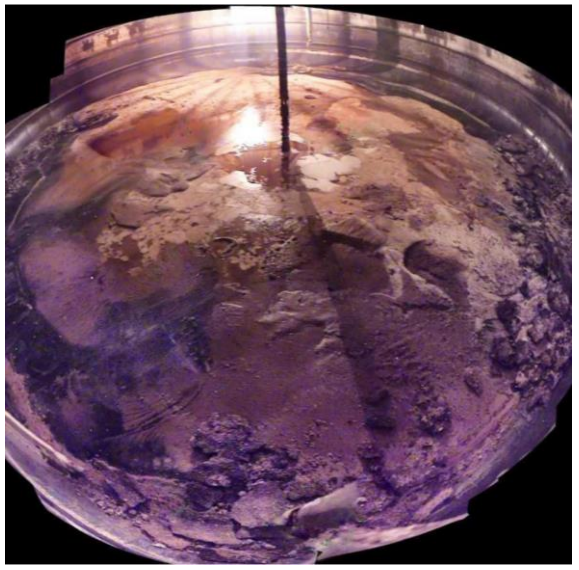
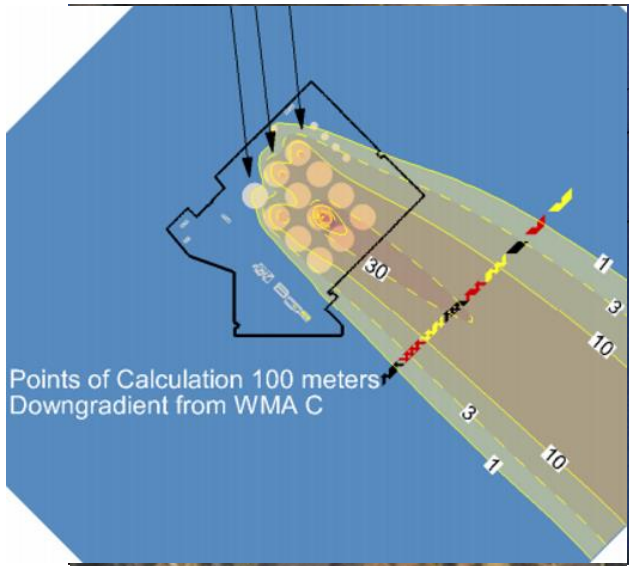
Hanford Radioactive Tank Wastes

C Farm Closure Update

OHCB Spring 2021 Meeting

Jeff Burright
Nuclear Waste Remediation Specialist





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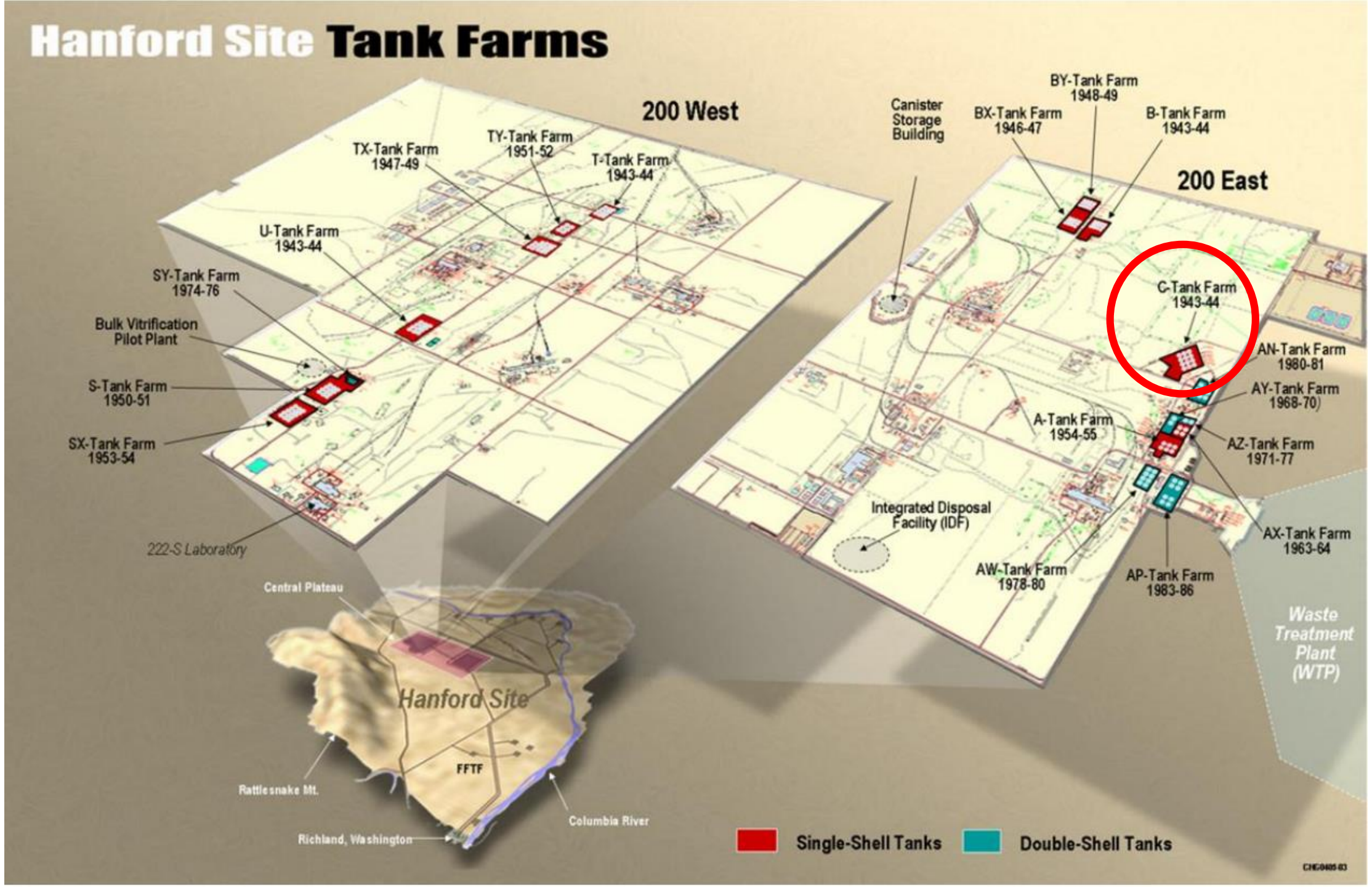
WASHINGTON
Washington
Seattle
Spokane
Hanford Site
Tri-Cities
Vancouver
Hanford Reach National Monument
CENTRAL PLATEAU
C Tank Farm
Tank Farms
Waste Treatment Plant
200 West Area
200 East Area
Hanford Reach National Monument
Mattawa
24-SW Rd
243
24
240
241
Saddle Mountain Lake
Columbia River
Road L SW
Hanford Rd
Savage Island
Basin City
Road 170
Mesa
17
Eltopia
395
Glade
FRANKLIN


Hanford Site Tank Farms
200 West
TX-Tank Farm
1947-49
TY-Tank Farm
1951-52
T-Tank Farm
1943-44
U-Tank Farm
1943-44
SY-Tank Farm
1974-76
Bulk Vitrification
Pilot Plant
S-Tank Farm
1950-51
SX-Tank Farm
1953-54
222-S Laboratory
Canister
Storage
Building
BY-Tank Farm
1948-49
BX-Tank Farm
1946-47
B-Tank Farm
1943-44
200 East
C-Tank Farm
1943-44
AN-Tank Farm
1980-81
AY-Tank Farm
1968-70
A-Tank Farm
1954-55
AZ-Tank Farm
1971-77
Integrated Disposal
Facility (IDF)
AX-Tank Farm
1963-64
AW-Tank Farm
1978-80
AP-Tank Farm
1983-86
Waste
Treatment
Plant
(WTP)
Central Plateau
Hanford Site
FFTF
Rattlesnake Mt.
Columbia River
Richland, Washington
Single-Shell Tanks
Double-Shell Tanks

Hanford's Single-Shell Tanks

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4-Nov-44

Tank Pipelines and Diversion Boxes

Retrieval in C-Farm: 16 tanks in 19 years

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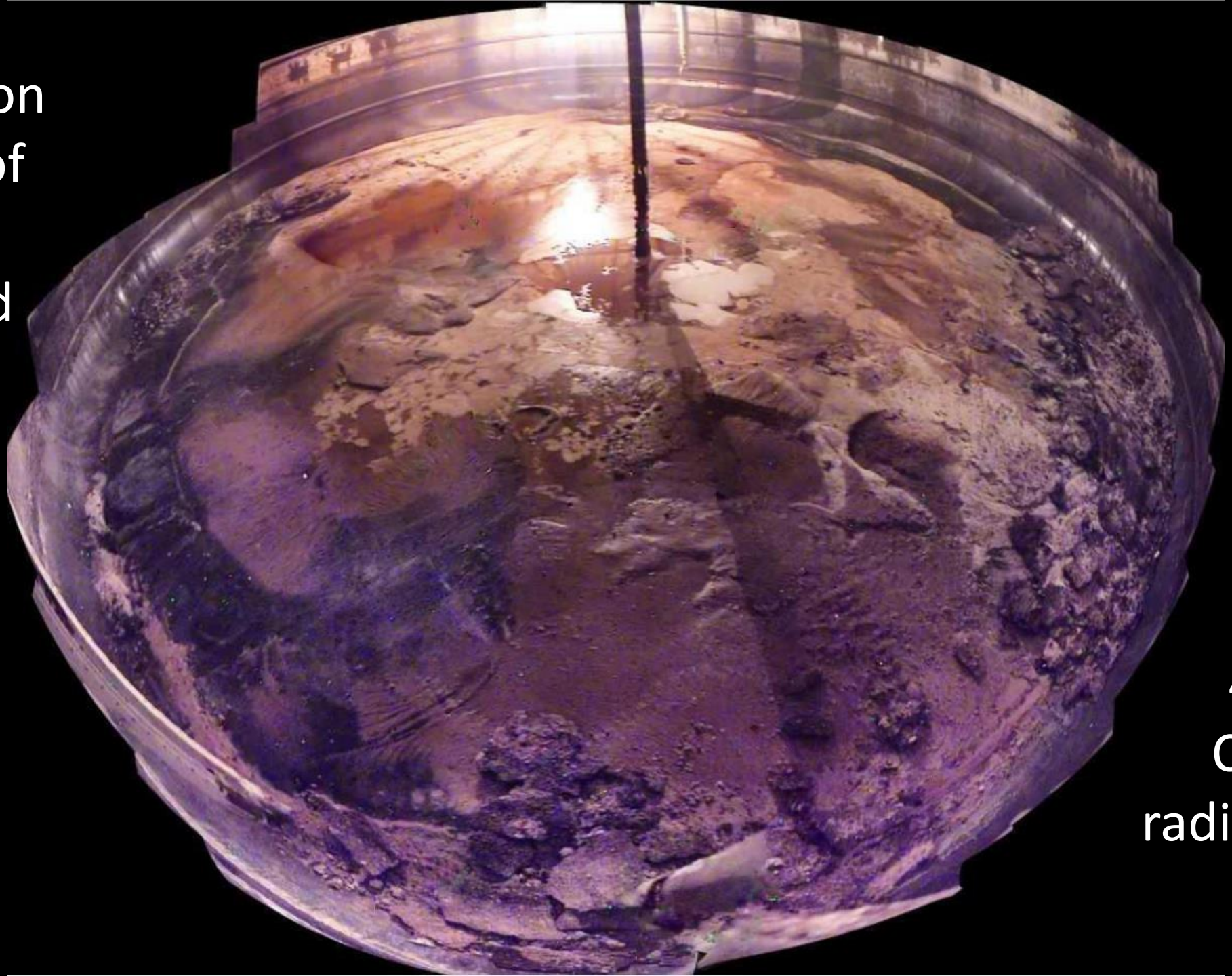
1.7 million gallons of waste retrieved

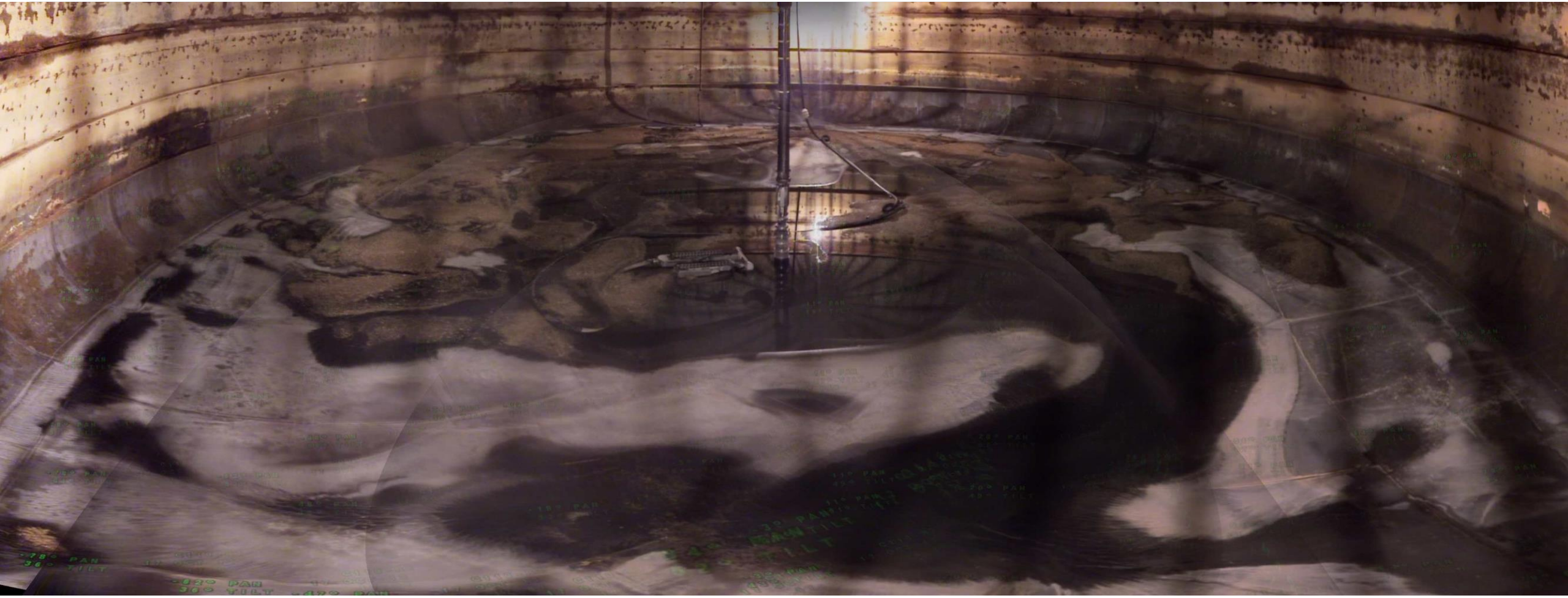
96% retrieval efficiency



67,000 gallons of waste remain

473,000 Curies of radioactivity remain

After tank waste retrieval



Tank C-110 – with the Foldtrak near the center

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Difficult waste retrieval

Tank C-102 – difficult sludge heel

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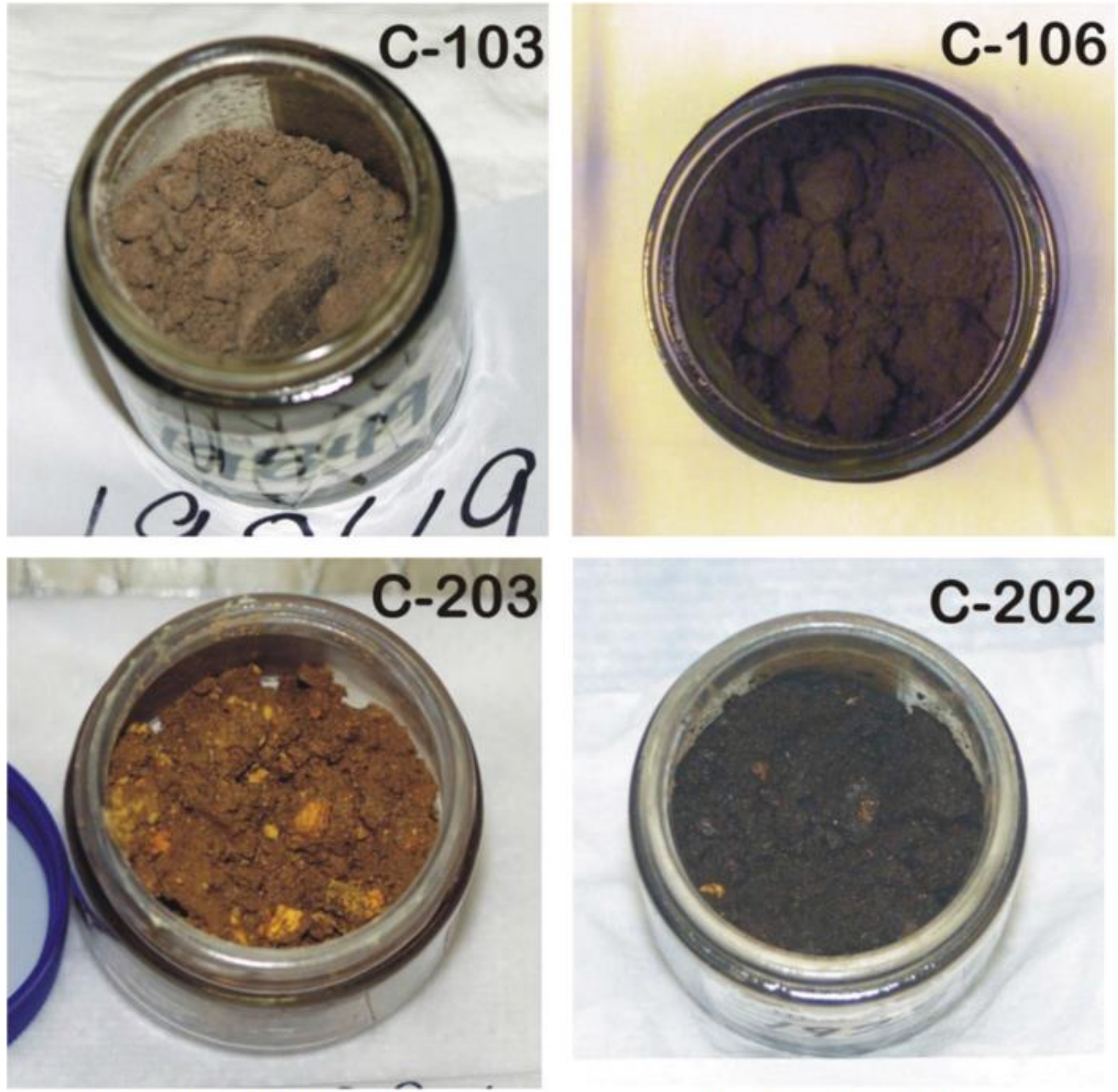
10:16PM
01May12
Pan:350
Tlt:095
C-109R3


10:39PM
25Jul12
Pan:216
Tlt:090
C-109R3


07:52PM
01May12
Pan:276
Tlt:102
C-109R3

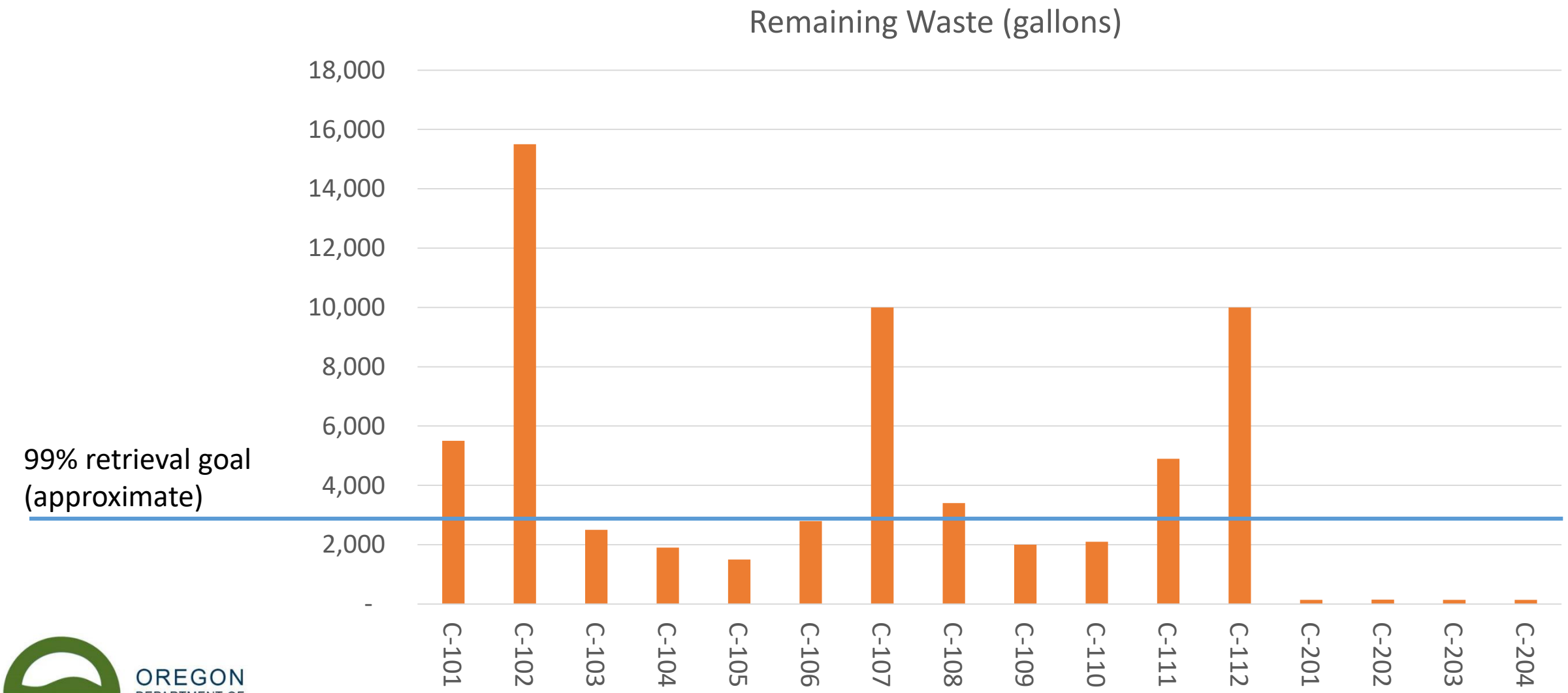

10:39PM
25Jul12
Pan:130
Tlt:105
C-109R3

Figure 5-1. Photographs of As-Received, Post-Final Retrieval Residual Waste Samples from Tanks 241-C-103, 241-C-106, 241-C-202, and 241-C-203.



Source: "Hanford tank residual waste – Contaminant source terms and release models" (Deutsch et al. 2011).

C-Farm Retrieval Efficiency



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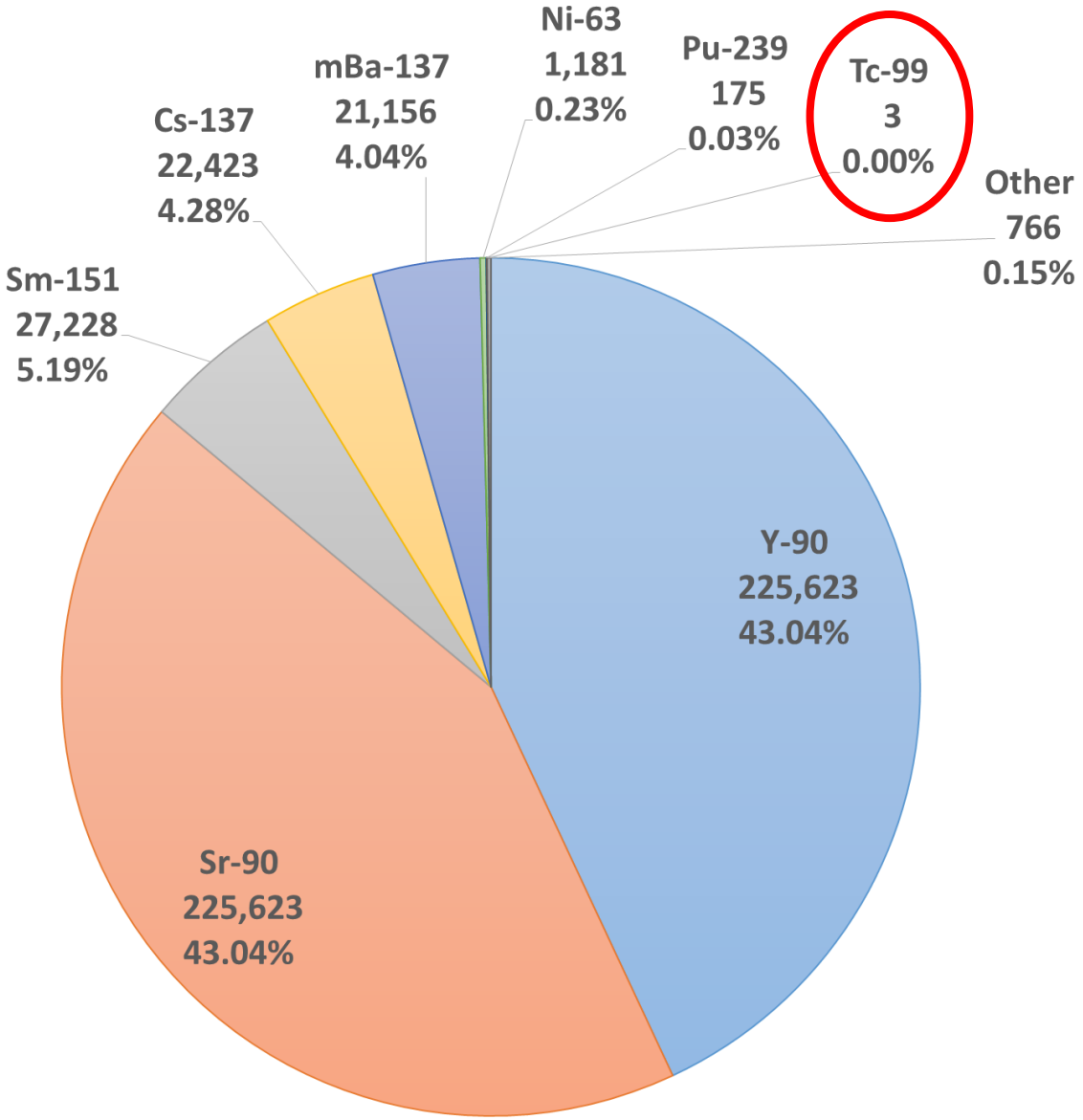
Residual Radionuclides in WMA-C Tanks



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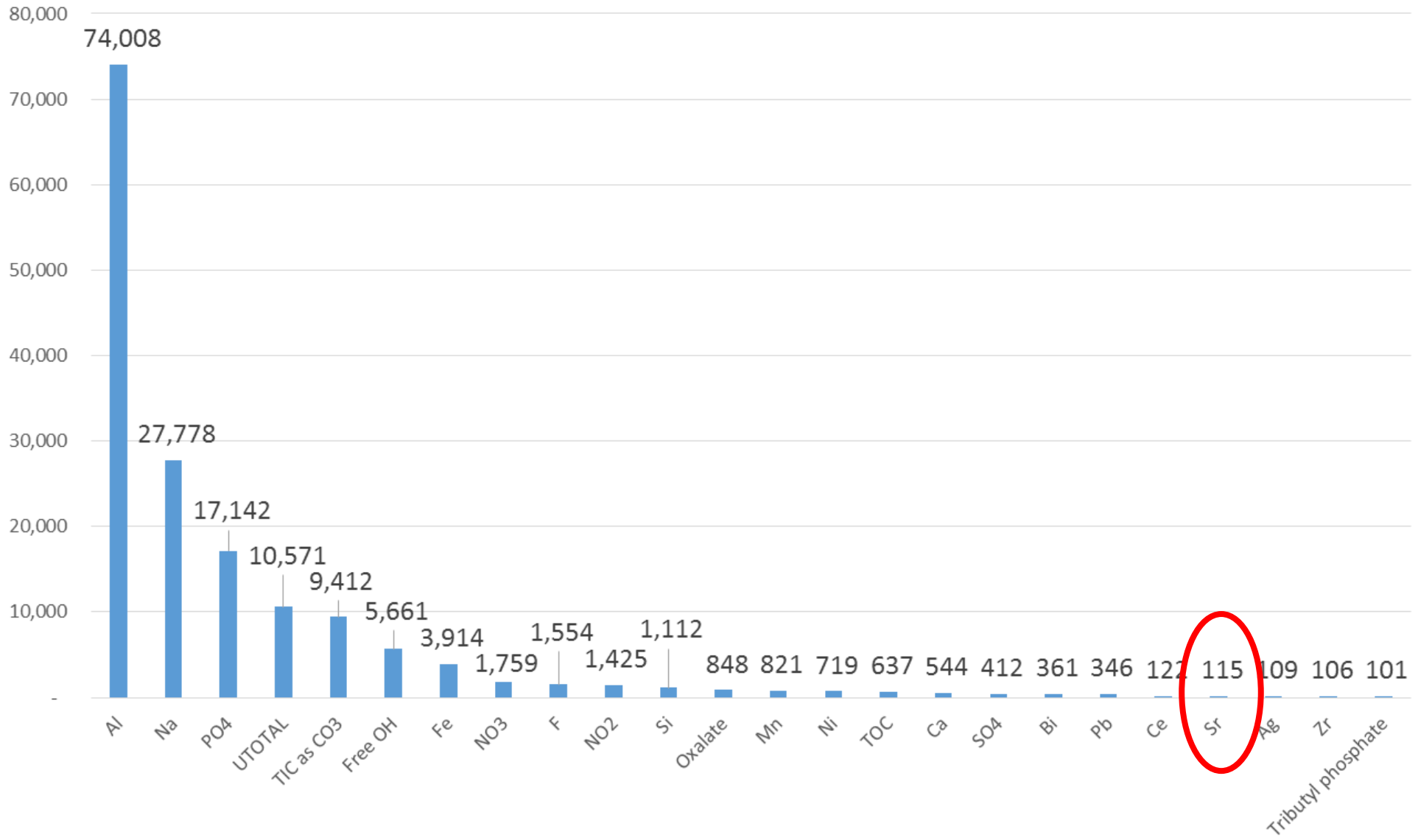
Curie values decayed as of 2015

Residual Constituents by Mass (kg)



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Decision 1:

High Level Radioactive Waste
or
Waste Incidental to Reprocessing (WIR)?

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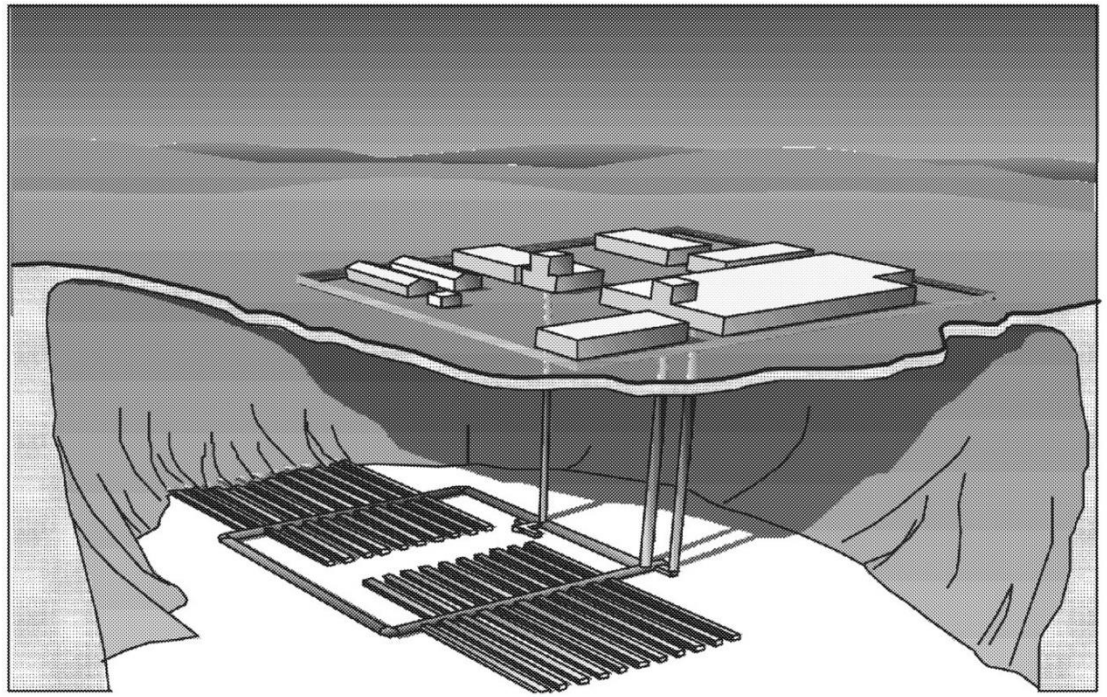
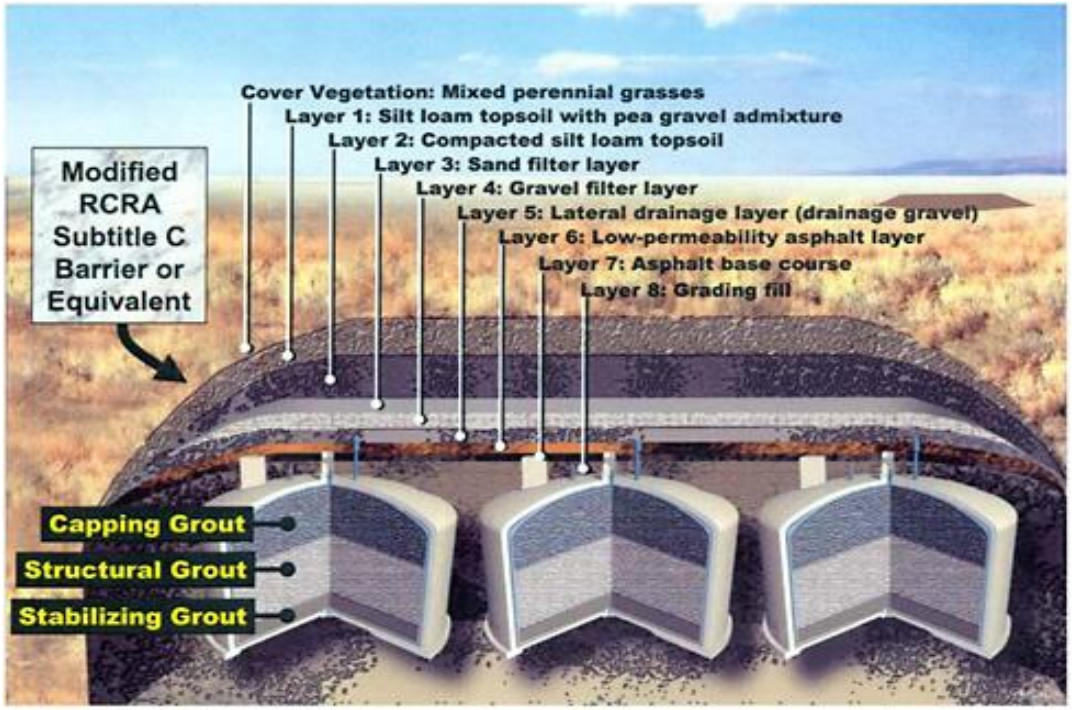
Decision 1: Can the waste left over in the C-Farm Tanks at Hanford be managed as "low-level waste"?



If it is high-level, it must be disposed in a Deep Geologic Repository for high-level radioactive waste, which does not yet exist in the United States.



If it is low-level, the tanks and residual waste heels can be closed in place forever at Hanford, assuming long-term safety can be "reasonably expected."

Definition of High Level Waste

Nuclear Waste Policy Act of 1982:

The term "high-level radioactive waste" means—

- (A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

- (B) other highly radioactive material that the (Nuclear Regulatory) Commission, consistent with existing law, determines by rule requires permanent isolation.

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From origin-based to risk-based

Retrieved sample from a WMA-C tank

Is this high-level waste?

Does it result from reprocessing spent nuclear fuel?

Yes

Then it is high-level waste.

Unless . . .

Can it meet criteria, developed by DOE and NRC, to demonstrate that it would not pose an unacceptable risk if managed as low-level or Transuranic waste?

No

Then it's still High-Level Waste.

Yes

Then it is **Waste Incidental to Reprocessing** and does not require deep geologic disposal.

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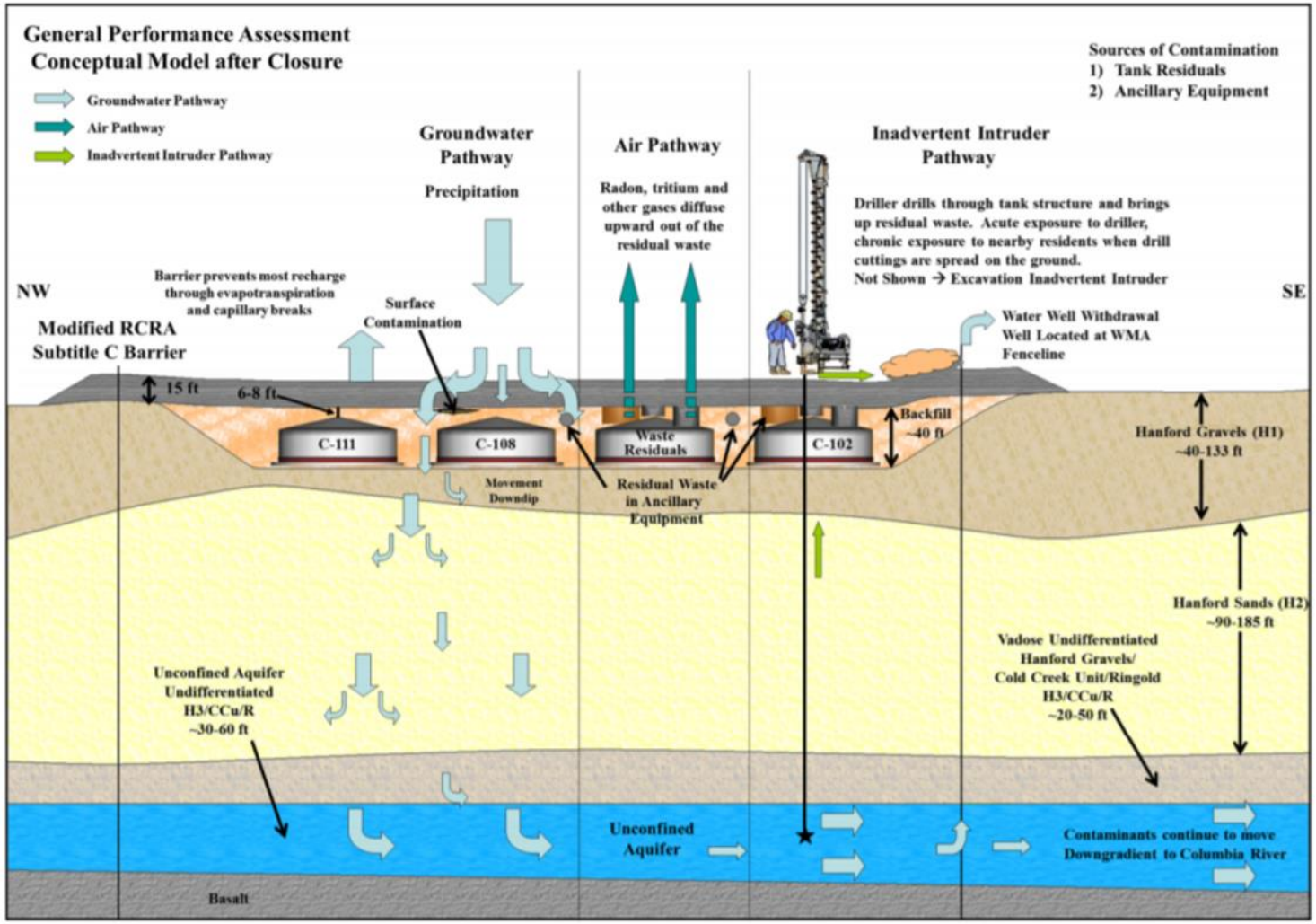
Future Exposure Scenarios in the C-Farm Performance Assessment

- Evaluates a future residential user, living 100 meters away, who grows crops, keeps livestock, and drinks groundwater.
- Evaluates an intruder after 100 years who lives onsite and drills a groundwater well through a buried pipeline.
- Model extends to 10,000 years.
- Assumes cap fails after 500 years.



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- C Tank Farm closure modeling shows maximum of 30 pCi/L in downgradient water wells, 1,500 years from now
  - Drinking water standard = 900 pCi/L
- Maximum dose to a future resident estimated at 0.1 millirem/year*
  - DOE standard = 25 mrem/yr
  - Background radiation =
    - ~90 mrem/yr (Hanford area)
    - ~350 mrem/yr (US average)
- Oregon: Uncertainty in the modeling

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Figure 7-24. Extent of Technetium-99 Plume in Groundwater 1,570 Years after Closure at the Time of the Maximum Concentration at the Point of Compliance.

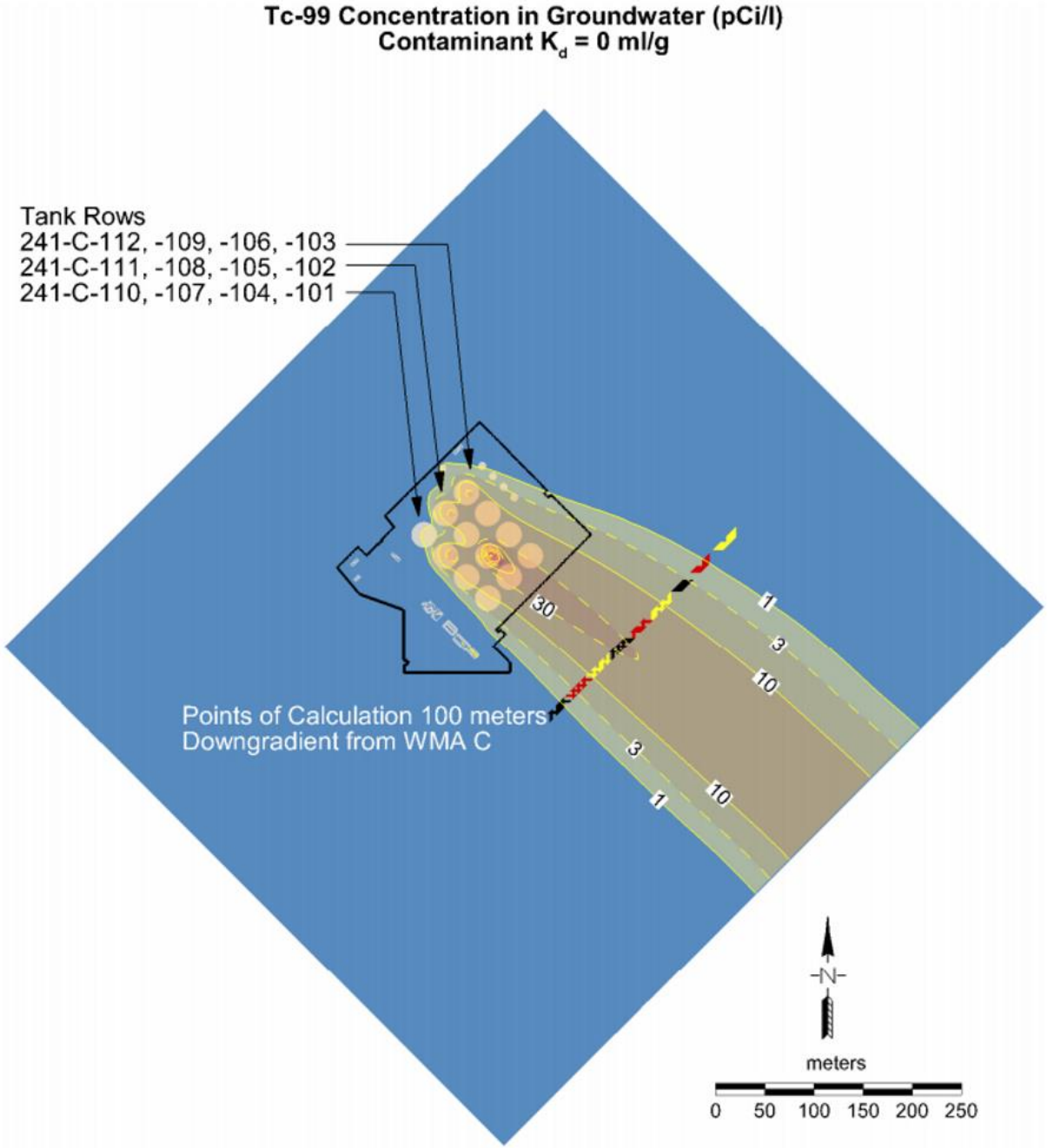
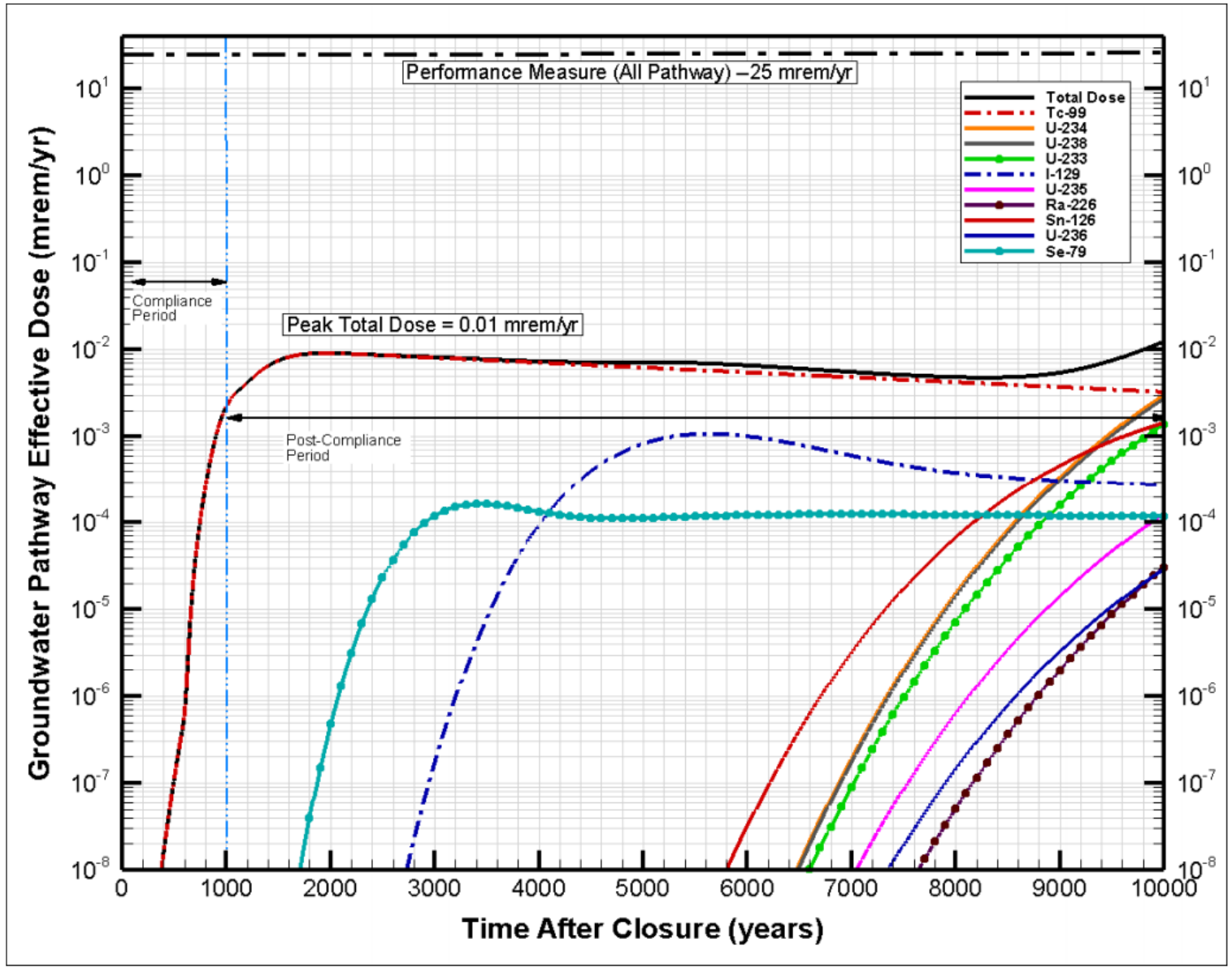
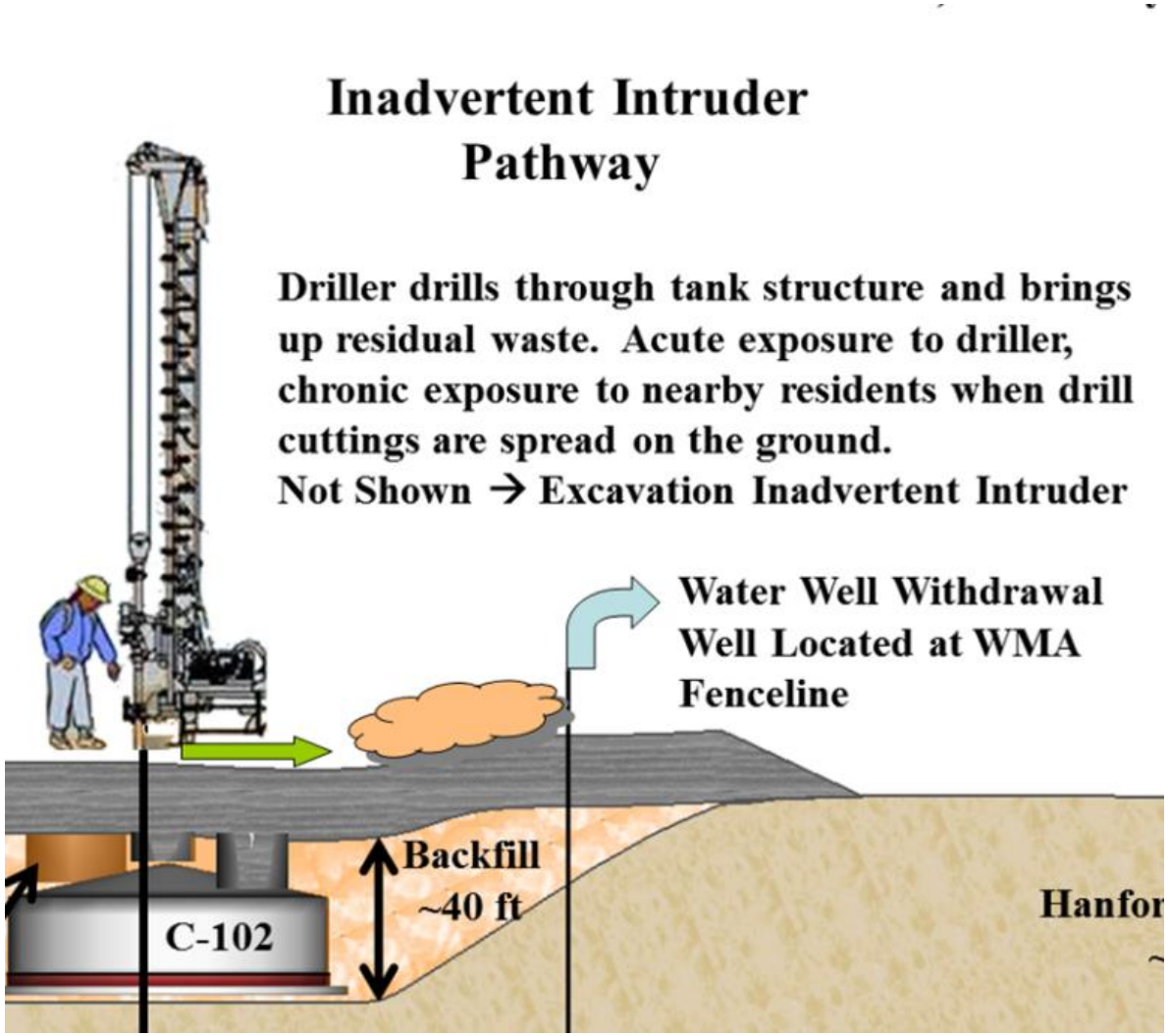


Figure 7-5. Groundwater Pathway Dose for the Special Analysis Using the System Model.



- Inadvertent Intruder modeling shows a maximum acute dose to a well driller = 36 millirem
  - Standard = 500 mrem
- Maximum chronic dose to an agricultural receptor spreading drill cuttings on crop land = 8.2 mrem/year
  - Standard = 100 mrem/year



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What sayeth the NRC?

- DOE has demonstrated the tanks and residuals are not HLW, EXCEPT:

> The NRC staff concludes the following for the plugged pipelines:
>
> - As a result of not having characterization data, the uncertainty in the inventory of plugged pipelines is too large. DOE has not demonstrated that it meets the above criteria for the plugged pipelines. The NRC recommends that DOE characterize the plugged pipelines to determine the concentration of radionuclides and the amount of free liquids that are present.

- NRC concurrence is also contingent upon:
  - **Design of the cap** to ensure erosion and human intrusion protection
  - **Final grout formulation** to "confirm that it will have no shrinkage, will not degrade significantly over the period of analyses, and verify that the grout will have the target [performance] for the field-scale materials."

These are important details . . .

United States Government Accountability Office

Report to Congressional Committees

January 2021

HANFORD CLEANUP

DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication

1. Obtain the assistance of an independent, third-party mediator to help reach agreement with Washington on a process for assessing the contaminated soil, and what role NRC should play in this process.
2. Develop a long-term plan for DOE's waste retrieval and tank closure mission at the Hanford site.
3. Assess DOE's efforts to involve stakeholders in the Hanford tank closure process to ensure that DOE engages them in the decision-making process, communicates with them throughout the process in a way that addresses their concerns regarding technical challenges, and provides them with transparent information about the science and rationale behind decisions.

Decision 2:

Clean Closure
or
Landfill Closure?

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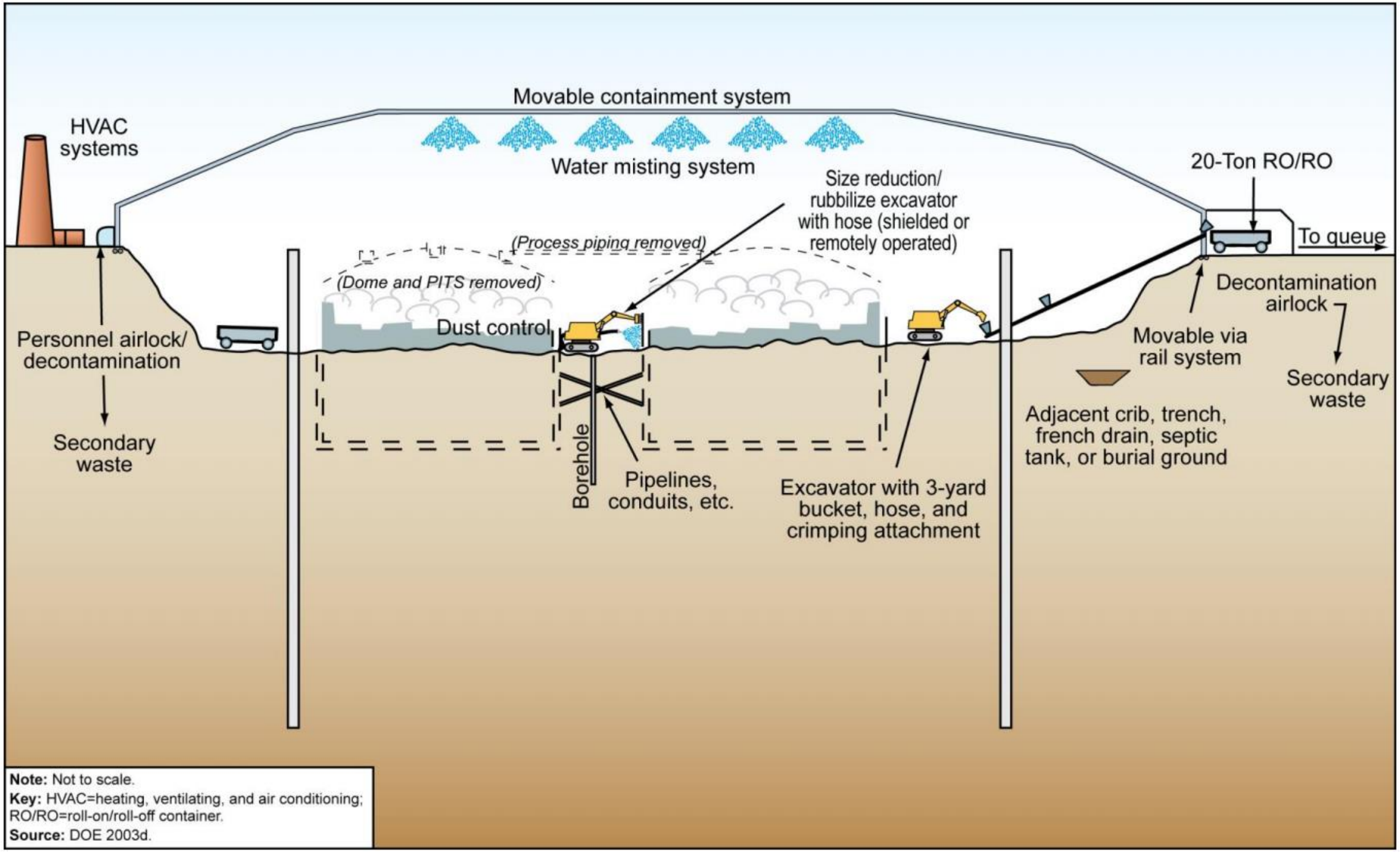
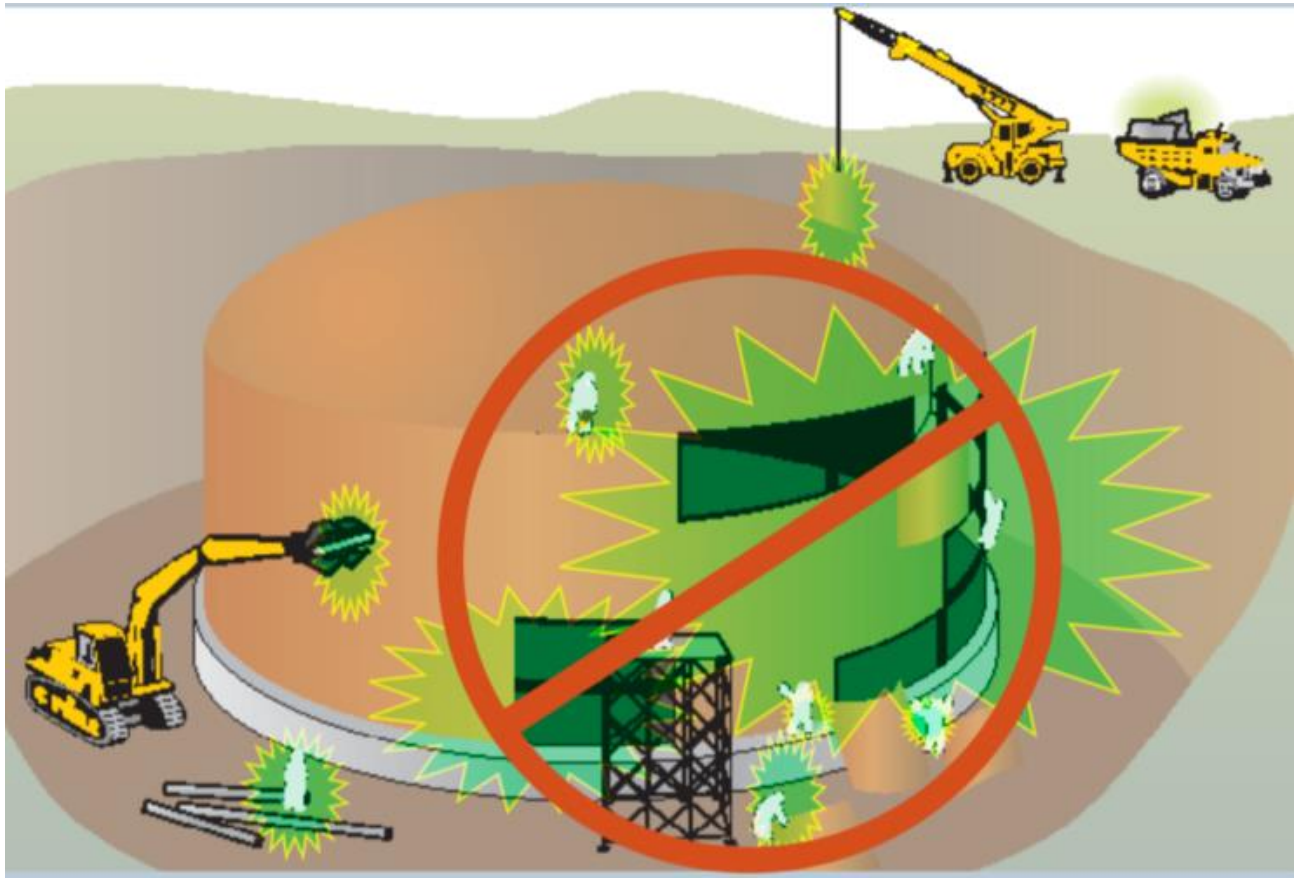


Figure E–26. Conceptual Drawing of Clean Closure Showing Domes and Pits Partially Removed

What If We Dig Up the Tanks?

- Estimated cost for excavating all SSTs: **~$37 Billion ($2.5B for C-farm only)**
  - Landfill closure = ~$18 billion for all SSTs
- Assumes 65 ft excavation minimum
- 5x higher worker latent cancer fatality
- 50% higher rate of industrial accidents resulting in illness, injury, or death.
- ~147,000 shielded storage boxes for disposal at a geological repository.
- ~60% more low-level waste and 5x more mixed low-level waste by volume than landfill closure.
- Significant technical uncertainty



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Source: SST Clean Closure Practicability Demonstration

Decision #?:

Leaks to Soil and Groundwater

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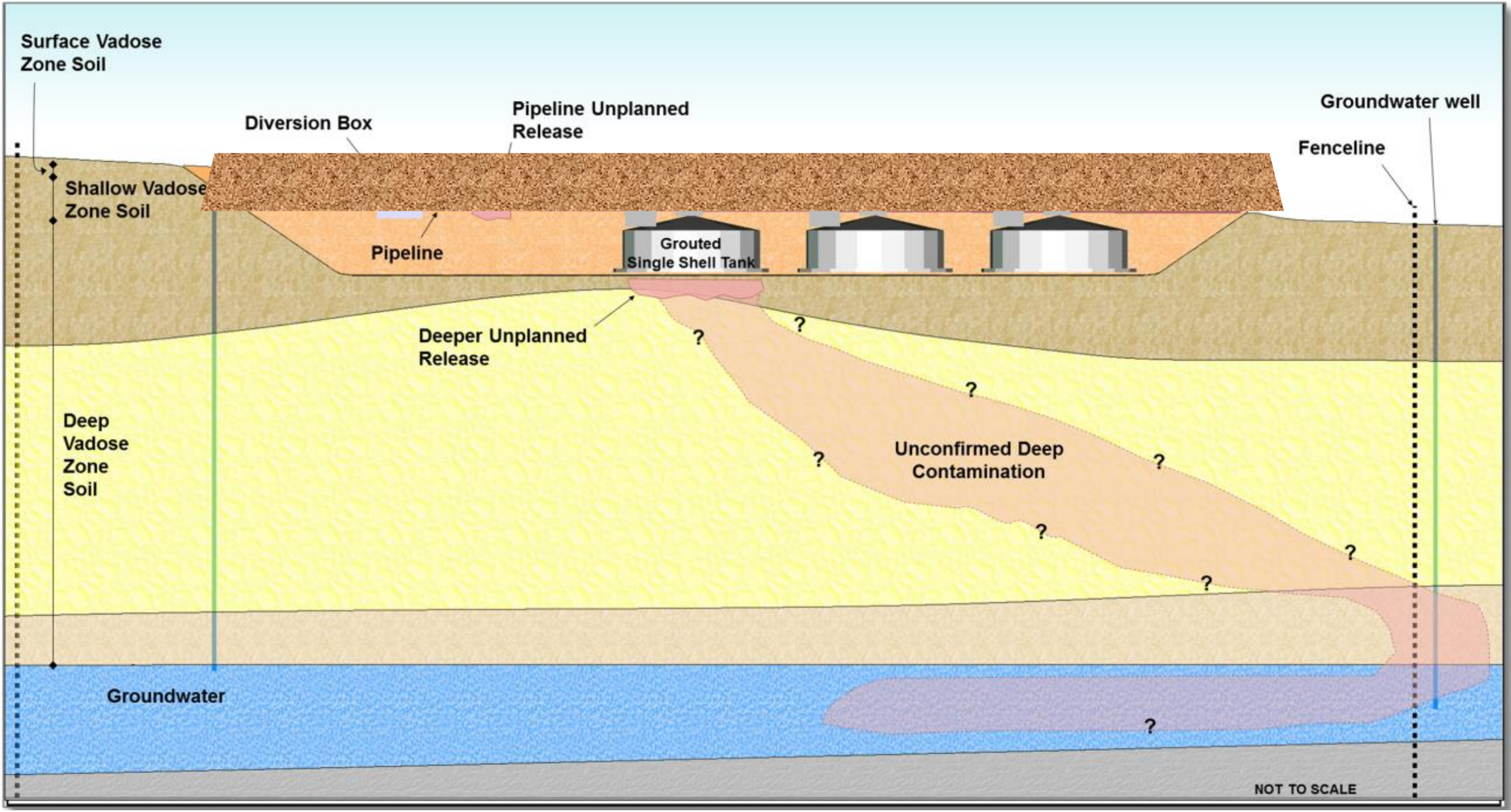
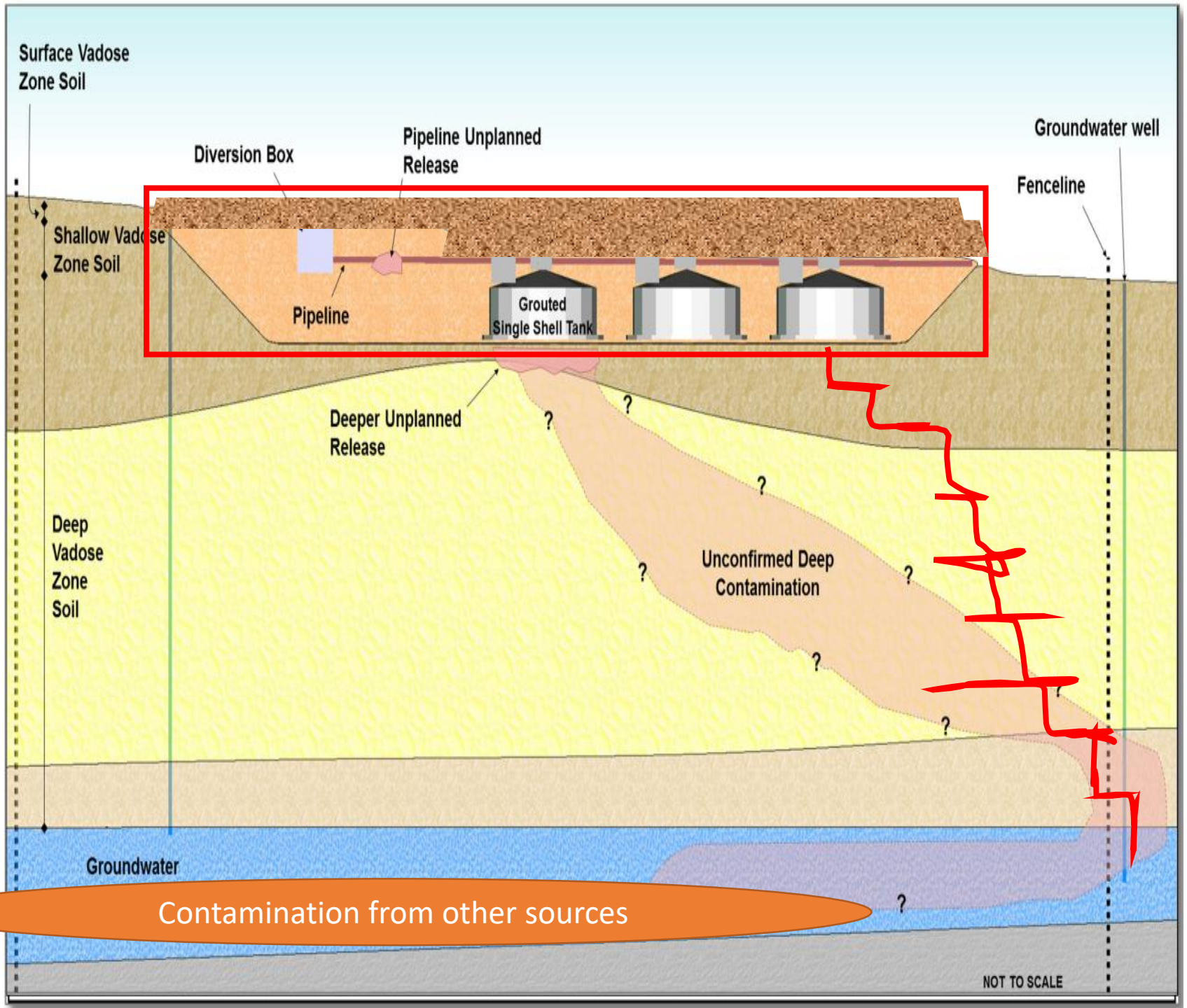

Surface Vadose Zone Soil
Diversion Box
Pipeline Unplanned Release
Groundwater well
Fenceline
Shallow Vadose Zone Soil
Pipeline
Grouted Single Shell Tank
Deeper Unplanned Release
Deep Vadose Zone Soil
Unconfirmed Deep Contamination
Groundwater
NOT TO SCALE



How do documents affect the ecosystem?

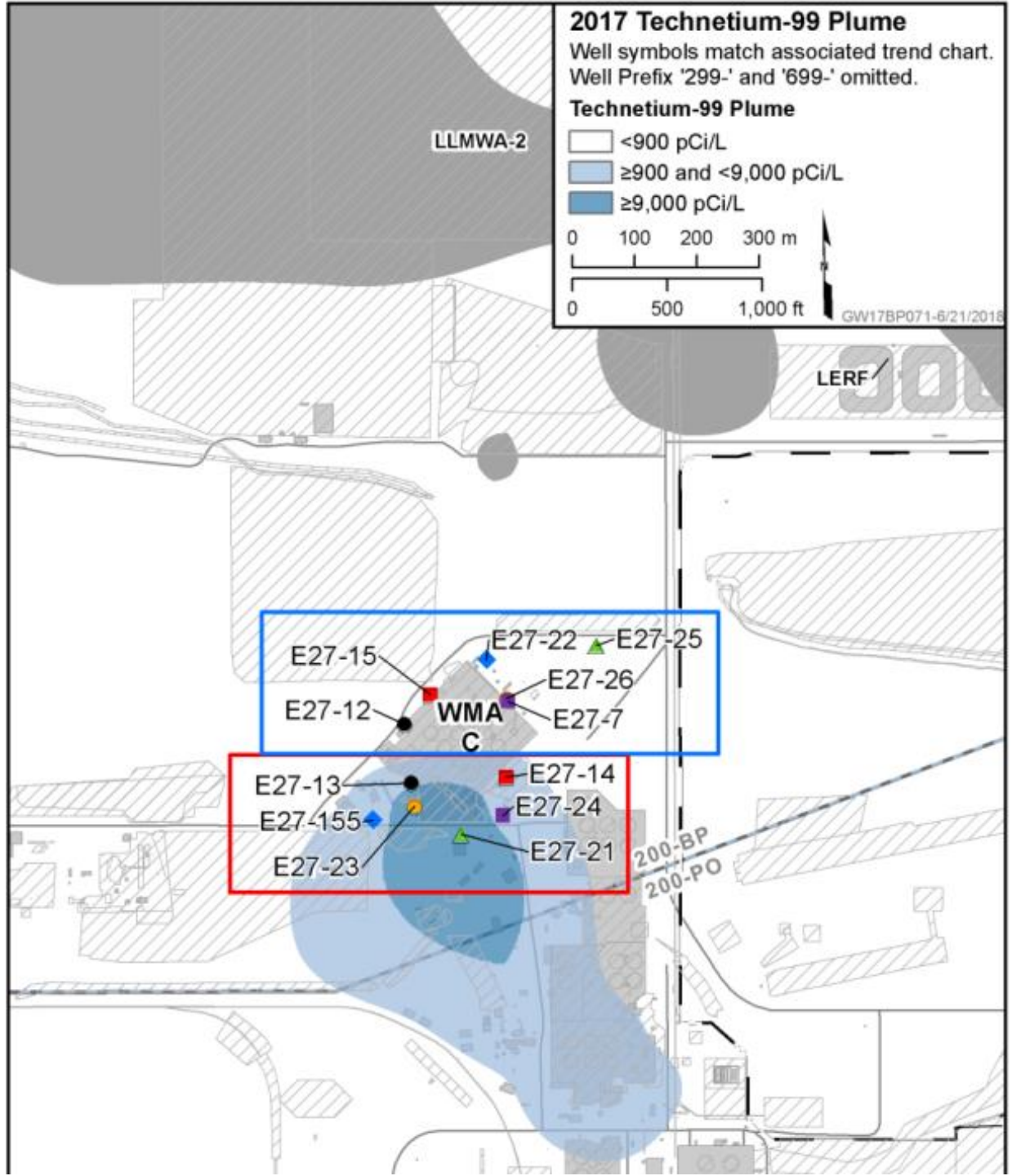
- Performance Assessment
- WIR Evaluation
- DOE Closure Plan
- RCRA Closure Plan

Soil remediation under RCRA and CERCLA

Groundwater remediation under CERCLA

Hanford TPA Appendix I Performance Assessment

Composite Analysis required for DOE Closure Plan



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Next Up:

RCRA Closure Plans

(Officially making C-Farm a mixed low-level waste landfill)

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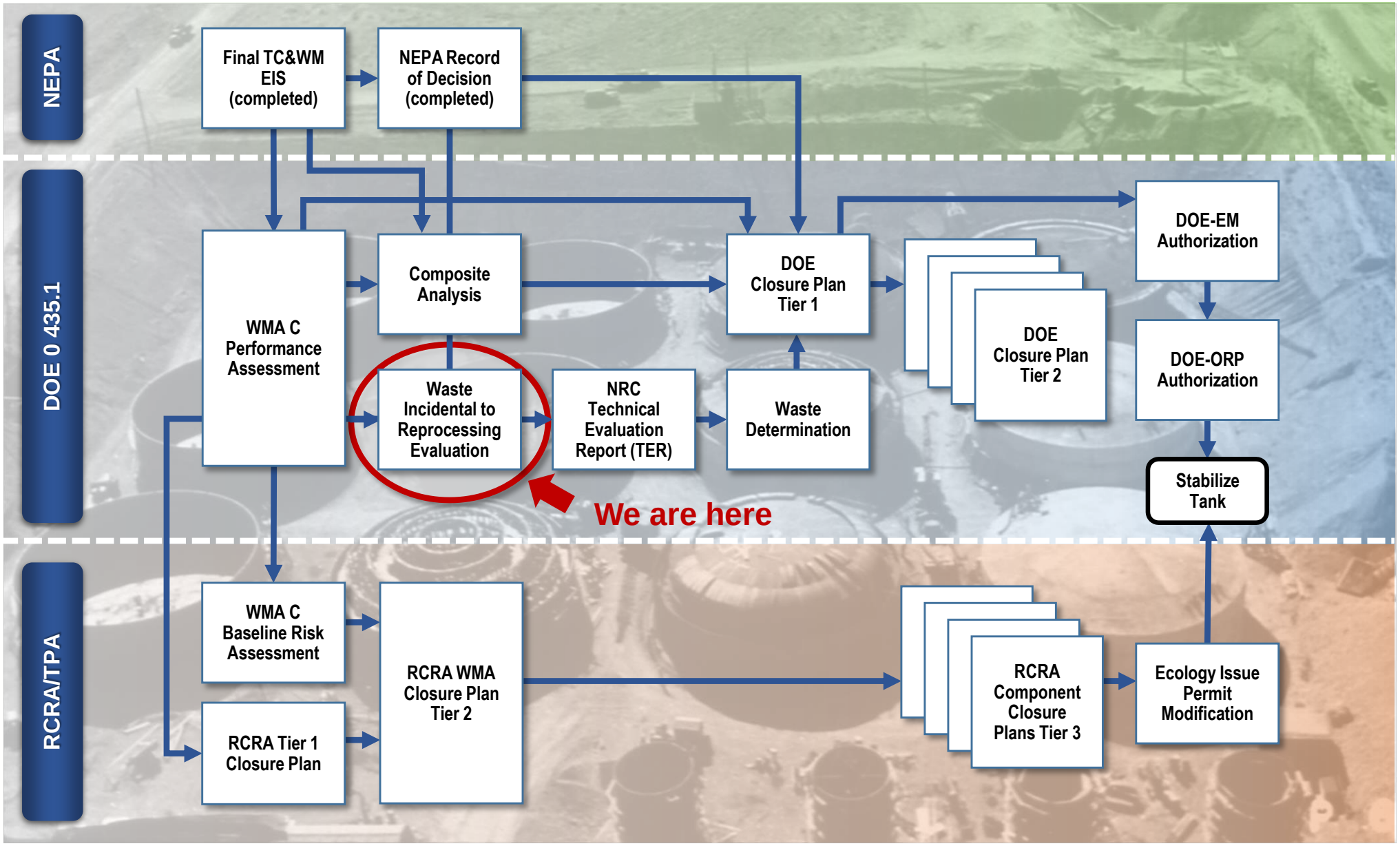
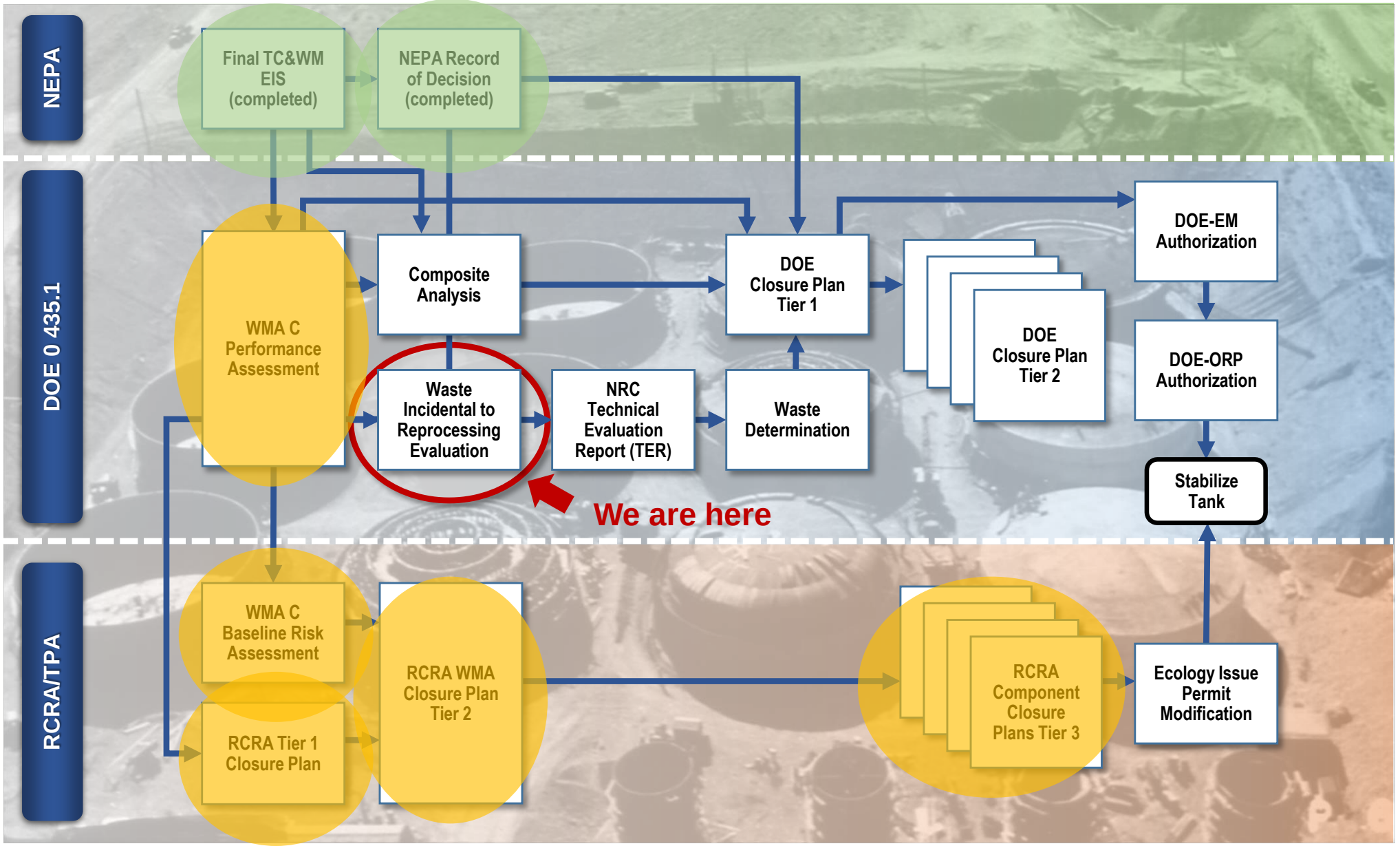
Regulatory Processes for Tank Closure



Regulatory Processes for Tank Closure



Complete

Under Review

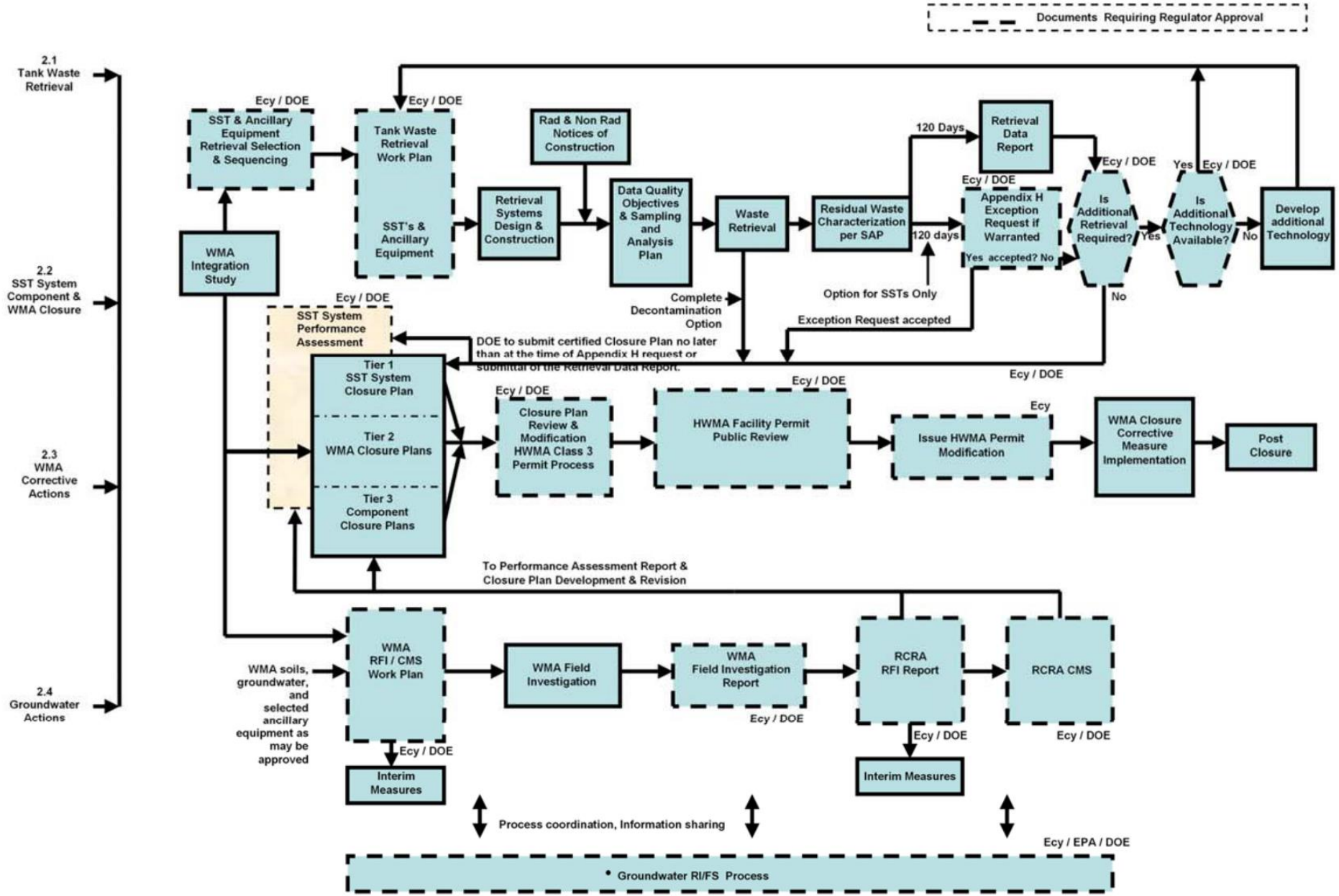


Figure I-1. Single-Shell Tank Waste Management Area Waste Retrieval and Closure Process

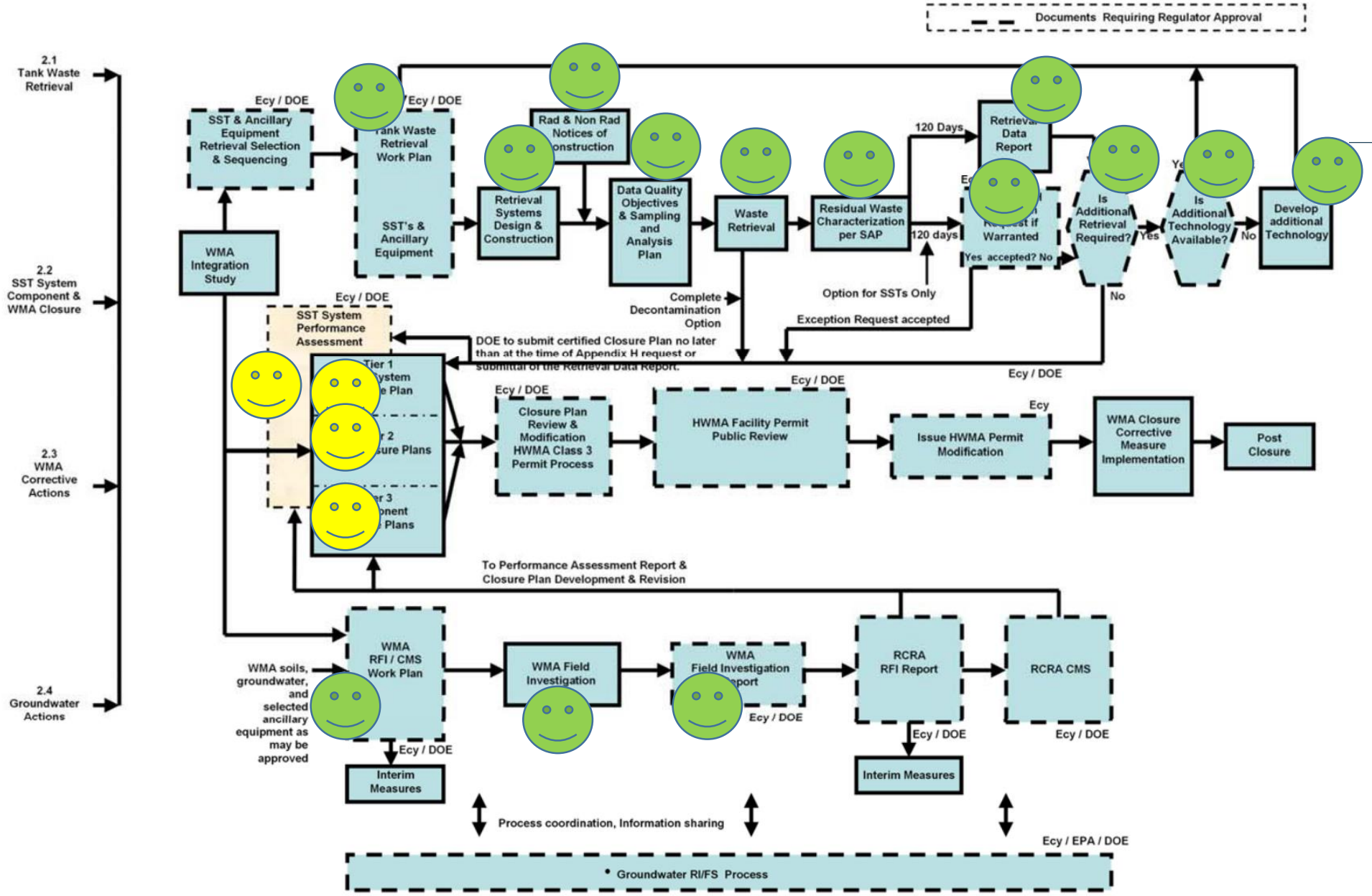


Figure I-1. Single-Shell Tank Waste Management Area Waste Retrieval and Closure Process

To Do:

- DOE and WA need to sort out the High-Level Waste classification debate (including DOE authority and NRC review results)
- Regulatory framework for the soil needs to be settled
- Cumulative Analysis (Composite Analysis and TPA Appendix I) still pending
- Finalize RCRA closure documents
- Finalize landfill closure design components