pretreated waste from Tables B-2 (6.96), B-3 (4.13), B-4 (3.18), and B-5 (2.14); and
- SOF_{DWPF} represents the sum of fractions of the DWPF recycle wastewater from Table B-6 (0.722).

Applying the appropriate information to this equation yields potential radiological consequences, as shown in Table B-8, for each waste group. In addition, Table B-8 also applies probabilities to present accident risks associated with each group. Per Section 3.3.4, there were 35.2 accidents per 100 million large-truck miles that involved injury or fatality. Additionally, the WM PEIS presents information from NUREG-0170 related to the varying severity categories of accidents (from a low Severity Category I accident to the highest Severity Category VII accident [DOE 1997]). This SA applies a fractional occurrence factor of 2.8E-03 (2.8×10^{-3}) to represent the potential occurrence of an accident with at least a Severity Category V to reflect the likelihood that the accident could result in a release from an LSA-II tanker or portable tank.

Therefore, the potential long-term impacts to the population around an accident range from 1.64E-04 to 5.27E-03 (1.64×10^{-4} to 5.27×10^{-3}), depending on the weather conditions, waste tank group, and population density.

In conclusion, this conservative assessment demonstrates a relatively good correlation with the scaling approach applied in Section 3.3.4 of this SA for potential impacts from a maximum reasonably foreseeable accident (Section 3.3.4 presents 5.3E-04 (5.3×10^{-4}) LCF to the exposed population for truck transportation of pretreated liquid waste, which is within the range presented in Table B-8). Regardless of which assessment is considered, the resultant transportation accident risks to the population along the routes from the Hanford Site to the TSD facilities in Texas or Utah would not be a substantive increase beyond that expressed in the TC&WM EIS (4.4E-02, or 4.4×10^{-2}; *see* Table 3-1 in this SA).

Table B-8 Potential Radiological Consequences and Risks to the Population from a Severe Transportation Accident Involving Pretreated Waste[a]

Location	Neutral-Weather Conditions[b]		Stable Weather Conditions[b]	
	Short-Term[c]	Long-Term[c]	Short-Term	Long-term
GROUP A				
Population Dose (person-rem)				
Rural	0.51	5,692	0.90	9,903
Suburban	61.5	13,076	108	22,691
Urban[d]	136.5	29,037	238	50,575
Dose Risk (LCF)[e, f]				
Rural	5.35E-08	5.93E-04	9.32E-08	1.03E-03
Suburban	6.41E-06	1.36E-03	1.12E-05	2.36E-03
Urban	1.42E-05	3.02E-03	2.48E-05	5.27E-03
GROUP B				
Population Dose (person-rem)				
Rural	0.31	3,383	0.53	5,886
Suburban	36.6	7,772	64	13,487
Urban[d]	81.1	17,259	142	30,060
Dose Risk (LCF)[e, f]				
Rural	3.18E-08	3.52E-04	5.54E-08	6.13E-04
Suburban	3.81E-06	8.09E-04	6.66E-06	1.40E-03
Urban	8.45E-06	1.80E-03	1.48E-05	3.13E-03
GROUP C				
Population Dose (person-rem)				
Rural	0.23	2,599	0.409	4,521
Suburban	28.1	5,970	49	10,360
Urban[d]	62.3	13,257	109	23,090
Dose Risk (LCF)[e, f]				
Rural	2.44E-08	2.71E-04	4.26E-08	4.71E-04
Suburban	2.93E-06	6.22E-04	5.12E-06	1.08E-03
Urban	6.49E-06	1.38E-03	1.13E-05	2.40E-03
GROUP D				
Population Dose (person-rem)				
Rural	0.16	1,750	0.275	3,045
Suburban	18.9	4,020	33.1	6,977
Urban[d]	42.0	8,928	73.3	15,550
Dose Risk (LCF)[e, f]				
Rural	1.64E-08	1.64E-04	2.87E-08	3.17E-04
Suburban	1.97E-06	1.97E-04	3.45E-06	7.26E-04
Urban	4.37E-06	4.37E-04	7.63E-06	1.62E-03

LCF = latent cancer fatality; km^2 = square kilometer

a National average population densities were used for the accident consequence assessment, corresponding to densities of 6 persons/km^2, 719 persons/km^2, and 1,600 persons/km^2 for rural, suburban, and urban zones, respectively. Potential impacts were estimated for the population within a 50-mile radius, assuming a uniform population density for each zone.

b For the accident consequence assessment, doses were assessed under neutral atmospheric conditions (Pasquill Class D with winds at 9 miles per hour) and under stable conditions (Pasquill Class F with winds at 2.2 miles per hour). The results for neutral conditions represent the most likely consequences, given a severe accident occurs. The results for stable conditions represent weather in which the least amount of dilution is evident; the air has the highest concentrations of radioactive material, which leads to the highest doses.

c Short-term consequences are from exposure within the first 2 hours of an accident, including plume passage. Long-term consequences are from exposure over a 50-year period following an accident without consideration for decontamination or cleanup efforts.

d It is important to note that the urban population density generally applies to a relatively small, urbanized area; very few, if any, urban areas have a population density as high as 1,600 persons/km^2 extending as far as 50 miles (DOE 2002; Weiner et al. 2006). The urban population density corresponds to approximately 32 million people within the 50-mile radius—well in excess of the total populations along most of the routes considered in this analysis.

e LCFs were calculated by multiplying the dose by the health risk conversion factor of 0.0006 fatal cancer per person-rem (ISCORS 2002).

f Risk include the contribution of probability, which uses data from Section 3.3.4, which indicates that 35.2 accidents occur per 100 million large truck miles per year. The probability assumes that 25 percent of the total miles are associated with each group. Additionally, per DOE (1997, Table E-6) the fractional occurrence of accidents that have a severity category of V or above (on a range from I to VIII) is estimated at 2.8E-3 (or one in every 357 accidents). This is an accident severity that would be more likely to cause a release.

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