Oregon Hanford Cleanup Board

April 2022 Updates

Jeff Burright
Oregon Department of Energy

Hanford's Tank Waste – 56,000,000 gallons of high-level waste

149 "single-shell" tanks
(28.5 million gallons)

- ✓ 55,000 to 1,000,000 gallon capacity
- ✓ 67 known or suspect leaking tanks – one **actively leaking to the soil**
- ✓ 18 tanks mostly emptied

28 "double-shell" tanks
(25.5 million gallons)

- ✓ 1,000,000 to 1,257,000 gallon capacity
- ✓ One out of service after actively leaking into containment

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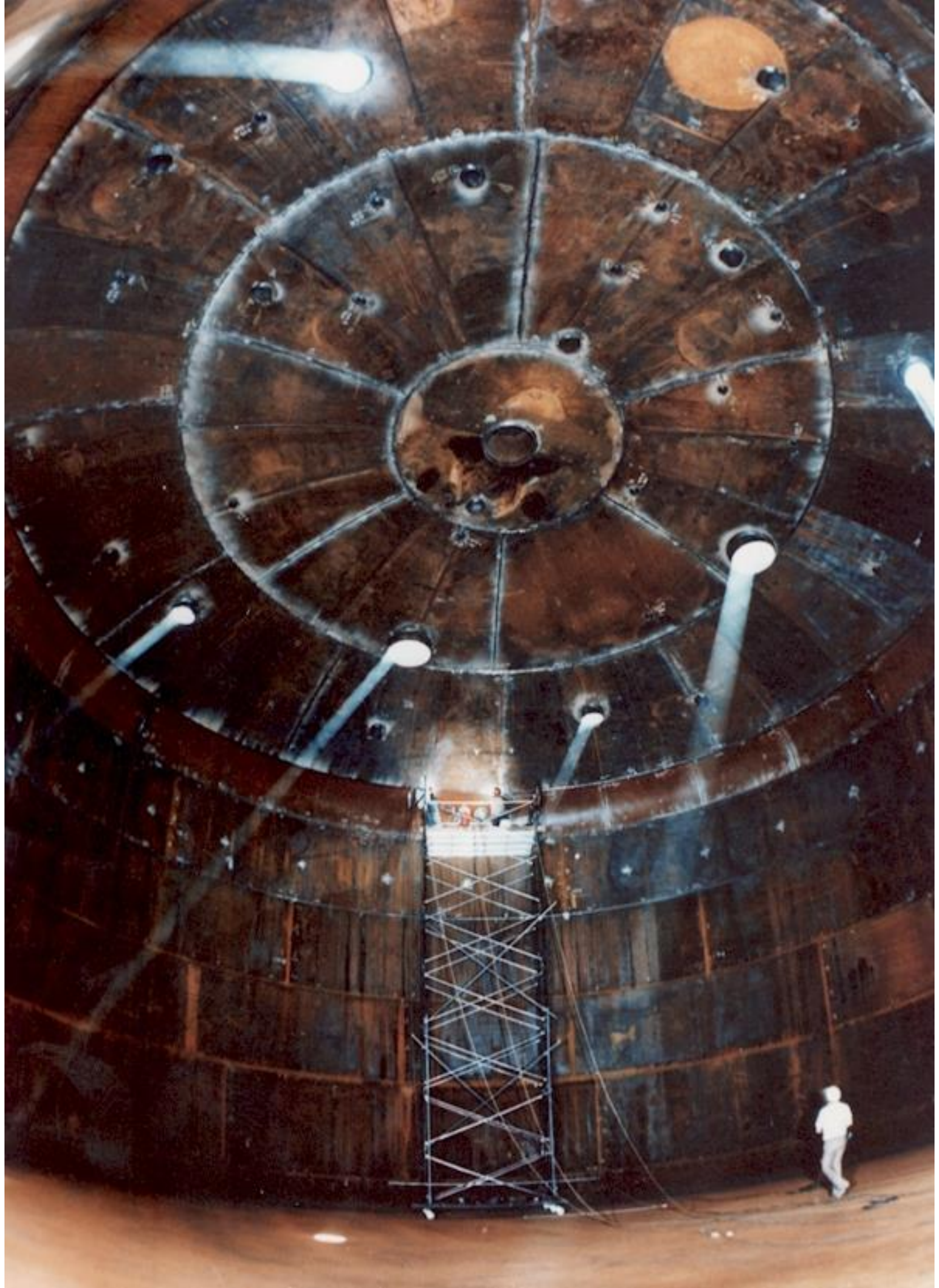


Tank Waste Types

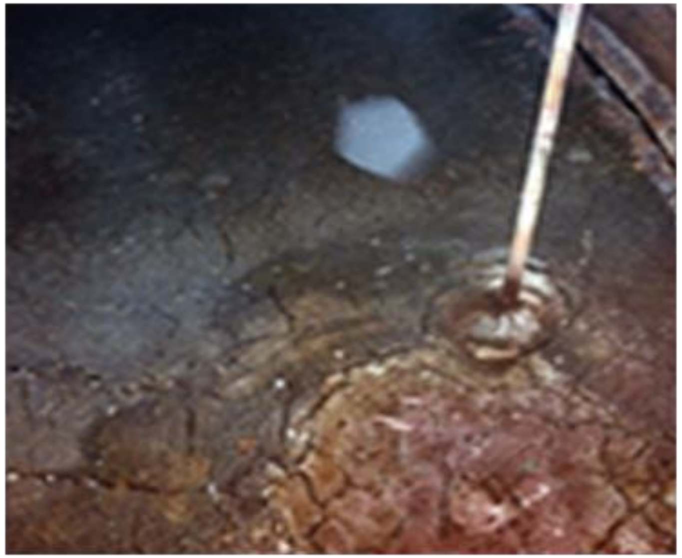
Saltcake
23M gallons

Mostly water-soluable salts; small amount of interstitial liquid

Supernate
21M gallons

Any non-intersitial liquid in the tanks - similar to saltcake in composition

Sludge
12M gallons



Water-insoluable metal oxides, significant amount of interstitial liquid - texture similar to peanut butter

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Balance of Facilities
High-Level Waste Facility
Low-Activity Waste Facility
Pretreatment Facility
Analytical Laboratory

TSCR- Mobile Cs/Sr removal

The Mission "Product"

High-Level Waste Canisters

- 2' x 14.75'
- 6,600 pounds of glass each
- 600 canisters produced/year
- ~ 7,200 to 27,800 canisters
- Temporarily stored at Hanford until National Repository opened

Low-Activity Waste Canisters

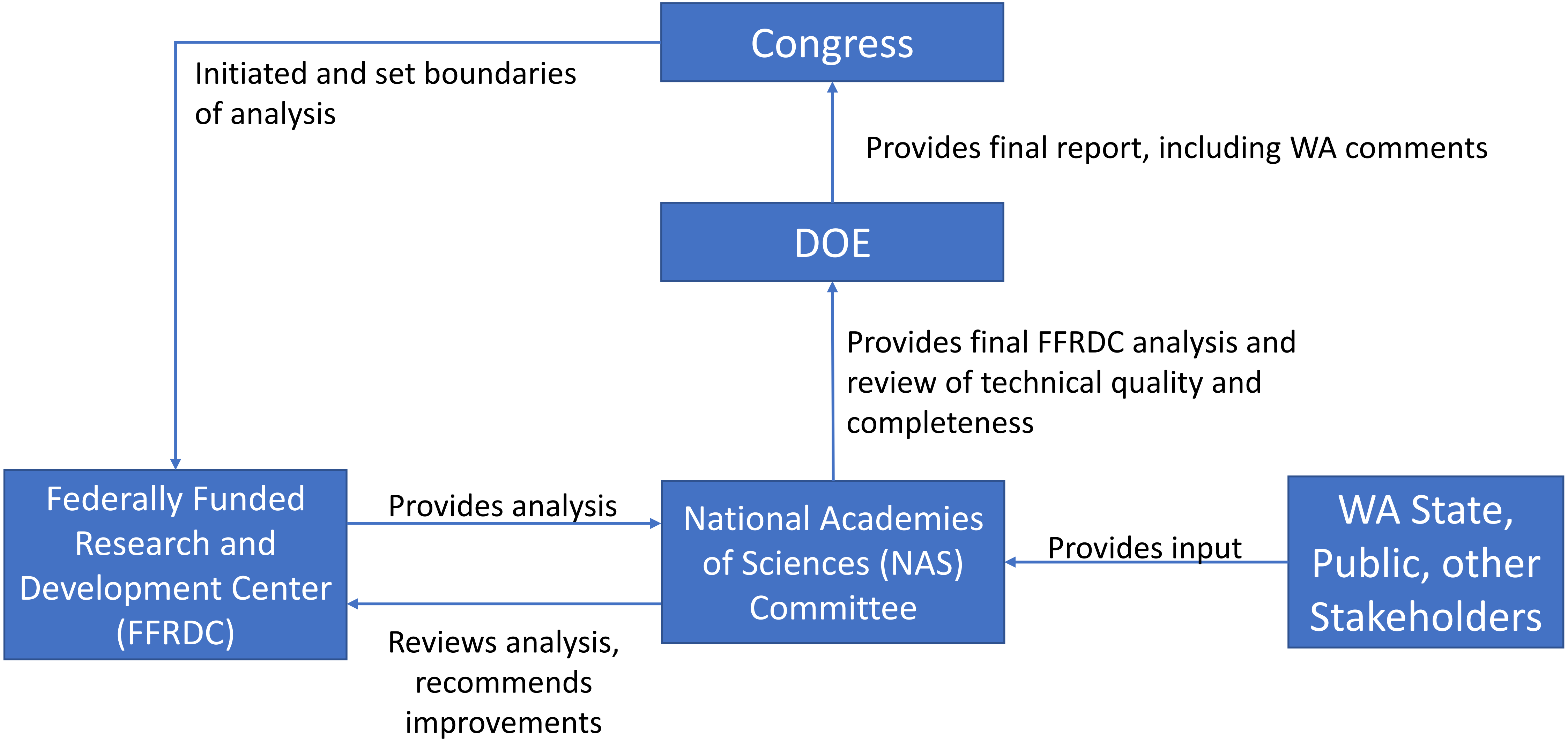
- 4' x 7.5'
- 13,000 pounds of glass each
- 1,300 containers produced/year
- ~ 58,000 to 96,000 canisters
- Disposed on Hanford Site
- **The current Waste Treatment Plant is only sized to treat ~50% of this waste.**

National Academy of Sciences

Supplemental Low Activity Waste Study

Phase 2

Simplified Study Process



Oregon Involvement in This Study

TinyURL.com/OR-LAW0	Opening Remarks on Phase 1 Study
TinyURL.com/OR-LAW1	Phase 1 Study Technical Comments (2019)
TinyURL.com/OR-LAW2	Phase 2 Kickoff Presentation (07/21)
TinyURL.com/OR-LAW3	Phase 2 Kickoff Spoken Remarks (07/21)
TinyURL.com/OR-LAW4	FFRDC Outline Discussion PPT (10/21)
TinyURL.com/OR-LAW5	FFRDC Report Outline Video (10/21)

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Cutting to the Chase

The FFRDC team makes the following recommendation:

DOE should expeditiously secure and implement multiple pathways for off-site grout solidification/ immobilization and disposal of LAW in parallel with direct-feed low-activity waste (DFLAW) vitrification process.

Table 5-1. High-Level Comparison of the Four Consolidated Alternatives for Supplemental Treatment of Low-Activity Waste

Alternative			
Vitrification 1: Disposal onsite at Hanford	FBSR 1A: Solid monolith product disposal onsite at Hanford	Grout 4B: Off-site grouting/disposal	Grout 6: Phased Approach Off-site grouting/disposal, then on-site grouting/disposal
Criterion 1: Long-term effectiveness (environmental and safety risk after disposal)			
Highly effective for primary waste; moderately effective for secondary waste. Medium confidence in the assessment.	Effective. Medium confidence in the assessment, due to technology immaturity.	Highly effective. High confidence in the assessment.	Highly effective. Good to high confidence in the assessment.
Criterion 2: Implementation schedule and risk (environmental and safety risks prior to mission completion, including risks driven by implementation and waste tank storage duration)			
High risk due to significant cost-based startup delays and operations limits. Moderate technical implementation risk. Construction finishes 2049, mission does not complete without significant additional annual budget.	High risk due to construction time required and technical execution risk. Construction finishes 2039; mission completes 2070.	Low risk due to immediate start, minimal construction, low-temperature process, likely capacity, and modest transportation and operations costs. Limited facilities (e.g., evaporator and load-out station) needed; mission completes 2065.	Very low risk due to immediate start, flexible timing of conversion to on-site low-temperature process, and inexpensive operations. Grout plant construction finishes 2039; mission completes 2065.
Criterion 3: **Likelihood of successful mission completion** (including affordability and robustness to technical risks)			
Very low probability of successful completion due to affordability.	Low probability of successful completion, due to technical risk.	Very high likelihood of successful completion.	High likelihood of successful completion.
Criterion 4: Lifecycle cost (discounted lifecycle costs)			
\$7.6B construction; \$5.1B operations (unaffordable, \$1.36B shortfall)	\$3.4B construction; \$\$2.2B operations	\$0.4B construction; \$3.4B operations	\$1.4B construction; \$2.7B operations

FBSR = fluidized bed steam reforming.

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Source: Photograph from Container Technologies Industries, LLC literature.

Figure D-8. Example of a Reusable Steel Split-Cavity Overpack (actual overpack would be smaller, lighter, and with a shallower lid)

Source: Photograph from PacTec, Inc literature.

Figure D-7. Example of Soft Side Container for Shipping Low-Specific Activity Materials

Waste Control Specialists, Texas

- Facility underlain by 600 ft of nearly impermeable redbed clays
- WCS facilities not over or adjacent to a drinking water aquifer
- ! WCS does not have limits for Technetium or Iodine
- DOE signed agreement to take ownership of Federal Waste Cell after closure
- Offsite disposal of Hanford Supplemental LAW estimated to take 26 railcars per month for 28 years

Figure 5-2 A Waste Control Specialists Disposal Cell and Wastes Being Placed in Modular Concrete Canisters (note workers for scale)

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EnergySolutions, Clive UT

- Originally sited and designed to accept uranium mill waste and TENORM
- Limited to only “Class A” low level waste
- Non-potable water under the facility and high evaporation vs. precipitation
- Licensed by State of Utah as an NRC Agreement State

Figure D-2.Aerial View of the Clive Facility

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Hanford Integrated Disposal Facility

Saltstone Disposal Units at Savannah River

Supplemental LAW Effects on Overall Tank Mission Schedule

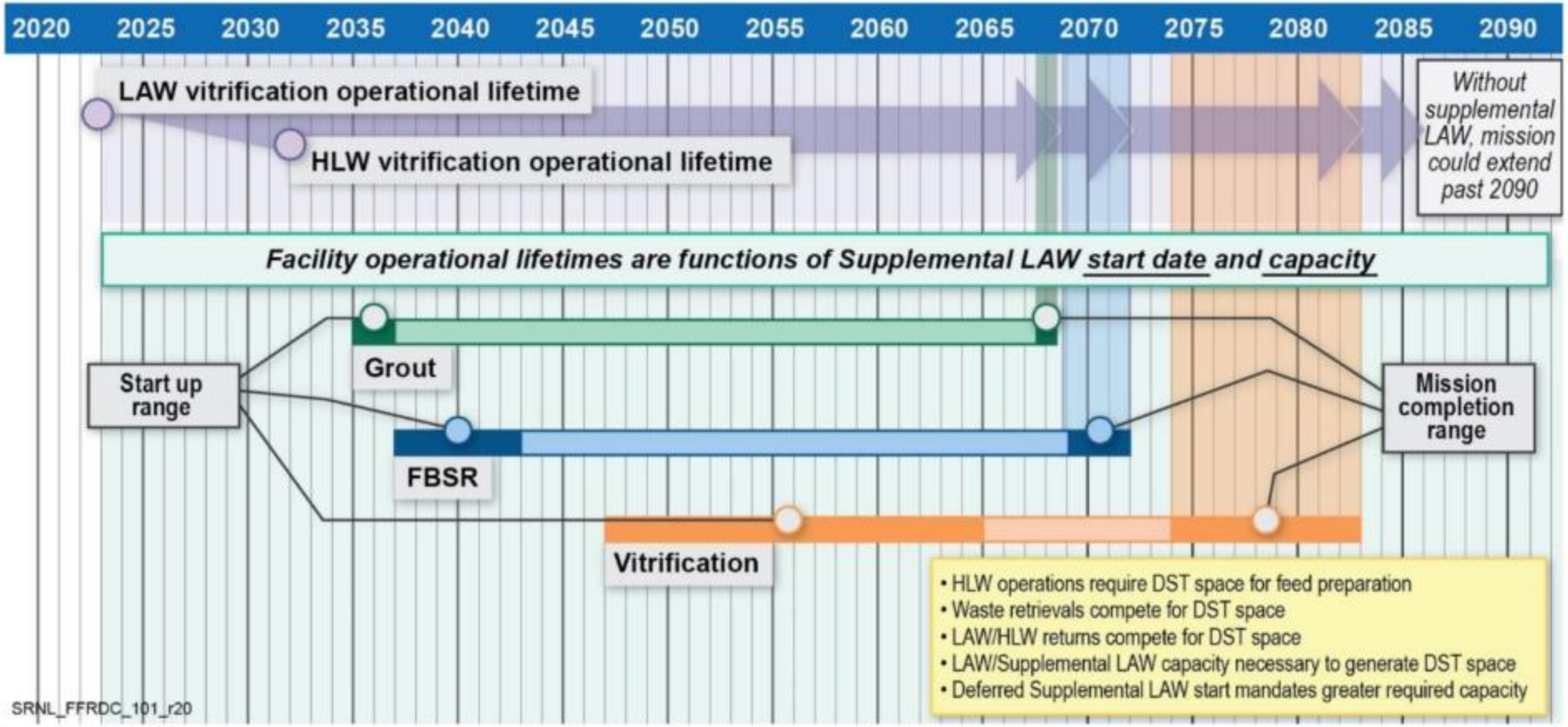

Figure 1.3-3. Relationship Between Low-Activity Waste Supplemental Treatment Start Date and Projected Tank Waste Mission Completion Date

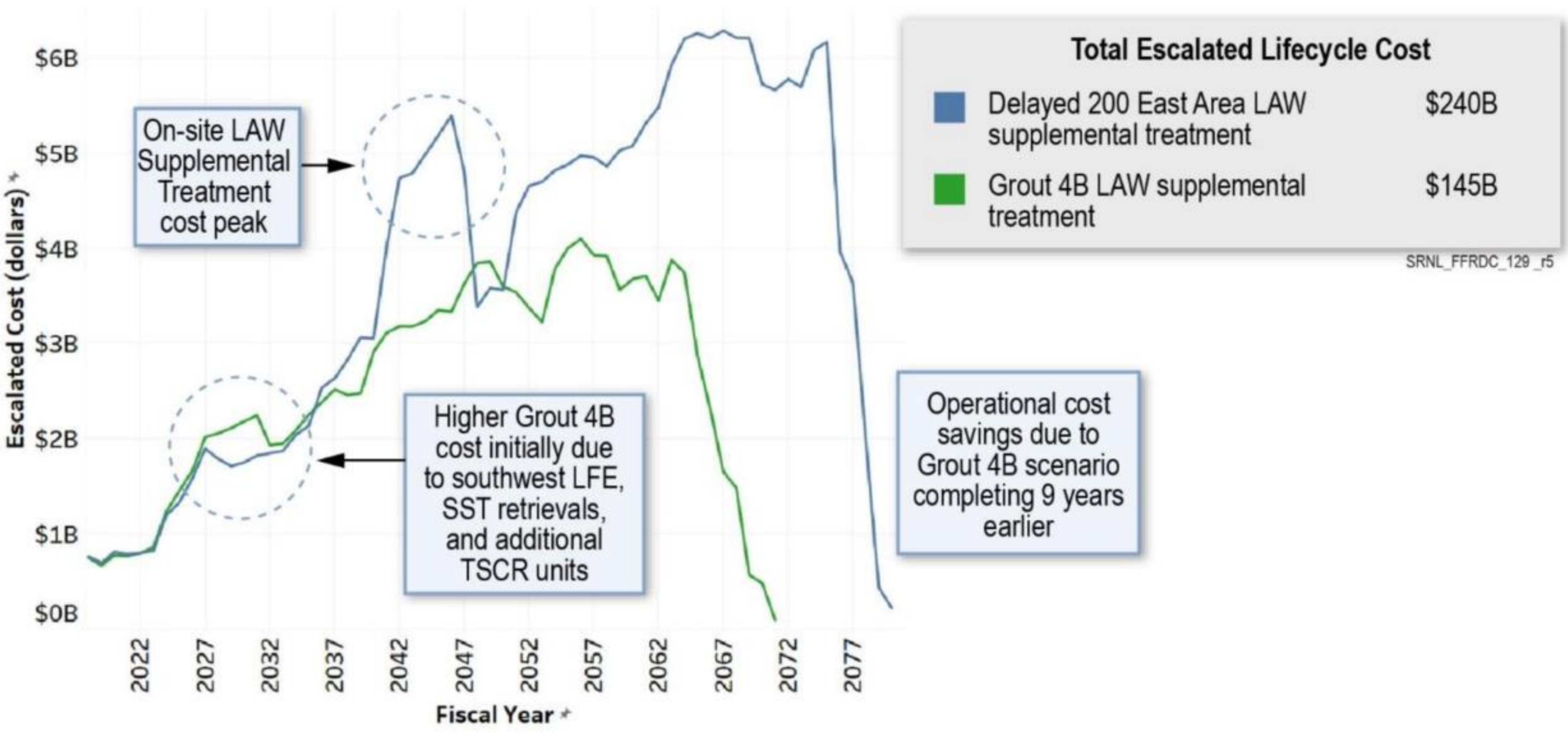

Figure 3.3-7. Annual Mission Cost Profile Comparison between Alternative Grout 4B and Delayed Low-Activity Waste Supplemental Vitrification

Grout 4B vs. Delayed LAW vit

Table F-12. Mission Performance and Cost Metrics – Alternative 4B and Delayed Low-Activity Waste Supplemental Vitrification

	Alternative 4B Early Start Offsite Grout	Delayed LAW Supplemental Vitrification (2050)
Treat all tank waste (calendar year)	2066	2075
HLW canisters produced	9,300	12,000
Maximum TSCR pretreatment required	5	8
Completions SST retrievals	2057	2070
Unescalated cost	$79B	$110B
Total escalated lifecycle cost	$145B	$240B

HLW = high-level waste.
LAW = low-activity waste.
SST = single-shell tank.
TSCR = tank-side cesium removal.

Several key parameters are worth noting. A primary result is the reduction of mission completion from 2075 (Delayed Vitrification) to 2066 (Grout 4B). This is accomplished due solely to the DST space generated by LAW supplemental treatment being used for HLW feed preparation, resulting in a 20% reduction in HLW canisters. At the same time, additional space generated by LAW supplemental treatment is sufficient to allow SST retrievals to complete 13 years earlier (2057 versus 2070). These

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Table 3.3-3. Technetium-99 Disposition – Alternatives 4B and Delayed Low-Activity Waste Supplemental Vitrification

Disposal	Waste Type	Treatment	Alternative 4B Ci Tc	Delayed Vitrification Ci Tc
Offsite	LAW	West TSCR	6,500	7,500
Offsite	LAW	East TSCRs	10,500	N/A
Onsite	LAW	LAW vitrification	6,800	11,900
Onsite	LAW	Supplemental LAW vitrification	N/A	4,400
Offsite	HLW	HLW vitrification	1,250	1,250
		Total	**25,050**	**25,050**

Notes: Tank farm inventory **25,000 Ci**
Expected loss 1%
HLW nominal content 5% (1,250 Ci)

HLW = high-level waste.
IDF = Integrated Disposal Facility.
LAW = low-activity waste.
Tc = technetium.
TSCR = tank-side cesium removal.

Summary Technetium Disposition

Off-site Grout 4B		Delayed LAW Supplemental Vitrification
18,250	Total offsite (Ci)	8,750
6,800	Total on-site IDF (Ci)	16,300

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Some Oregon Questions and Issues

- ~~Key radionuclide retention in grout~~
- ~~Nitrate/Nitrite budget for IDF~~
- ~~Organics treatment uncertainties~~
- ~~Cross Site Transfer line~~

FFRDC Preferred Alternative(s)

"Start with offsite grout disposal, keep working the grout science, buy some risk budget, and save onsite grout performance for another day."

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Some Other Oregon Questions and Issues

- Grout & “Mission Acceleration” -> Sludge Management?
- Integration with Analysis of Alternatives and Holistic Negotiations
- Vitrification Alt 2: The “Faster Horse Hypothesis”
- Nitrate/Nitrite: where do we leave it for later?
- Offsite transportation analysis clarifications
- Cross Site Transfer line assumptions and risks
- Regulatory and community acceptance

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Alternative Risk Management (What's the fallback?)

Grout 6
(offsite first, onsite later)

Build an evaporator

Grout 4B
(all offsite)

We have an extra evaporator

FBSR? Vit 2?
(dare to dream)

We learn by 2027 which path we are on.

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Offsite Transportation of LAW

- Analysis estimates ~600 trains over 42 years
- Relative non-rad transportation risk of the Oregon route (to Clive) is significantly less than non-Oregon route (WCS).
- Significant risk difference if liquid or solid?
- Transport to an offsite rail spur?
- Oregon is willing to work with DOE on safe LAW transportation options and accident response planning.

Figure D-11. Rail Routes from Hanford (Perma-Fix) to Waste Control Specialists (Texas) and Clive (Utah)

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Regulatory and Community Acceptance

- *We are not beyond convincing, but we must be convinced.*
- *Oregon Hanford Cleanup Board may also provide feedback on waste disposal and transportation issues.*
- *VLAW WIR is still in NRC's court.*
- *Risk-based is ok, but the how matters as much as the what.*
- *"If you're concerned, I'm concerned."*
- *What happens next will happen at the speed of trust.*

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Next Steps

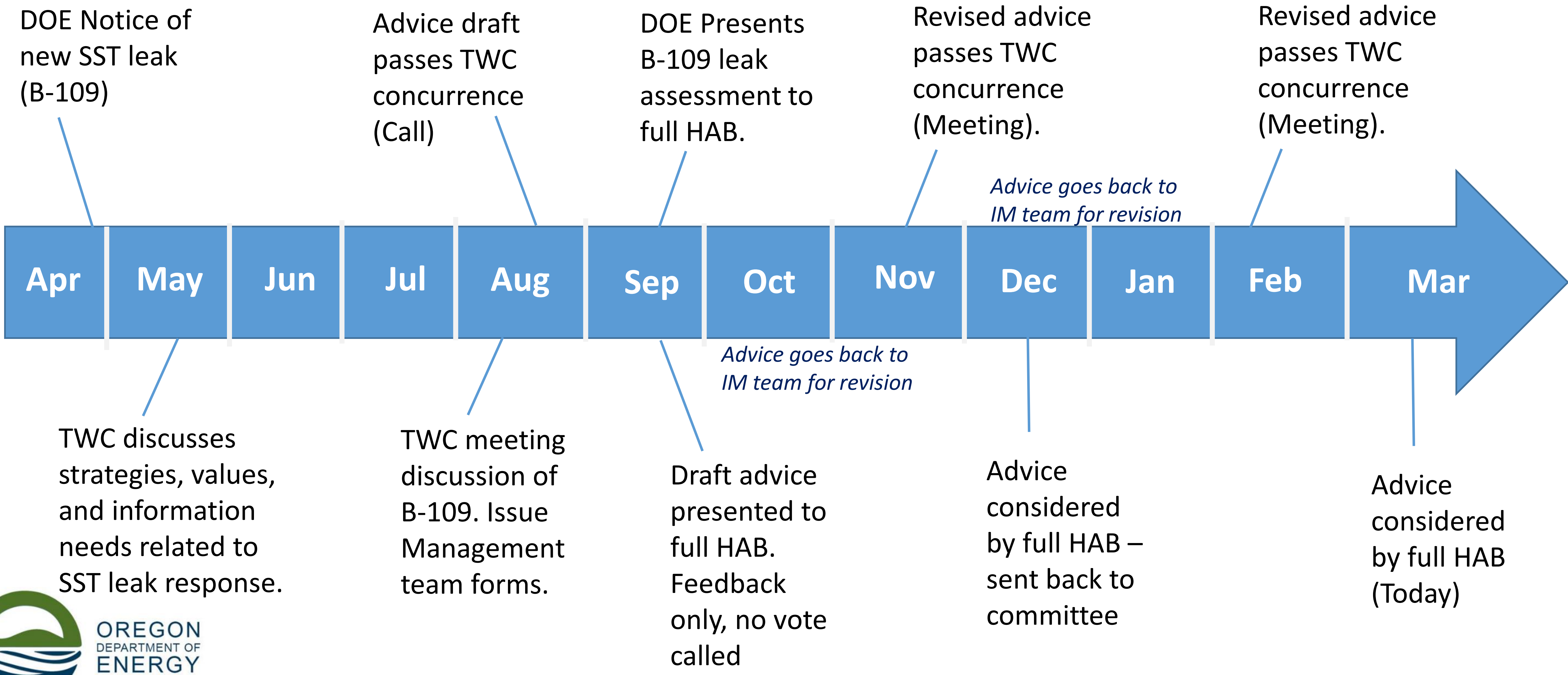
- Written comments on the FFRDC report due June 11th
  - Search “Supplemental LAW Hanford” to find the study website, which contains videos of meetings and the report in question (see the April 26-28 meeting)
- National Academies will provide their review of the FFRDC report in September 2022.
- Another public meeting planned for this winter.
- Study scheduled to complete in May 2023.

Hanford Advisory Board

Proactive Single Shell Tank Leak Mitigation

Advice Passed March 2022

Timeline of Advice Development



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Main Points of the **2nd Revised** Advice:

1. Board believes: agencies should remove liquid waste, including interstitial liquid, ASAP before they have a chance to leak.
2. Develop a comprehensive plan to address SST leak detection, characterization, mitigation, cleanup, and communication.
   a) Include external input
   b) Timely assessment and communication of SST leaks, including <u>long-term risk</u>.
   c) Evaluate risk from remaining 3.34 million gallons of drainable liquid in SSTs.
   d) Board advised policy: Respond to SST leaks through abatement or mitigation, to the extent necessary and feasible, without delay. Afford public comment. Board sees value in having a dedicated team equipped and trained for this purpose.
   e) Assess the feasibility of current and potential future abatement technologies (considering effectiveness, implementability, and cost)
   f) Develop abatement technologies (invest in/support new tools)
   g) Allocate budget for managing SST leaks proactively

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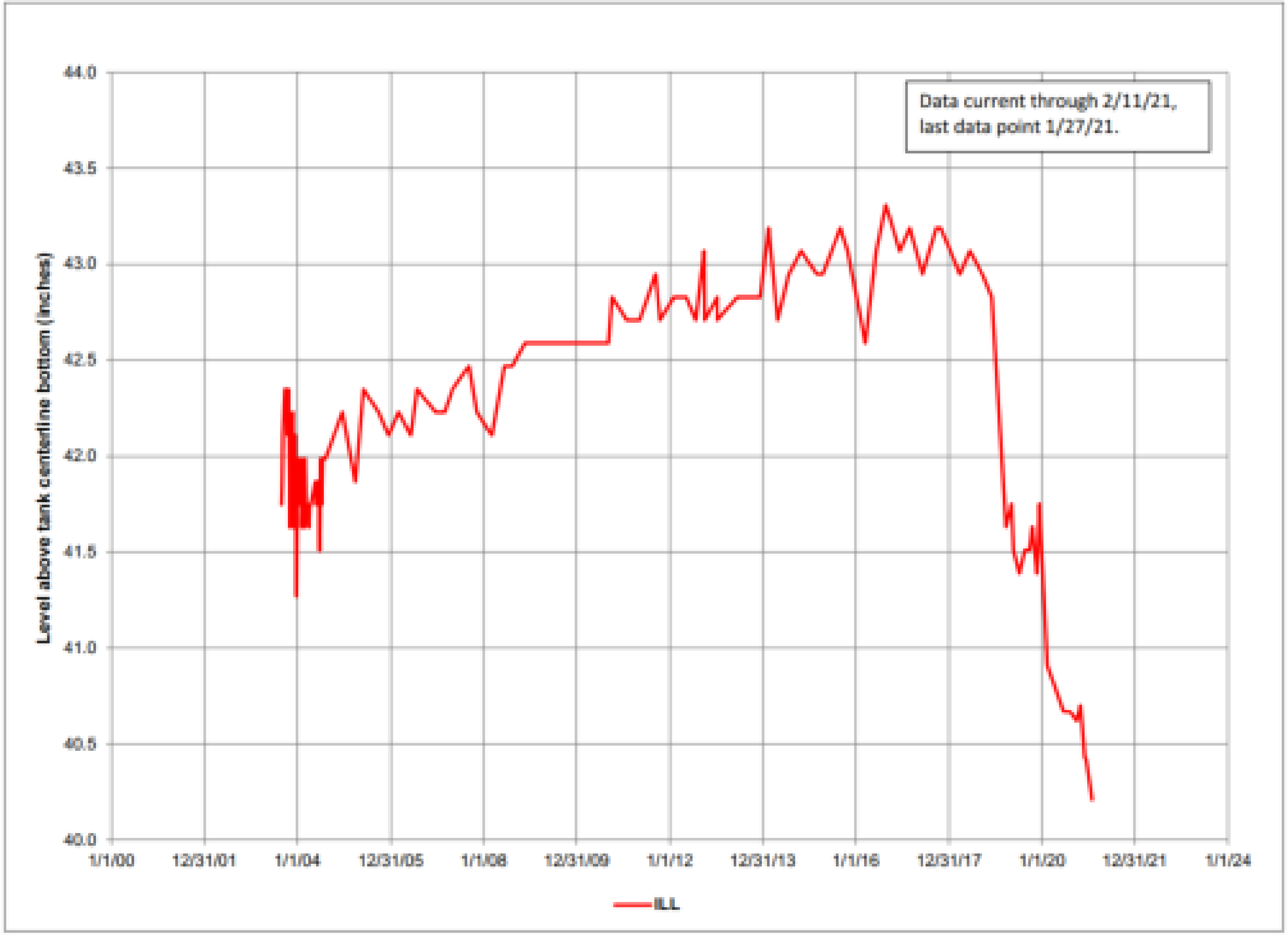

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Figure 5-2. Tank B-109 ILL Data Since 2003 LOW Installation

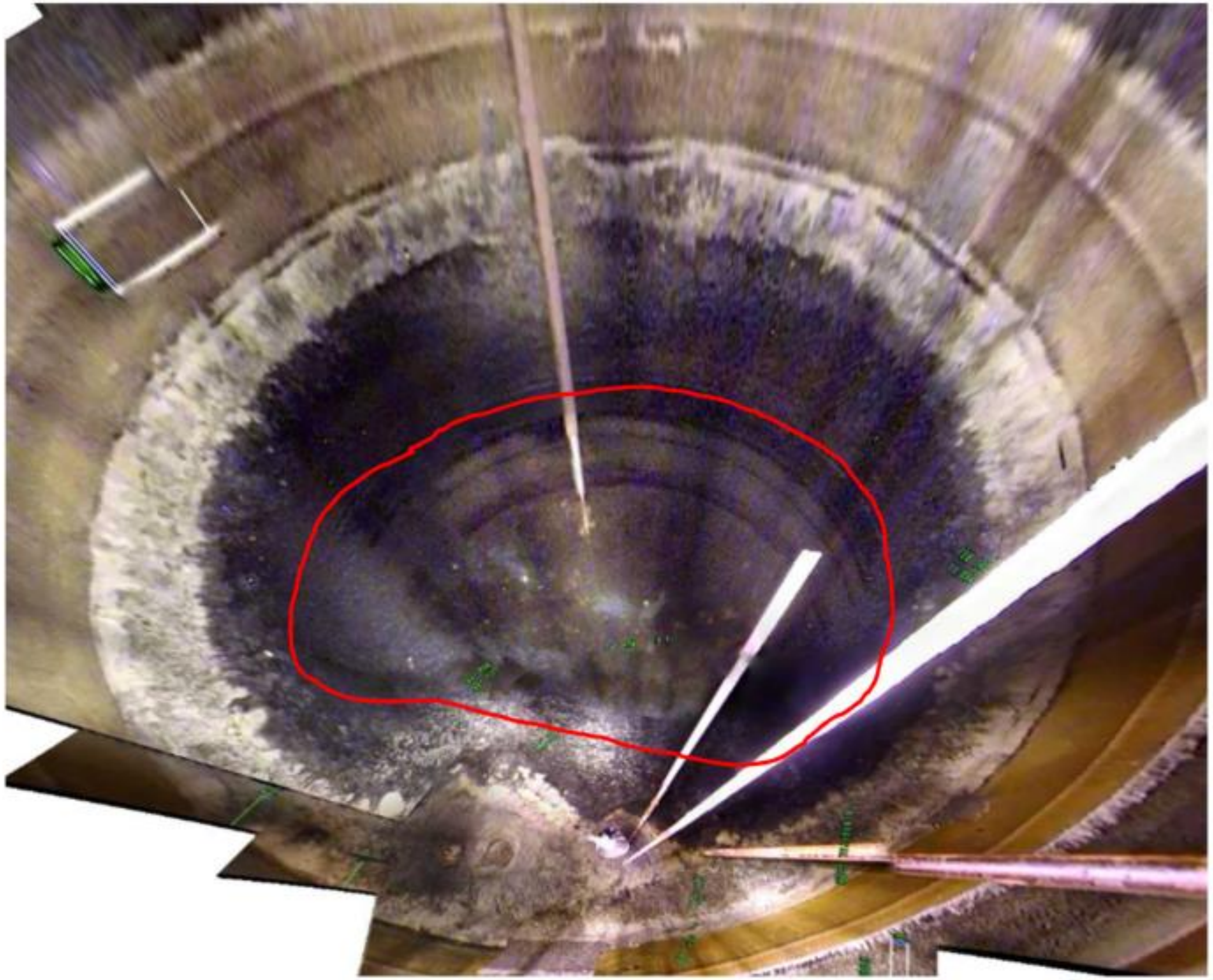

Figure 5-5. Tank B-109 February 11, 2014 Waste Surface Composite View from Riser 2

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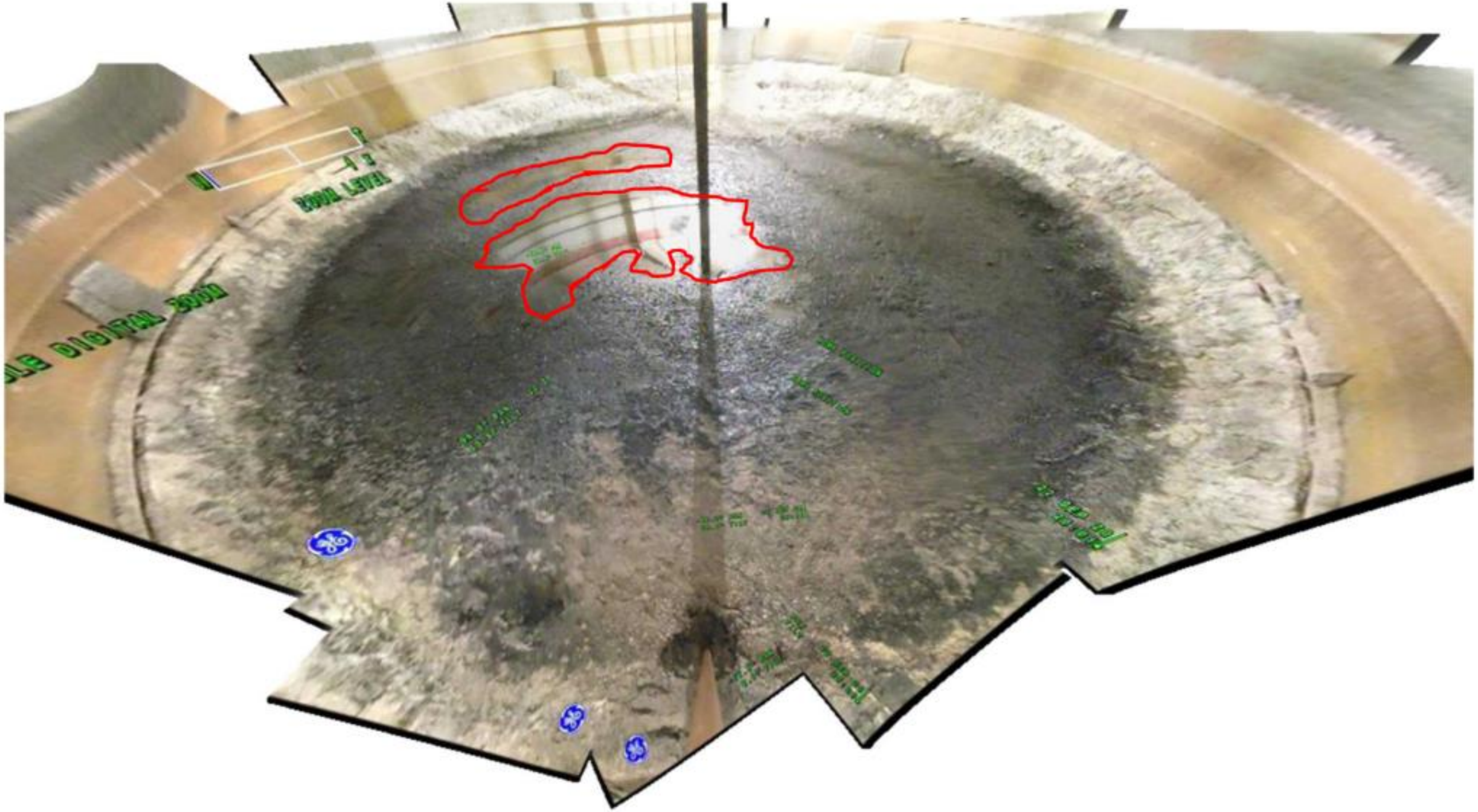

Figure 5-7. Tank B-109 September 22, 2020 Waste Surface Composite View from Riser 7

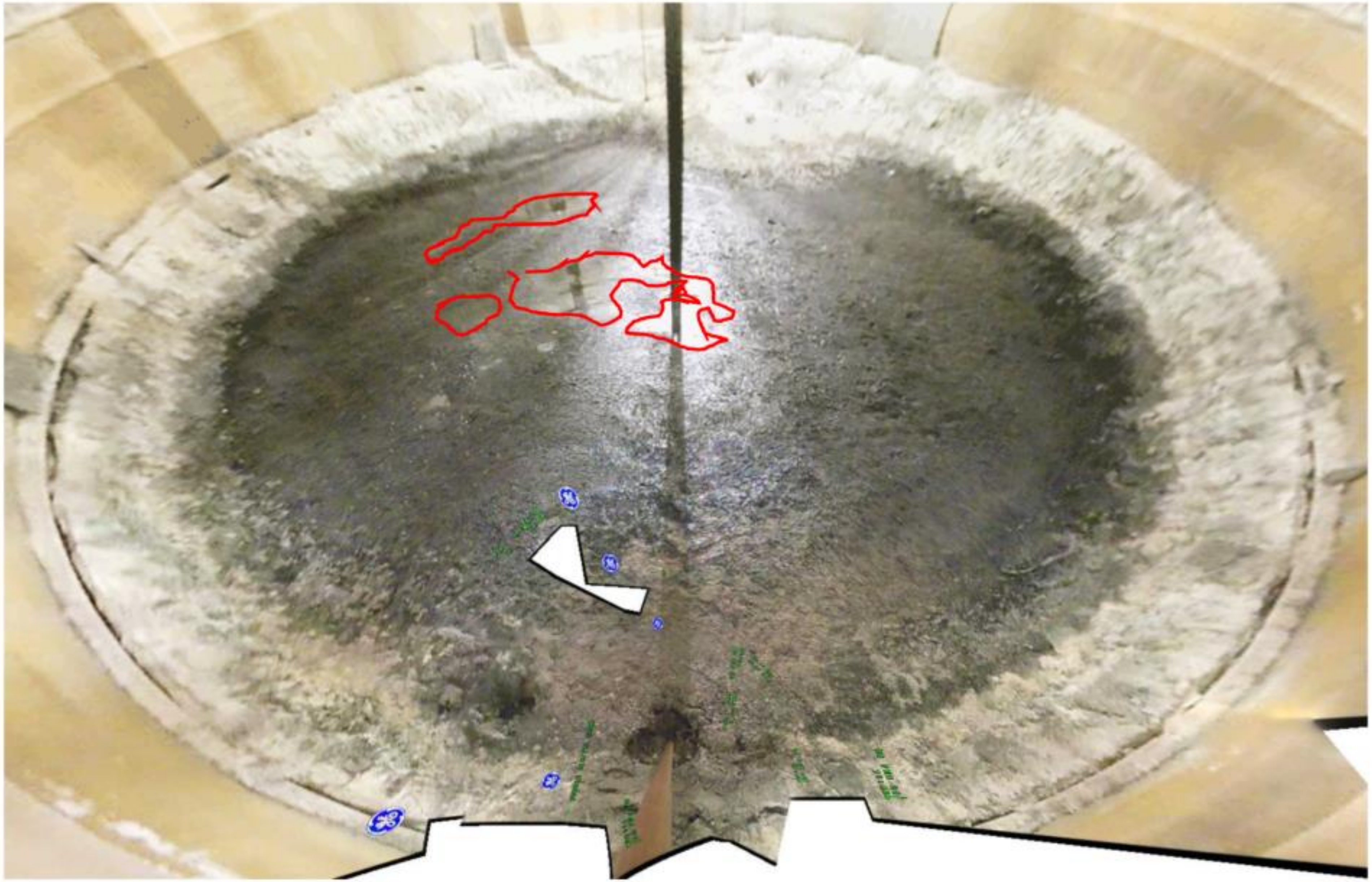

Figure 5-8. Tank B-109 February 5, 2021 Waste Surface Composite View from Riser 7

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Figure 5-6. Baseline Case – Single-Shell Tank Retrieval Sequence and Timing.

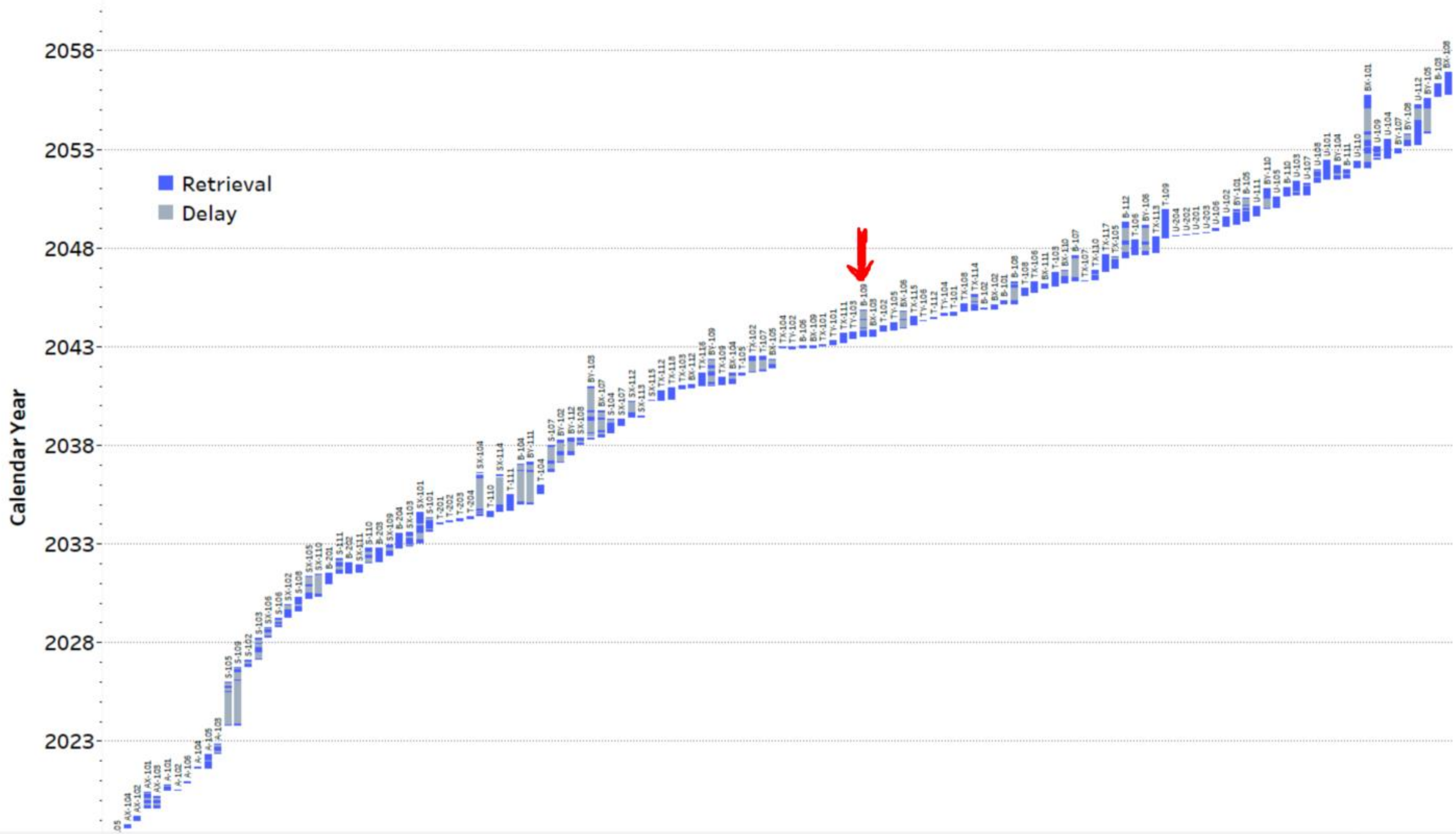
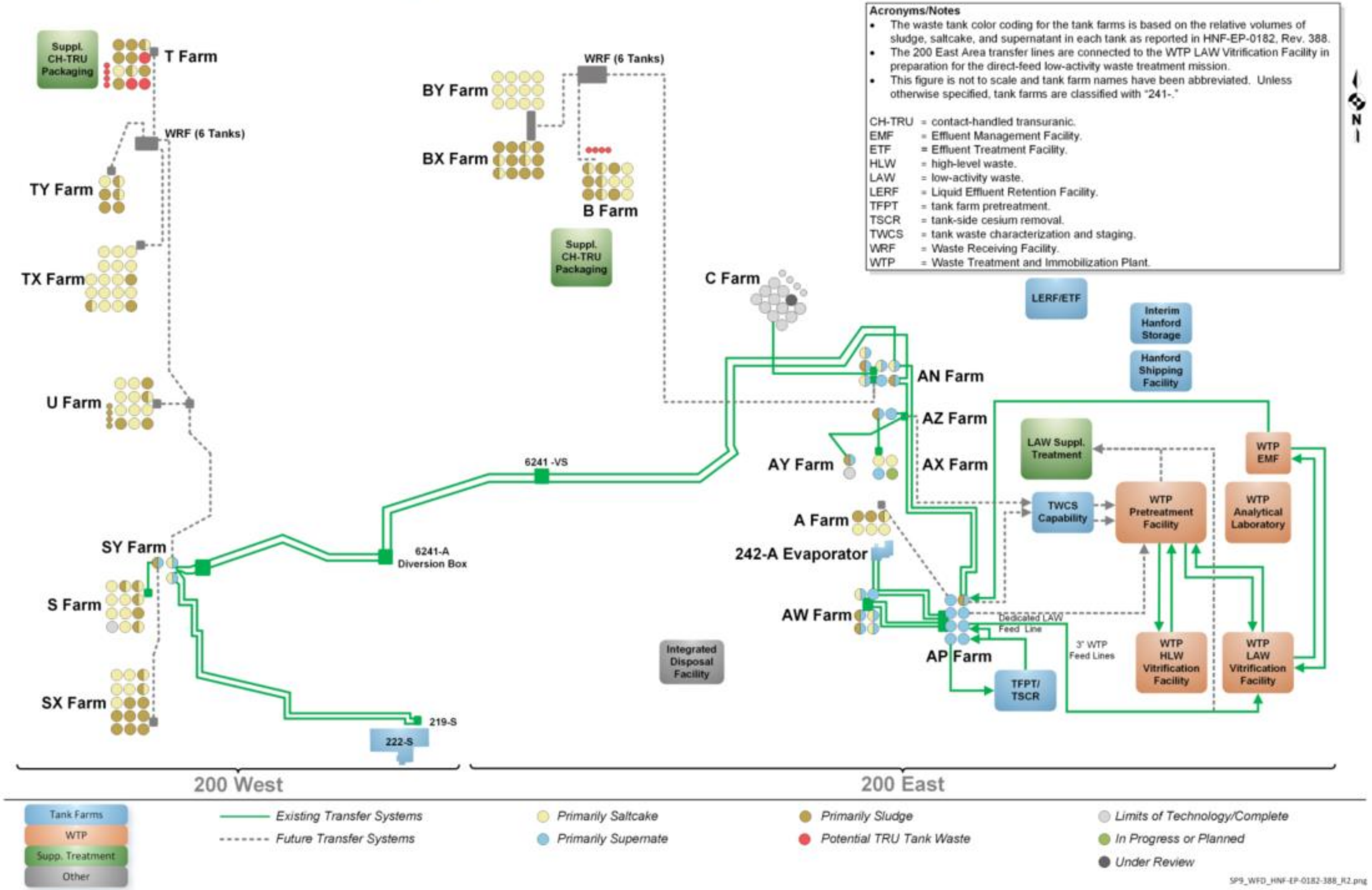


Figure 3-8. Simplified Representation of the Hanford Waste Feed Delivery System.



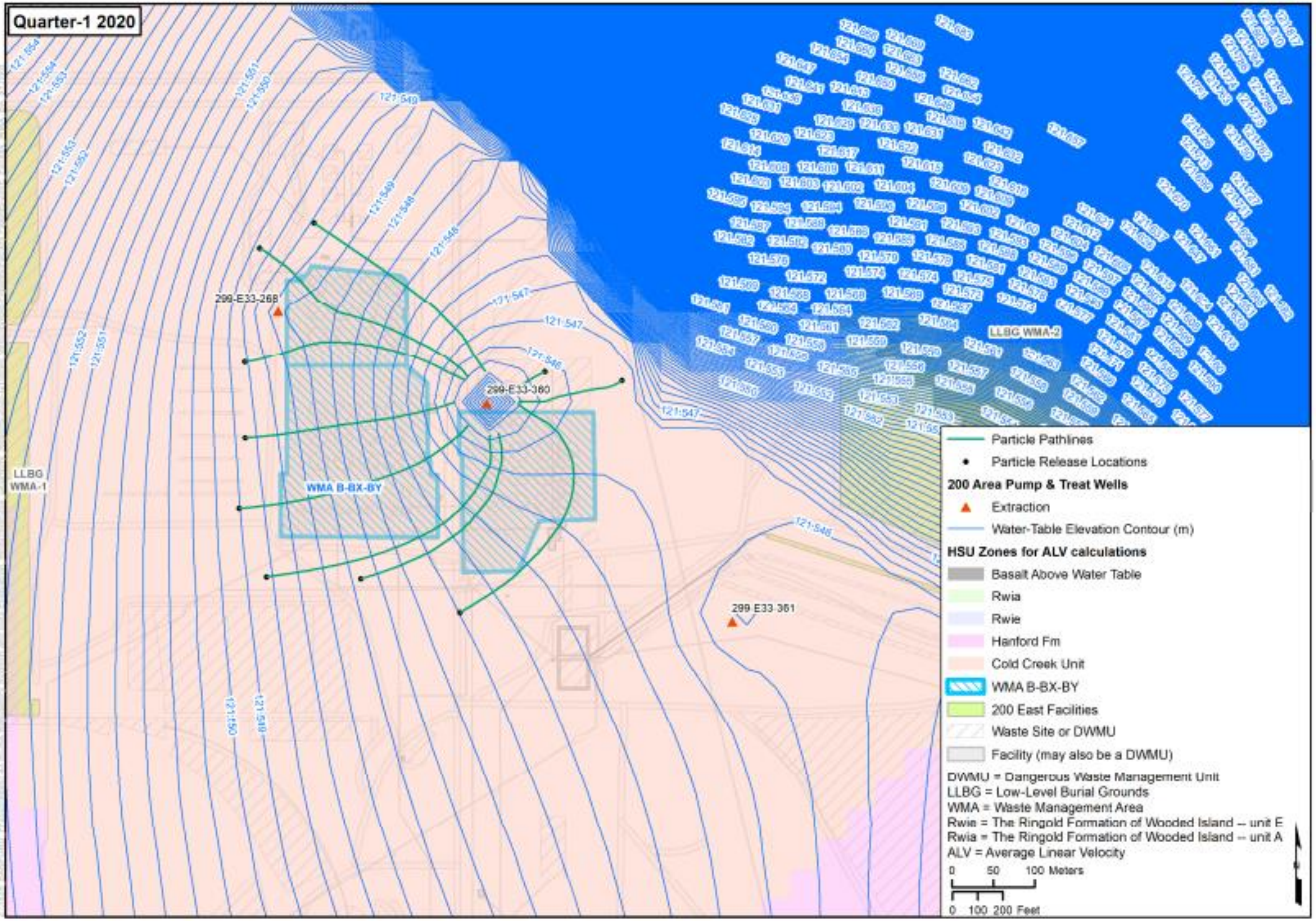


Figure 7-47. Calculated Particle Pathlines Representing General Groundwater Flow Directions at WMA B-BX-BY for the First Quarter of 2020

HNF-EP-0182
Revision 409

Waste Tank Summary Report for Month Ending January 31, 2022

Table 4-1. Inventory and Status by Tanks – Single-Shell Tanks (6 pages)

All volume data obtained from Tank Waste Information Network System (TWINS)

Tank (241-)	Tank Integrity	Table 1-1 Tank Status	Total Waste (kgal)[a]	Drainable Interstitial Liquid (kgal)[108]	Waste Volumes[26] Supernatant Liquid (kgal)	Sludge (kgal)	Saltcake (kgal)	Solids Volume Update[89]
A Farm Status								
A-101[27]	Sound		351	37	5	3	343	8/1/2020
A-102	Sound	WI	41	5.7	2	1	38	3/1/2016
A-103[28]	Sound		390	87	12	2	376	10/1/2020
A-104	Assumed leaker		28	0	0	28	0	4/1/2019
A-105	Assumed leaker		20	0	0	20	0	4/1/2020
A-106	Sound		79	0	0	50	29	4/1/2016
6 tanks – Total			**909**		**19**	**104**	**786**	
AX Farm Status								
AX-101	Sound		323	43	0	2	321	6/1/2020
AX-102	Sound	RC	2.9	Retrieval completed 9/13/2021[5]				9/1/2021
AX-103	Sound	R	25	Retrieval in Progress				1/27/2022
AX-104	Sound	R	5.1	Retrieval in Progress				9/1/2021
4 tanks – Total			**356**		**16**	**14**	**326**	
B Farm Status								

B Farm Status					
B-101	Assumed leaker		105	18	0
B-102	Sound		31	5.7	4
B-103	Assumed leaker	WI	38	8.3	1
B-104	Sound		368	58	5
B-105	Assumed leaker		289	18	0
B-106	Sound		113	12	4
B-107	Assumed leaker		157	20	1
B-108	Sound		85	15	0
B-109	Assumed leaker	AL	130	13	0
B-110	Assumed leaker		244	33	7
B-111	Assumed leaker		220	29	5
B-112	Assumed leaker	WI	34	4.2	3
B-201	Assumed leaker	WI	30	4.2	2
B-202	Sound	WI	29	4.1	2
B-203	Assumed leaker		50	7.7	1
B-204	Assumed leaker		50	7.6	2
16 tanks – Total			**1,973**		**37**

Total Drainable Liquid across all SSTs: 3.37 million gallons

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Figure A4-5. Technology 5 – Enhanced Saltwell Pumping.