THE HANFORD SITE

Site Cleanup Overview

Introduction:

Brian Vance, Hanford Site Manager

April 26, 2022

THE HANFORD SITE

Agenda – Site Cleanup Overview

Site and History, Cleanup Progress	–	Elaine Porcaro, Chief Engineer, DOE Hanford Karthik Subramanian, Chief Engineer, WRPS
The Tanks and the Groundwater	–	Elaine Porcaro, Chief Engineer, DOE Hanford Naomi Jaschke, Soil and Groundwater Division Supervisor, DOE Hanford
Tank Integrity	–	Karthik Subramanian, Chief Engineer, WRPS Erik Nelson, Tank Integrity Lead, DOE Hanford
Treatment and System Planning	–	Todd Wagnon, Flowsheet Integration Manager, WRPS Richard Valle, Tank Farms Program Manager, DOE Hanford
Other Impacts of Treatment Options	–	Laura Cree, Flowsheet Definition and Analysis Manager, WRPS
Summary	–	Ricky Bang, Tank Farms Program Division Director, DOE Hanford

Hanford Site Location

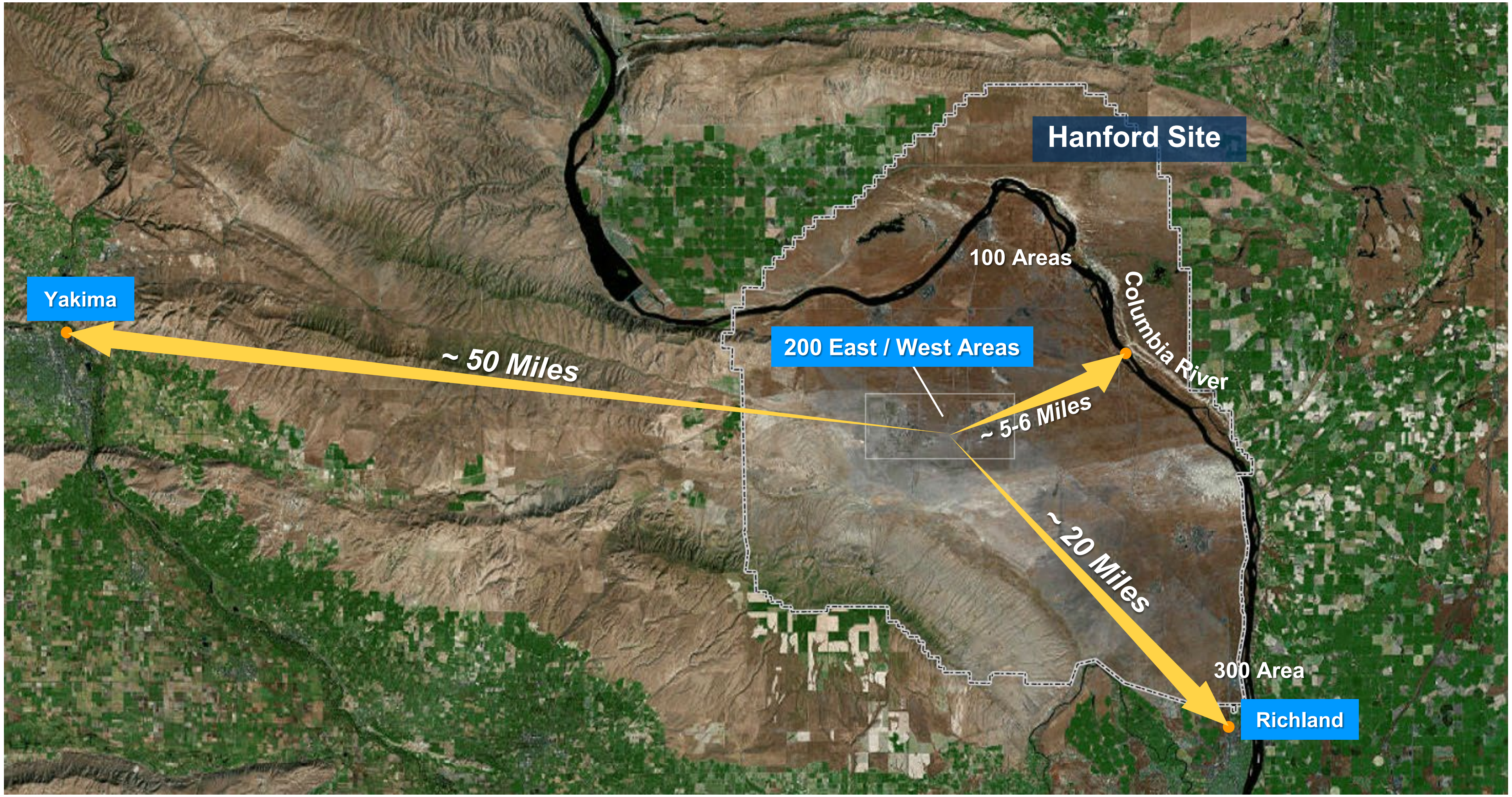


Photo of eastern Washington showing Hanford Site. The 580 square-mile Hanford Site is high desert / shrub steppe. The average annual precipitation is 7.1 inches. The Columbia River discharge below Priest Rapids Dam is 78,000 - 101,000 cubic feet per second (per USGS 25th-75th percentile data). The aquifer is 250-350 feet below ground in the central plateau

What is Hanford?

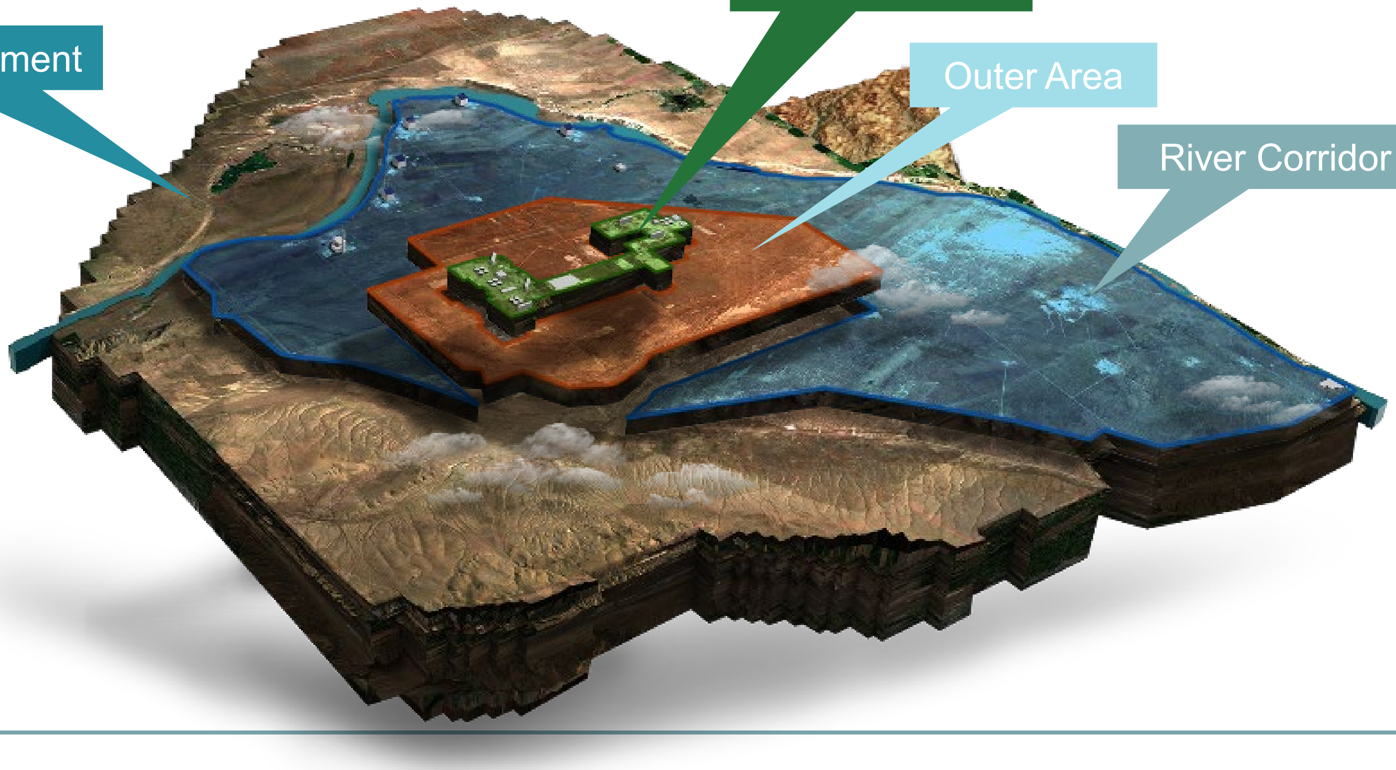
THE HANFORD SITE

History

- One of the sites selected for the Manhattan Project during World War II
- Produced plutonium from 1943 to 1989

Today and since 1989…

- Largest nuclear cleanup project in the country



U.S. DEPARTMENT OF ENERGY

ONE HANFORD

Hanford Timeline

1940s
Building Hanford

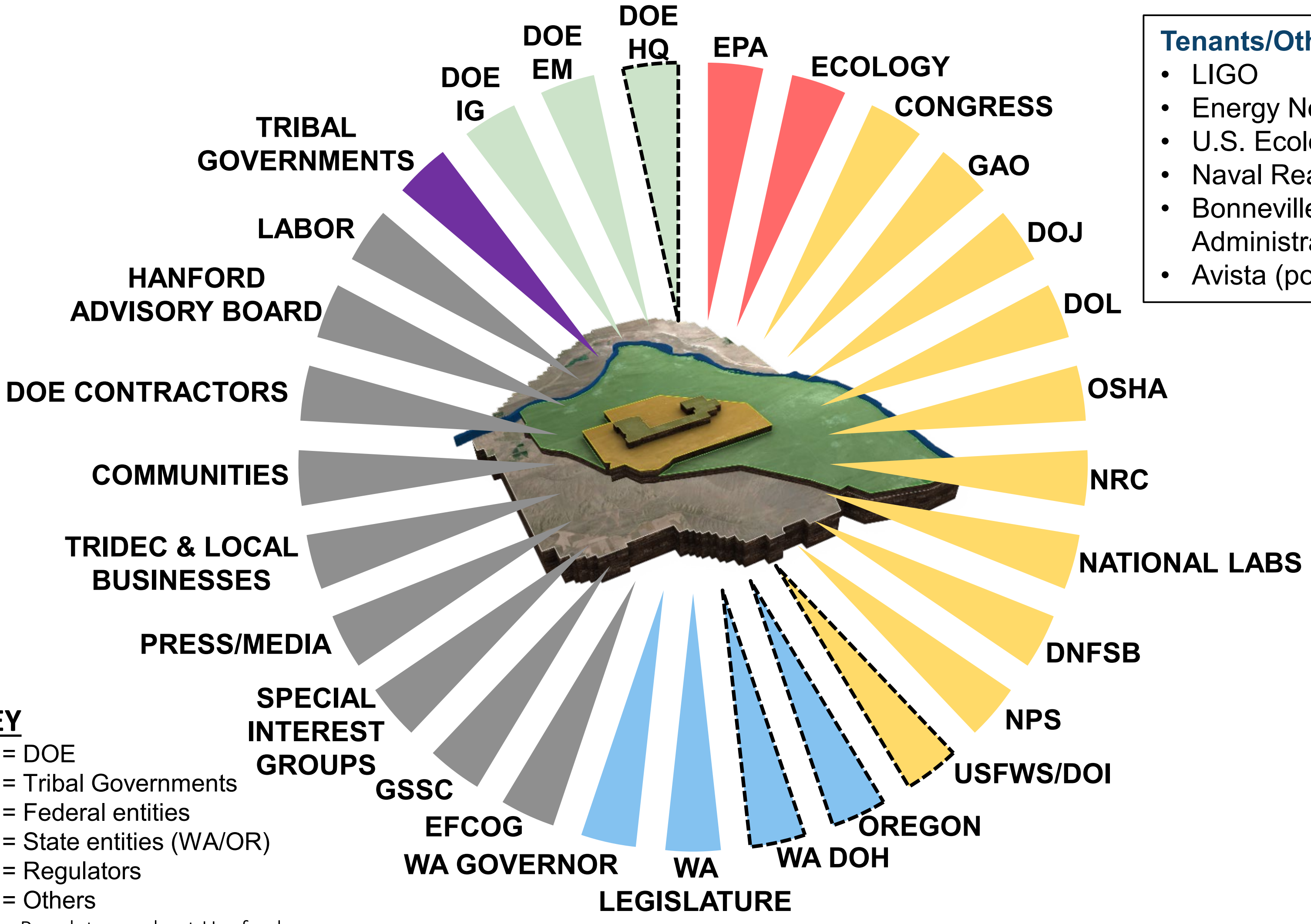
1944 – 1989
Plutonium Production

1990s – 2000s
Cleaning up near the Columbia River

Present
Shifting focus to the Central Plateau

Future Timeline
NAS/FFRDC Reports Will Help Inform Decisions

Engagement Arena



Tenants/Others:
- LIGO
- Energy Northwest
- U.S. Ecology
- Naval Reactors
- Bonneville Power Administration
- Avista (power lines)

KEY
- = DOE
- = Tribal Governments
- = Federal entities
- = State entities (WA/OR)
- = Regulators
- = Others
- = Regulatory role at Hanford

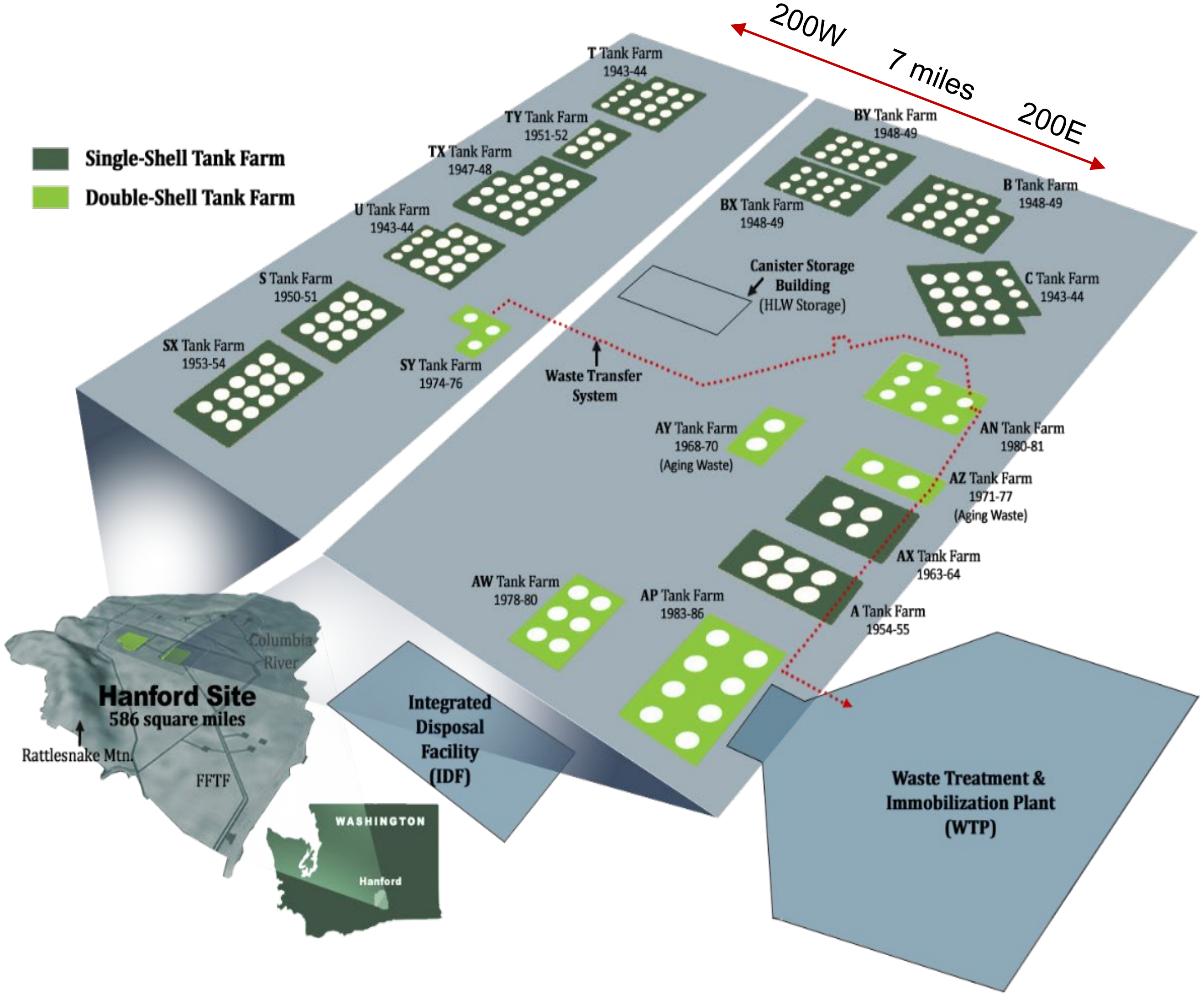
Cleanup Progress Since 1989

Hanford Cleanup by the Numbers…

Tank Farms

Single-shell tanks
- 149 built
- 18 retrieved
- 2 in retrieval/approval

Double-shell tanks
- 28 built
- 1 retrieved



Waste in the Tanks

56 million Gallons of Waste

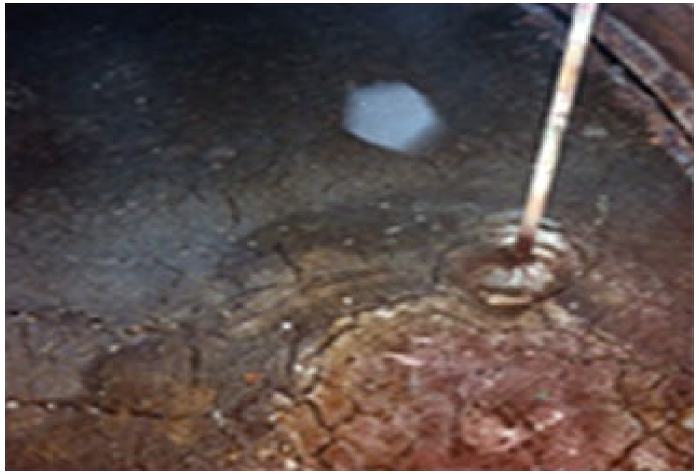
Saltcake
23M gallons

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

Agenda – Site Cleanup Overview

Site and History, Cleanup Progress	–	Elaine Porcaro, Chief Engineer, DOE Hanford Karthik Subramanian, Chief Engineer, WRPS
The Tanks and the Groundwater	**–**	**Elaine Porcaro, Chief Engineer, DOE Hanford** **Naomi Jaschke, Soil and Groundwater Division Supervisor, DOE Hanford**
Tank Integrity	–	Karthik Subramanian, Chief Engineer, WRPS Erik Nelson, Tank Integrity Lead, DOE Hanford
Treatment and System Planning	–	Todd Wagnon, Flowsheet Integration Manager, WRPS Richard Valle, Tank Farms Program Manager, DOE Hanford
Other Impacts of Treatment Options	–	Laura Cree, Flowsheet Definition and Analysis Manager, WRPS
Summary	–	Ricky Bang, Tank Farms Program Division Director, DOE Hanford

The Tanks and the Groundwater

- Past environmental releases of tank waste
  - Cascaded waste released to the soil column in past
  - Past tank and infrastructure leaks to the soil column
  - Waste remaining in the tanks

- Defense-in-depth actions to protect the environment
  - Interim stabilization
  - Infiltration controls
  - Interim barrier installation
  - Pump and treat groundwater remediation
  - Tank Integrity Program
  - Tank waste retrieval, treatment, and stabilization

The Tanks and the Groundwater (cont.)

~ 525 M gal

Tank Waste Generated (1944-1988 Production)

Past Practice: Disposed to Ground after radionuclide Scavenging or cascading 105 M gal[a]

510 Ci Tc-99[a]

Leaked to Ground ~1.4 M gal[b]

155 Ci Tc-99[c]

Reprocessed 50 M gal

Evaporated ~310 M gal

~56 M gal Remaining in Tanks

25,255 Ci Tc-99[d,e] (10,400 Ci Tc-99[d] in SSTs)

- Over 97 percent of the long-lived radionuclide Tc-99 in the waste created during production is still in the tanks
- Due to interim stabilization, 59 percent of tank farm's Tc-99 is in the DSTs

[a] ECF-HANFORD-17-0079, 2018, *Hanford Soil Inventory Model (SIM-v2), Calculated Inventory of Direct Liquid*, Rev. 0, CH2M HILL Hanford Group Inc., Richland, Washington. From 200-BC-1 and 200-DV-1 waste sites that received tank waste after radionuclide scavenging or cascading.

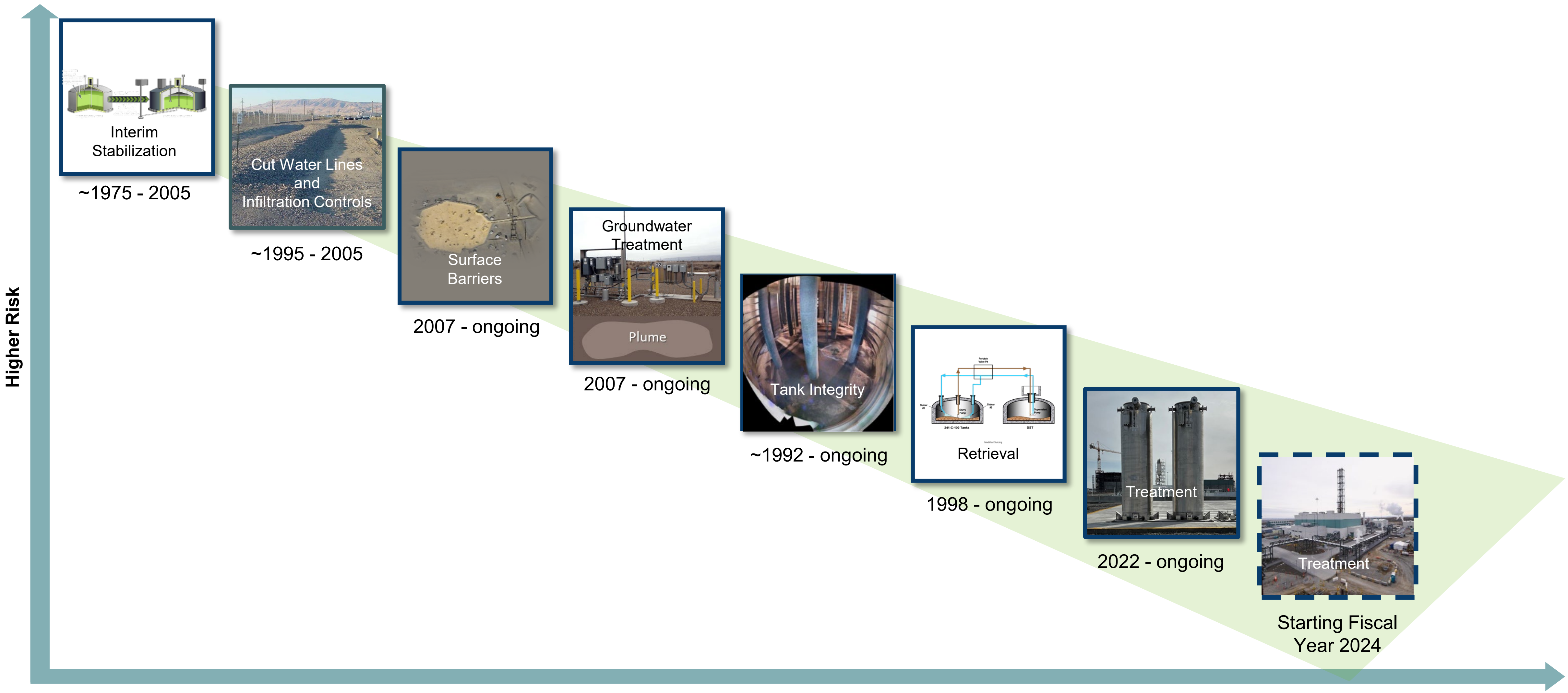
[b] RPP-RPT-61279, 2019, *Single-Shell Tank Farm Leak Inventory Assessments Summary*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

[c] ECF-HANFORD-17-0079, 2018, *Hanford Soil Inventory Model (SIM-v2), Calculated Inventory of Direct Liquid*, Rev. 0, CH2M HILL Hanford Group Inc., Richland, Washington. Includes transfer system releases within WMA boundaries.

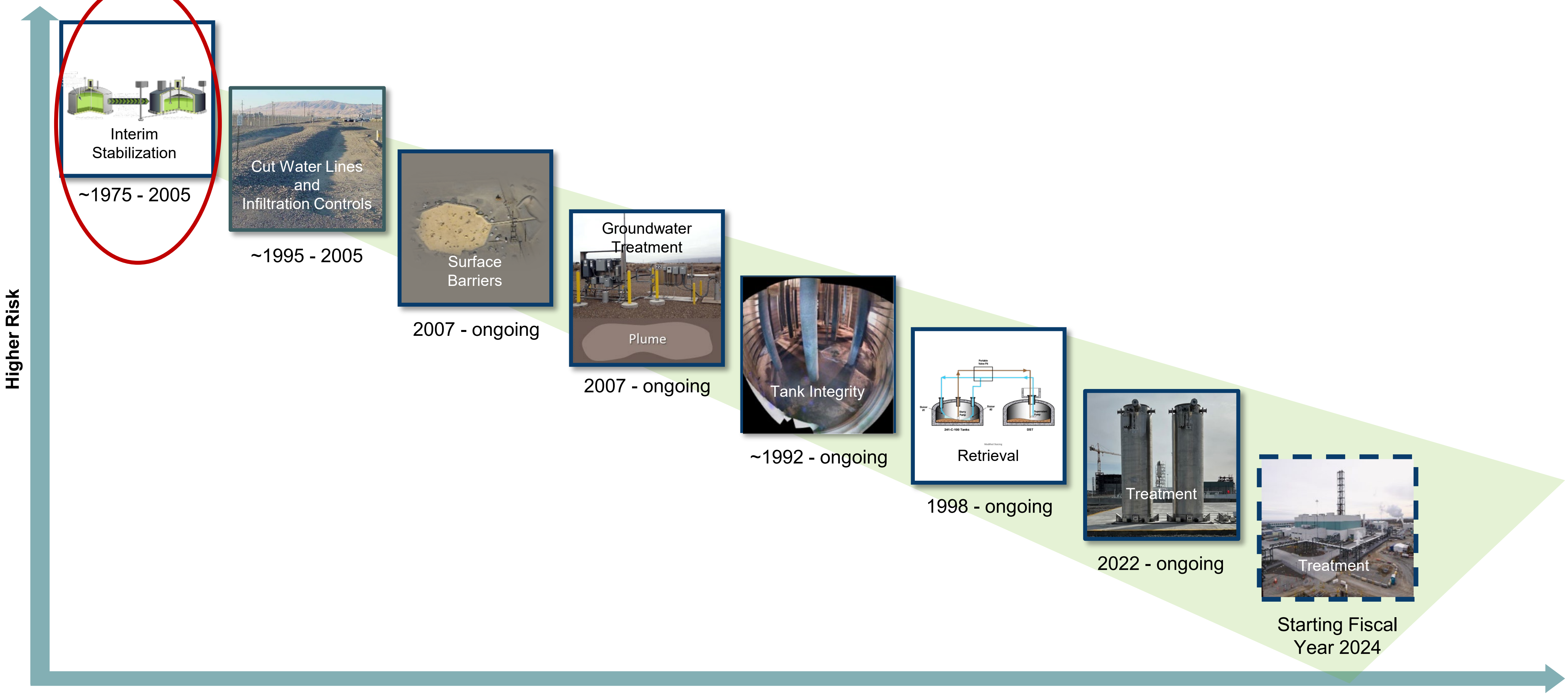
[d] Best Basis Inventory (BBI), is used by the Hanford Site to estimate the chemical and radionuclide constituents within the waste. It is based on tank sampling events as well as the Hanford Defined Waste (HDW) model. The BBI is updated quarterly to capture new sampling events, waste transfers, evaporation, water or chemical additions. HDW model reference: RPP-19822, 2004, *Hanford Defined Waste Model, Revision 5.0*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

[e] I-129 is also considered an environmental risk to groundwater, but Tc-99 is commonly used as a leading indicator because there are only approximately 18 Ci of I-129 in Hanford tanks.

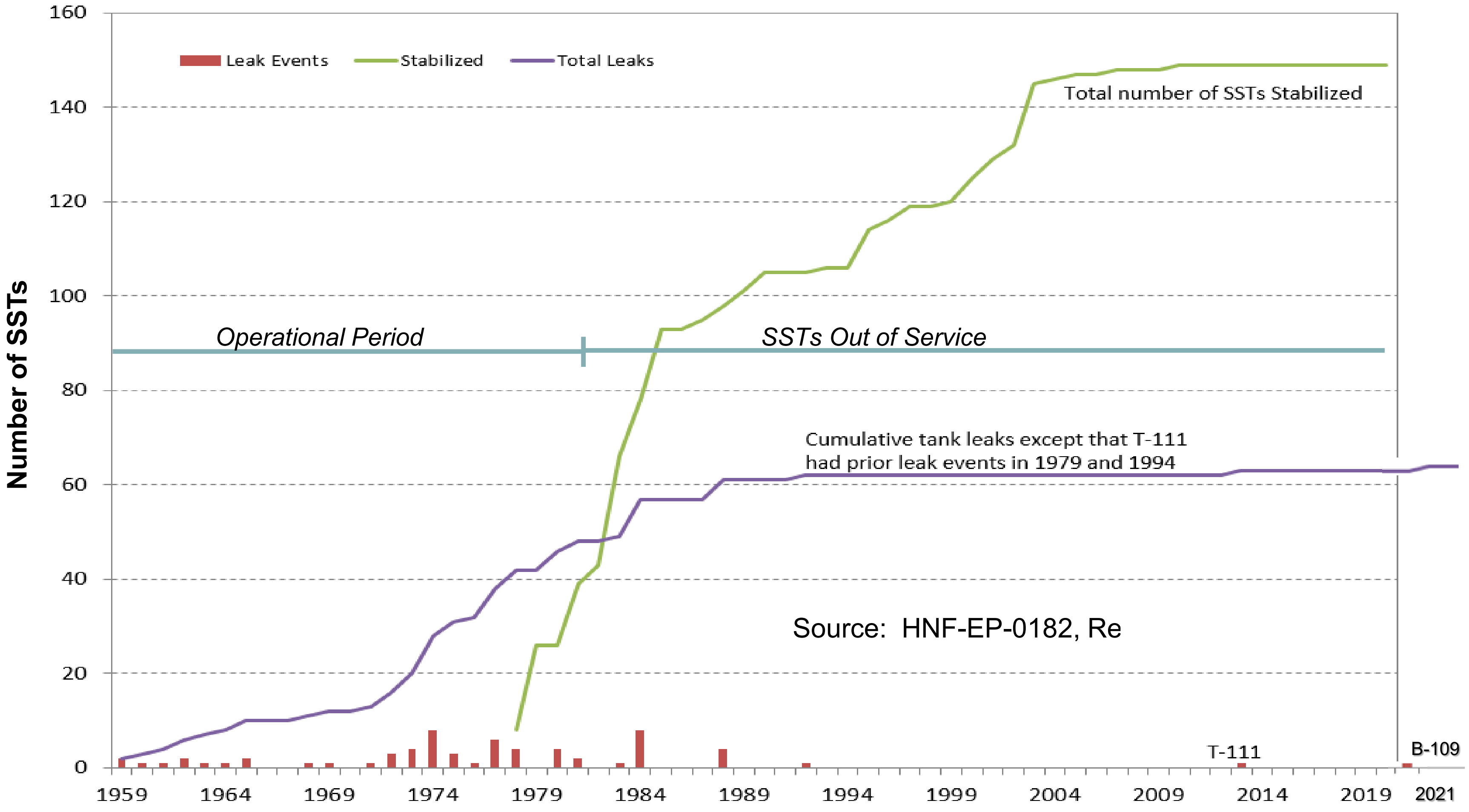
Groundwater Risk Reduction Steps



Groundwater Risk Reduction Steps

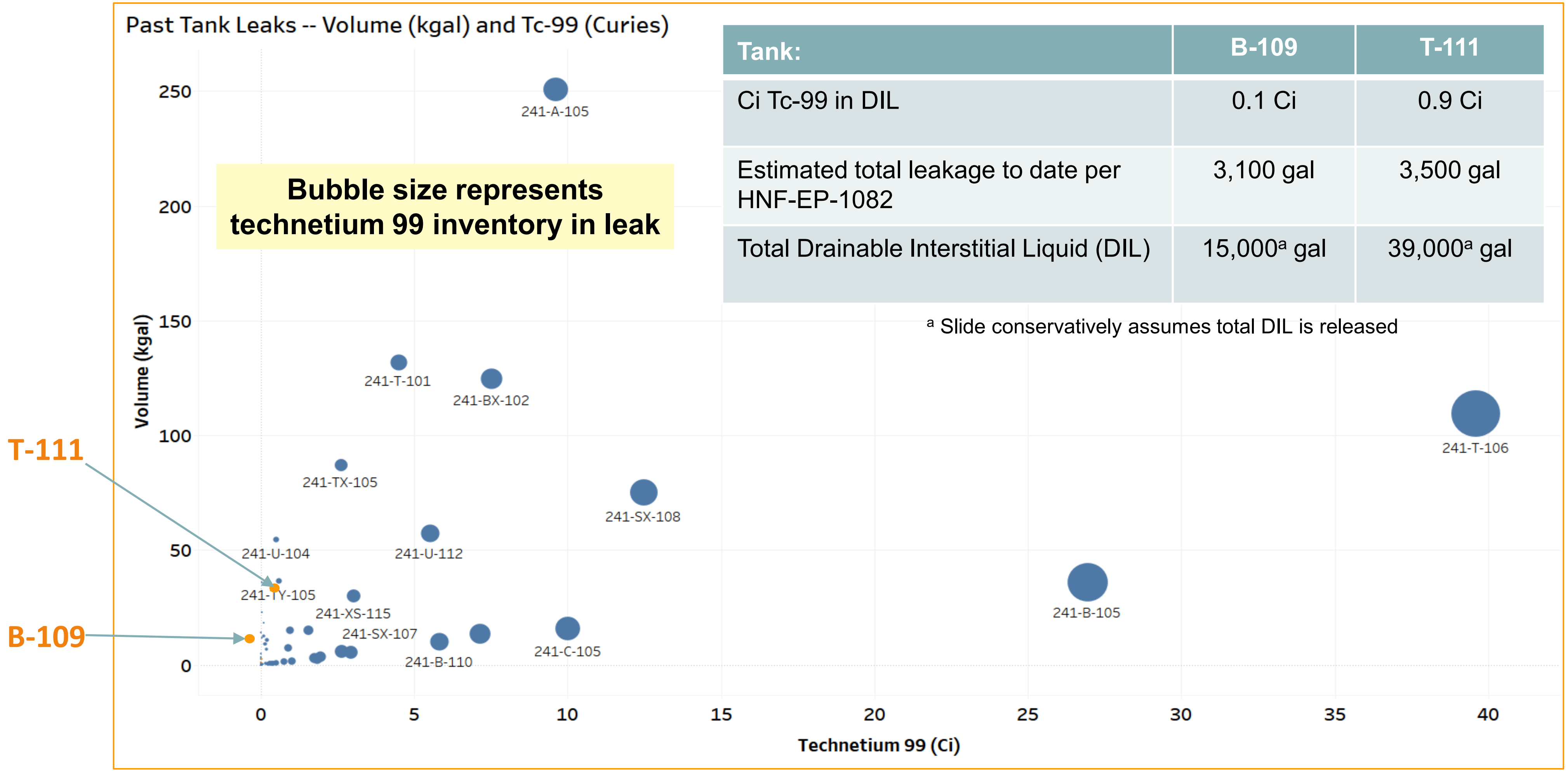


Single-Shell Tank Leak and Stabilization History



Historical SST Leak Events and Interim Stabilization History

Past Tank Leak Events

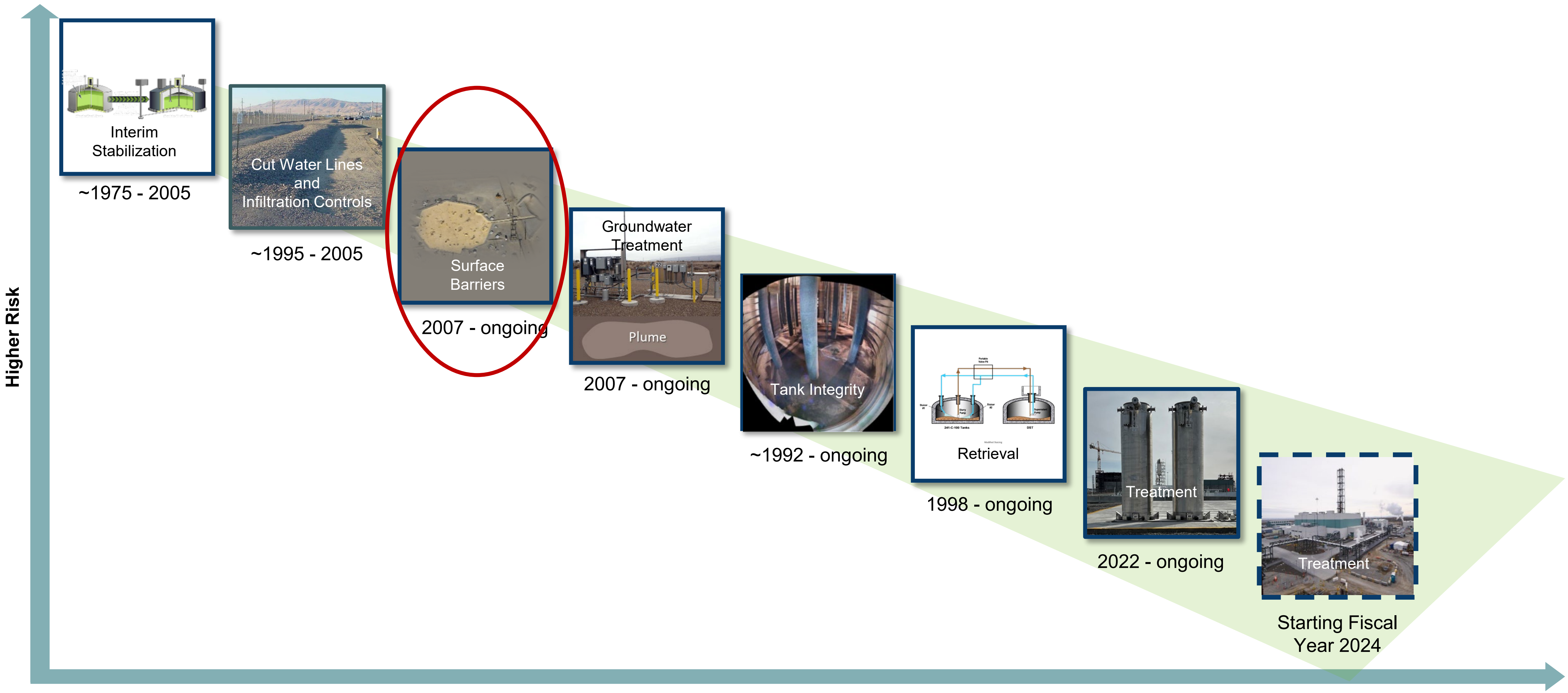


Tank:	B-109	T-111
Ci Tc-99 in DIL	0.1 Ci	0.9 Ci
Estimated total leakage to date per HNF-EP-1082	3,100 gal	3,500 gal
Total Drainable Interstitial Liquid (DIL)	15,000[a] gal	39,000[a] gal

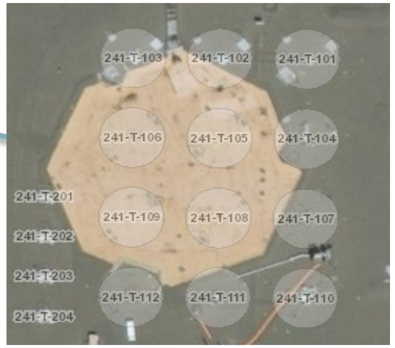
[a] Slide conservatively assumes total DIL is released

Inventory Tc-99 (Ci) and Volume (kgal) T-111 and B-109 Estimated Leaks Shown in Context

Groundwater Risk Reduction Steps



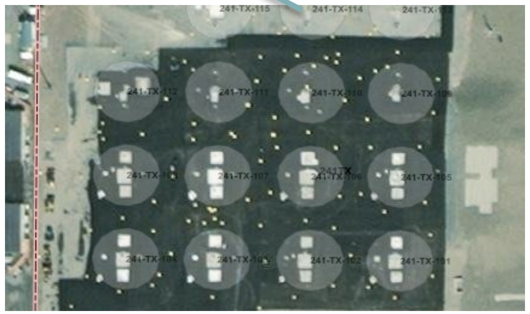
Interim Surface Barriers



T Tank Farm Barrier
(Polyurea)

TY Tank Farm Barrier

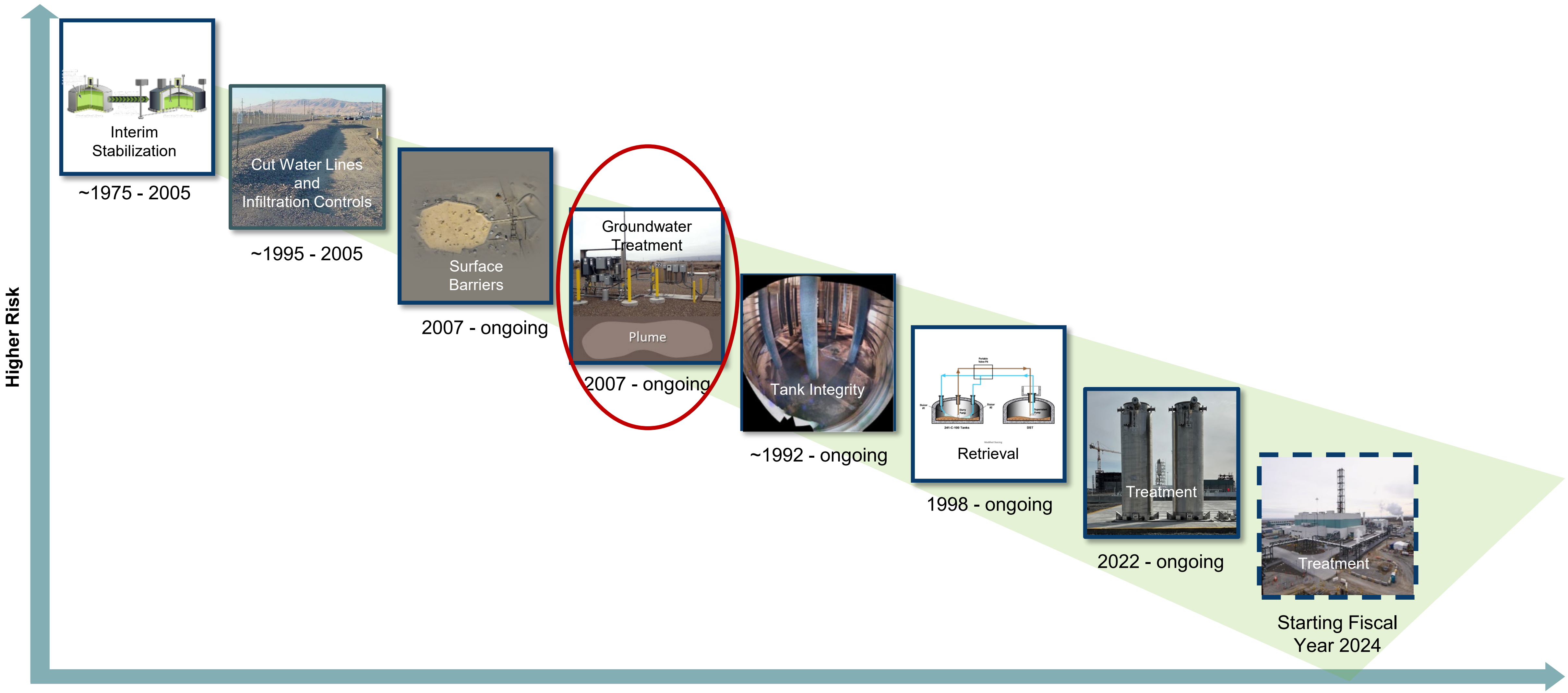
SX Tank Farm Barrier



TX Tank Farm Barrier

Interim barriers protect the environment by reducing water influx – slowing the driving force on past releases and reducing mobility of any new releases that could occur prior to retrieval and treatment

Groundwater Risk Reduction Steps

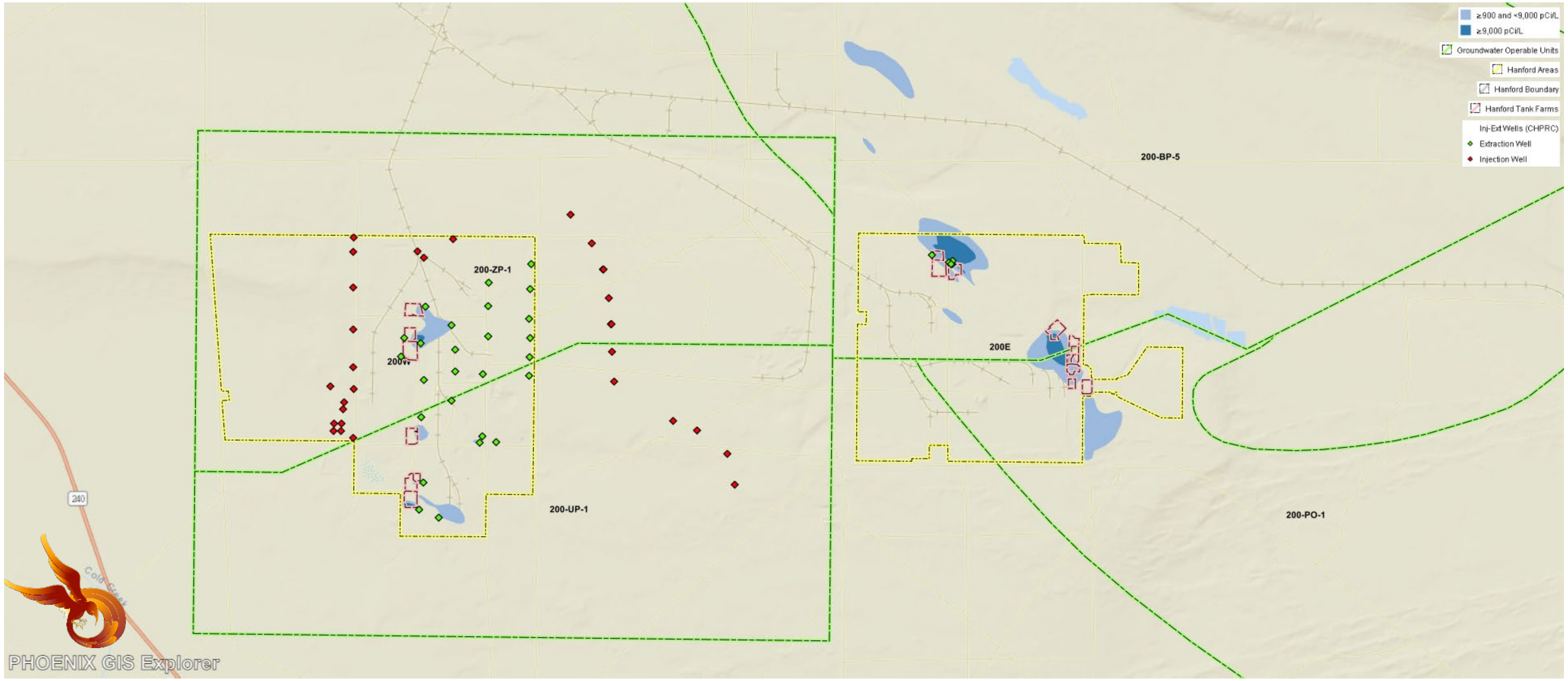


Groundwater - 200 West Pump and Treat

Reducing Risk: Removing Contamination from Groundwater

Over 2 Billion Gallons of Hanford Site Groundwater are Treated to Remove Contaminants Each Year

Central Plateau Technetium-99 Plume (2020)



B Complex Area Technetium-99 Plume (2014-2020)

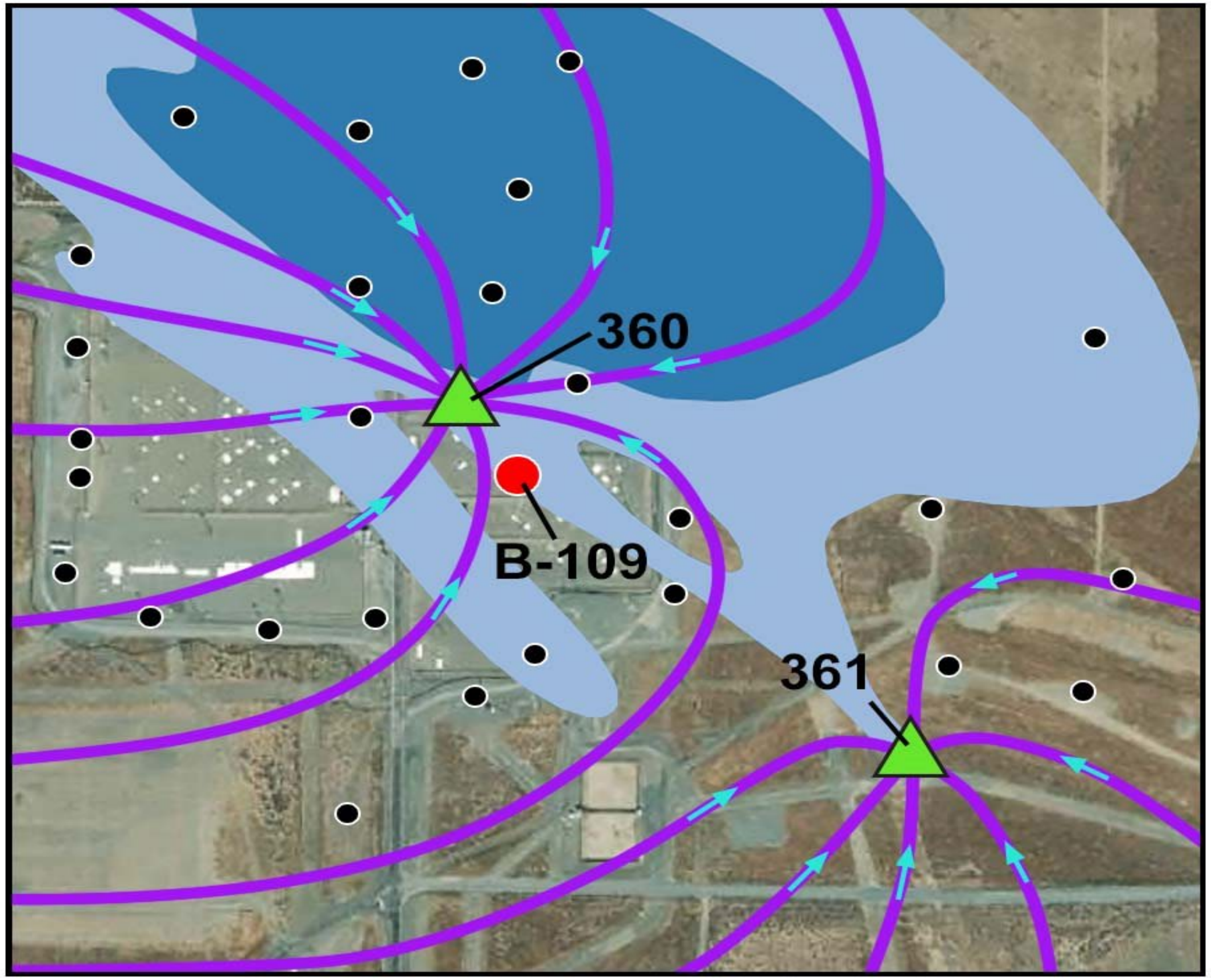
Images obtained from the PNNL Hanford Online Information Exchange (PHOENIX), Pacific Northwest National Laboratory, Richland, Washington, U.S. Department of Energy. Accessed Thu Apr 07, 2022, https://phoenix.pnnl.gov

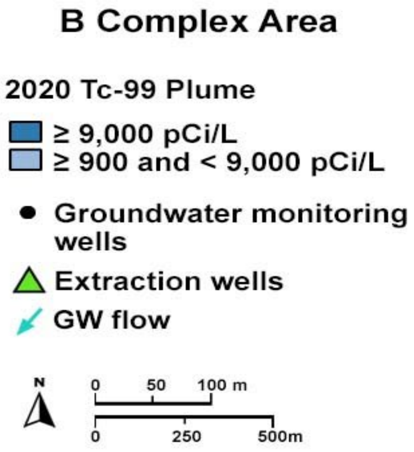
THE HANFORD SITE

S-SX Tank Farm Area Technetium-99 Plume (2012-2020)

Images obtained from the PNNL Hanford Online Information Exchange (PHOENIX), Pacific Northwest National Laboratory, Richland, Washington, U.S. Department of Energy. Accessed Thu Apr 07, 2022, https://phoenix.pnnl.gov

B Complex Capture Zone Map





2020 Technicium-99 plume layer from PHOENIX (Accessed Thu Apr 07, 2022, https://phoenix.pnnl.gov) added to the map and legend provided by N. Jaschke (email to R. Mackley on April 6, 2022)

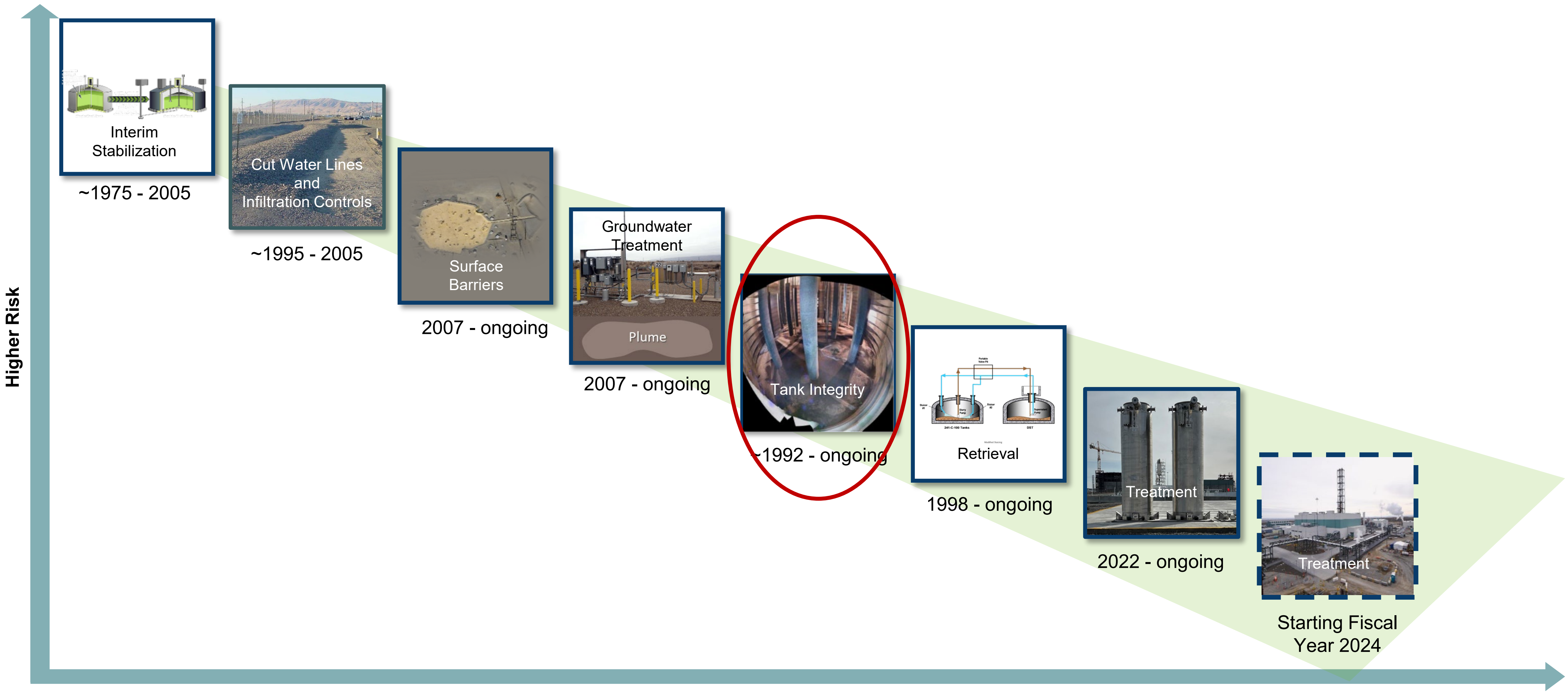
Questions?

THE HANFORD SITE

Agenda – Site Cleanup Overview

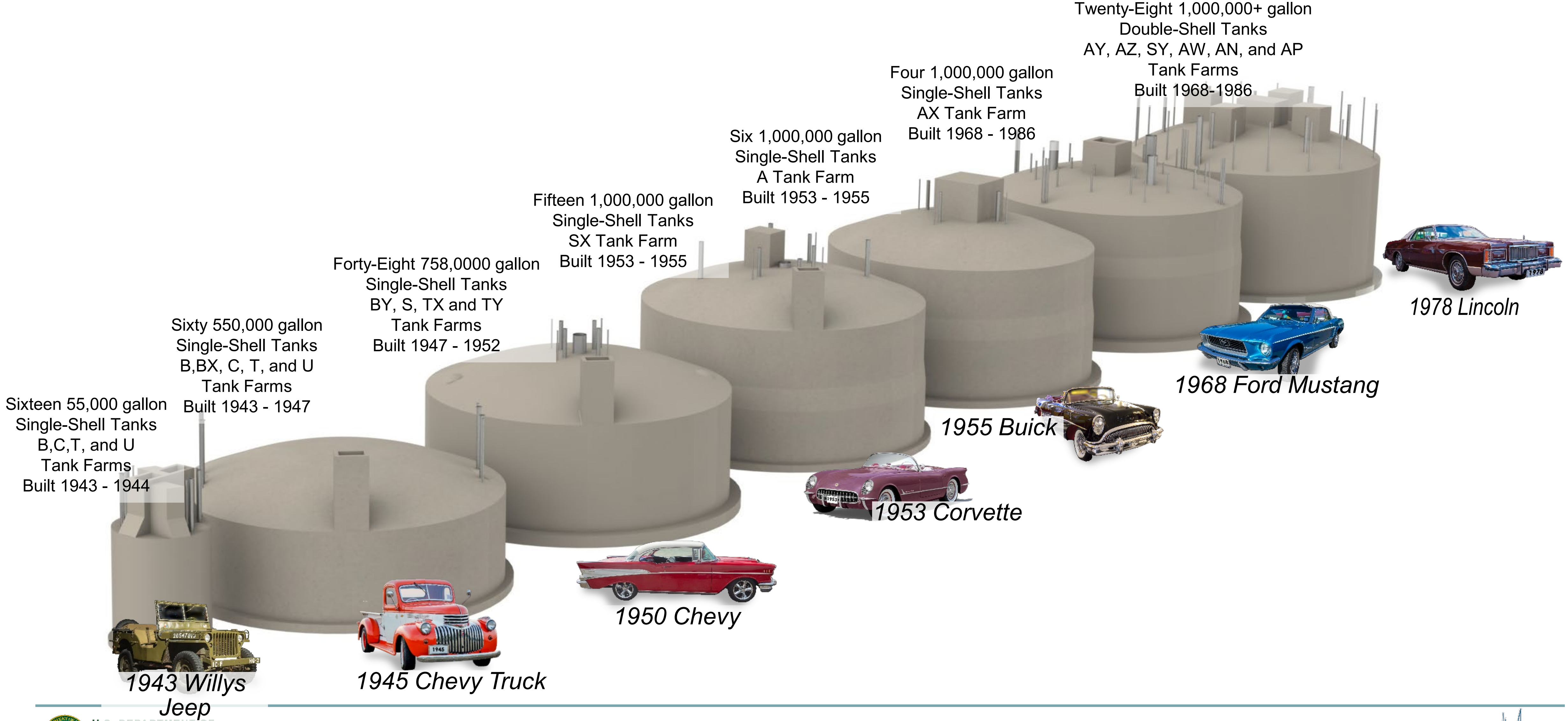
Site and History, Cleanup Progress	–	Elaine Porcaro, Chief Engineer, DOE Hanford Karthik Subramanian, Chief Engineer, WRPS
The Tanks and the Groundwater	–	Elaine Porcaro, Chief Engineer, DOE Hanford Naomi Jaschke, Soil and Groundwater Division Supervisor, DOE Hanford
Tank Integrity	**–**	**Karthik Subramanian, Chief Engineer, WRPS** **Erik Nelson, Tank Integrity Lead, DOE Hanford**
Treatment and System Planning	–	Todd Wagnon, Flowsheet Integration Manager, WRPS Richard Valle, Tank Farms Program Manager, DOE Hanford
Other Impacts of Treatment Options	–	Laura Cree, Flowsheet Definition and Analysis Manager, WRPS
Summary	–	Ricky Bang, Tank Farms Program Division Director, DOE Hanford

Groundwater Risk Reduction Steps



THE HANFORD SITE

Single-Shell Tanks and Double-Shell Tanks Sizes and Model Years

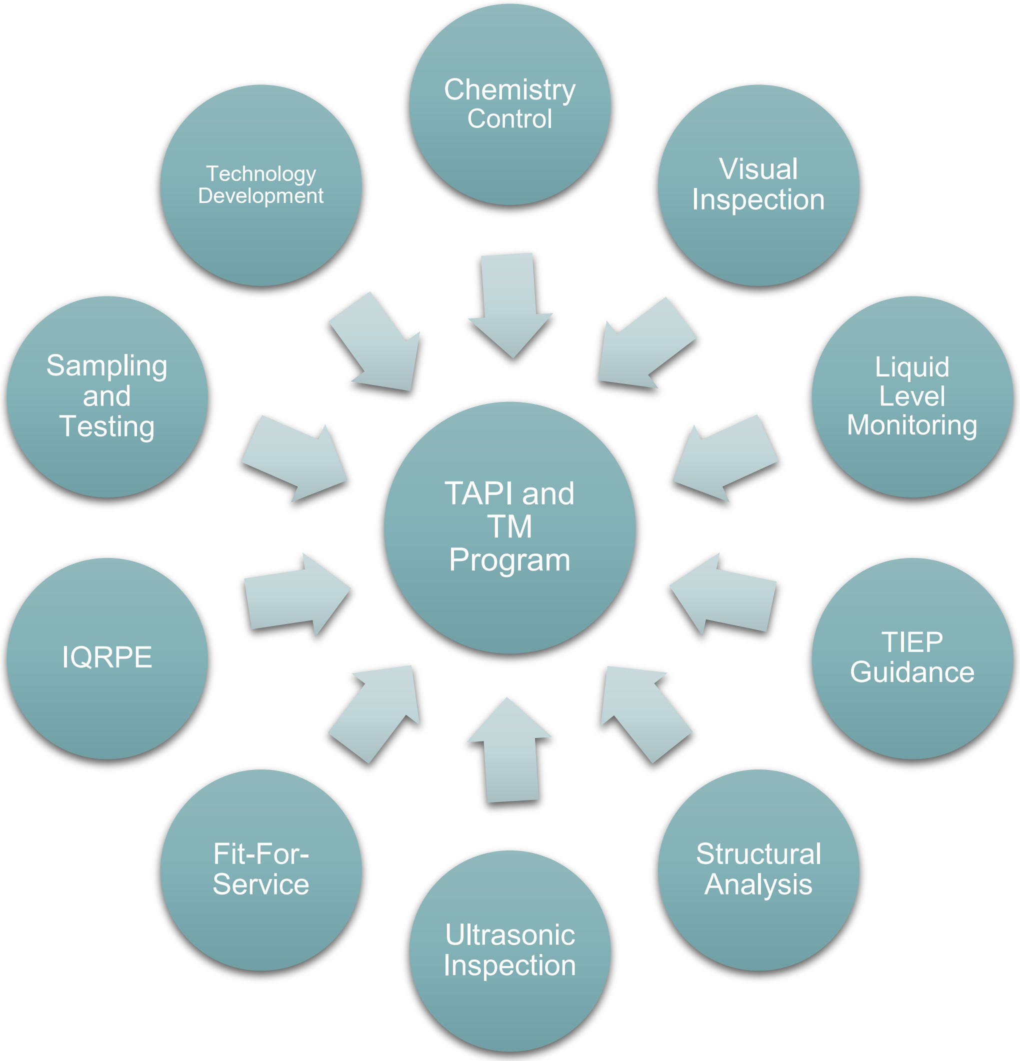


U.S. DEPARTMENT OF ENERGY

ONE HANFORD

Tank and Pipeline Integrity and Tank Management Program Overview

- The U.S. Department of Energy (DOE) administers a robust Integrity Program that supports activities in service of three major areas:
  - Double-Shell Tank Integrity Program
  - Single-Shell Tank Integrity Program
  - Waste Transfer System Fitness-for-Service
- Additionally, support periodic inspection and assessment of several ancillary facilities
- Intent is to implement controls, monitoring, and inspections to ensure that tank and system integrity is extended throughout the length of the mission



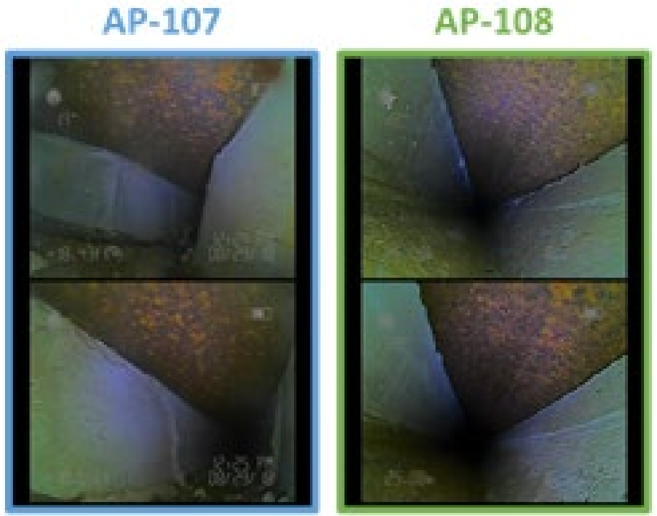
Tank Integrity Expert Panel

- Panel of experts from industry, national laboratories, and academia that make independent recommendations on improvements to the Hanford Tank Integrity Program
- Expertise in fields including:
  - Corrosion
  - Chemistry
  - Electrochemistry
  - Structural analysis
  - Materials
  - Nondestructive examination
  - Policy execution

Tank Integrity Meeting

Double-Shell Tank Integrity Program

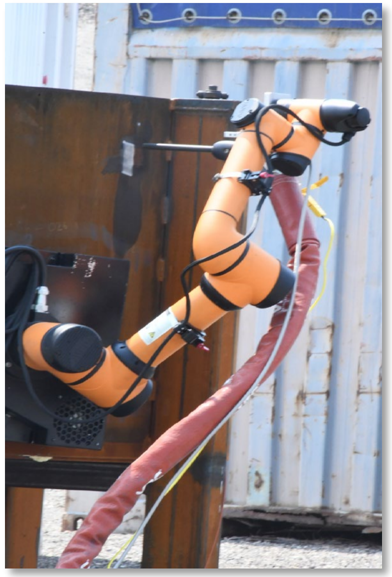
- Maintain double-shell tanks (DST) integrity to support waste processing operations while maintaining safe storage
- Meet regulatory requirements and provides defense-in-depth
- Program elements:
  - Corrosion Control
    - Waste chemistry envelope
    - Waste chemistry sampling and adjustment
  - Inspections
    - Visual and volumetric
    - Primary tank wall
    - Secondary tank
    - Under-tank Inspection
  - Structural analyses and studies
  - Independent qualified registered professional engineer assessments
  - Monitoring:
    - Waste level
    - Leak detection pit
    - Dome deflection surveys



Images From AP Tank Farm Annulus Visual Inspections

Tank Integrity Technology Development

- Investigating two separate systems for primary tank bottom ultrasonic testing
  - Remote Air-Slot Volumetric Inspection System (RAVIS) deployed via air slots
  - Remote Electromagnetic Acoustic Transducer (EMAT) Volumetric Inspection System (RREVIS) deployed via annulus floor
  - Targeting routine field deployment around 2025
- Began investigating tank repair and refurbishment technologies in 2020
  - Successful preliminary tests of two technologies:
    - Cold spray tank wall repair (Used in U.S. Department of Defense applications)
    - Epoxy grout primary bottom sealant (Layered application; used in Fukushima mitigation)

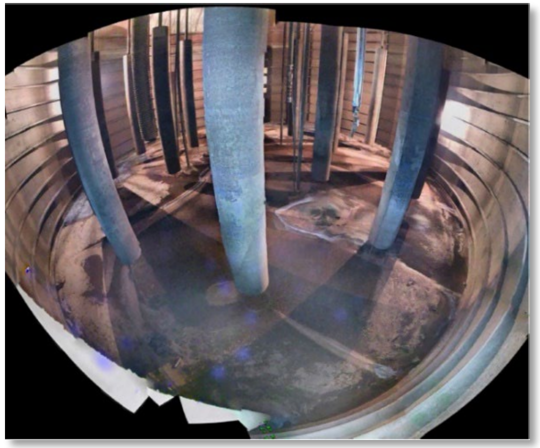


Cold Spray Tank Wall Repair Demonstration

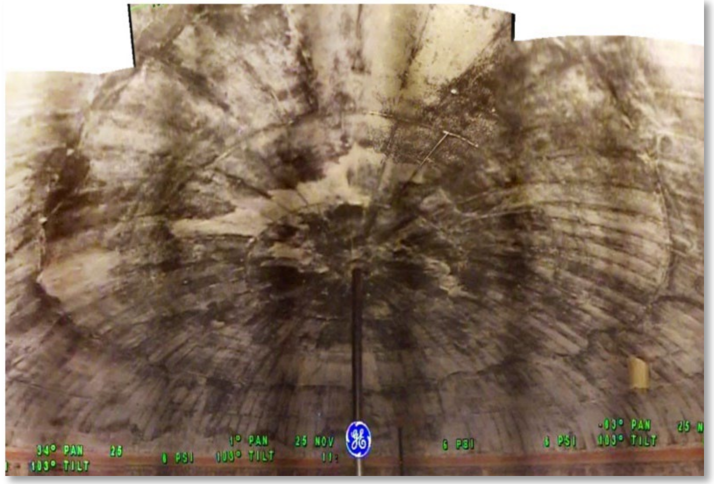
Remote Air-slot Volumetric Inspection System

Single-Shell Tank Integrity Program

- Program elements:
  - Structural analyses
  - Waste liquid level evaluations
  - Visual inspections – 15 per year average
    - Waste surface, tank liner, and dome conditions
  - Dome loading program, dome deflection surveys
  - Laser scans
  - Intrusion mitigation
  - Groundwater monitoring in the tank farms



Tank AX-102 Interior



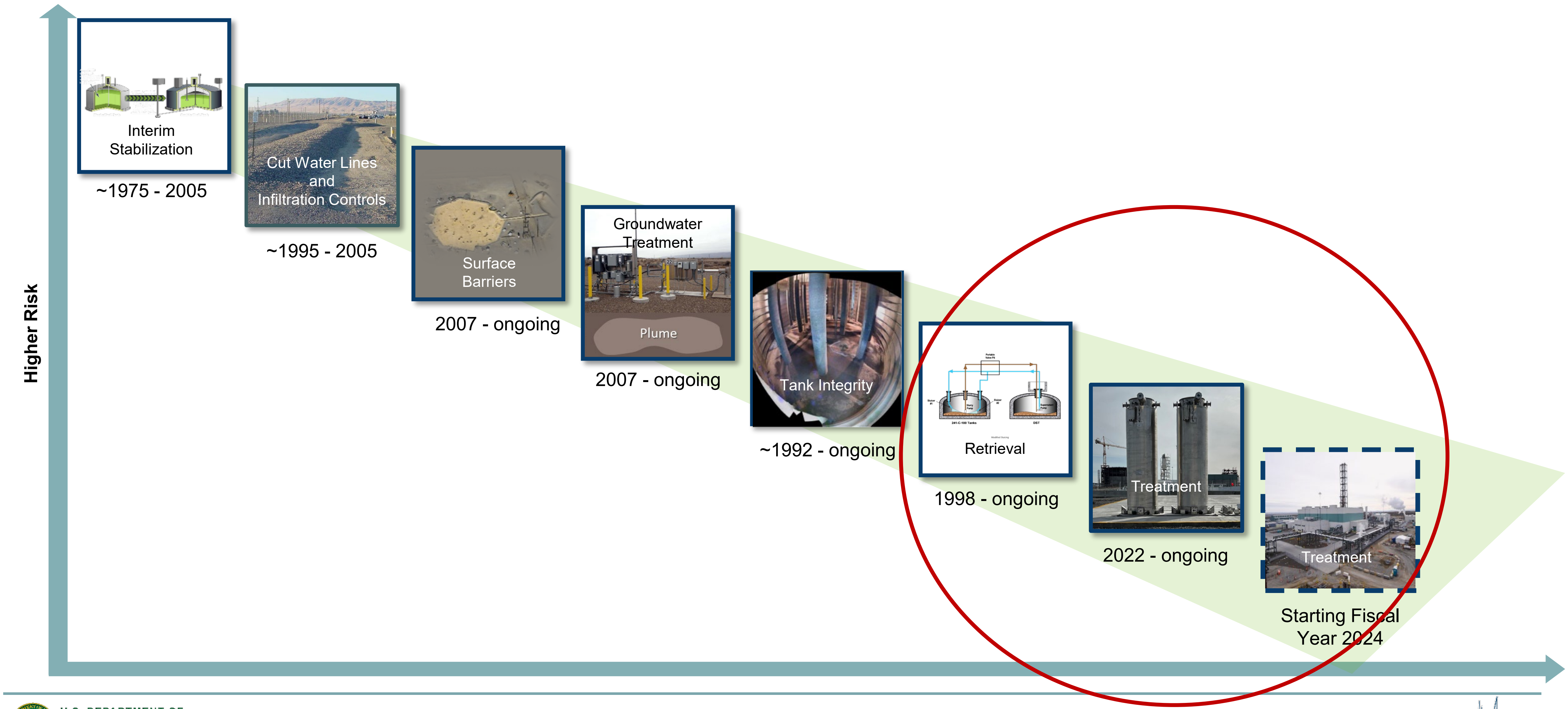
B-106 Dome


Questions?

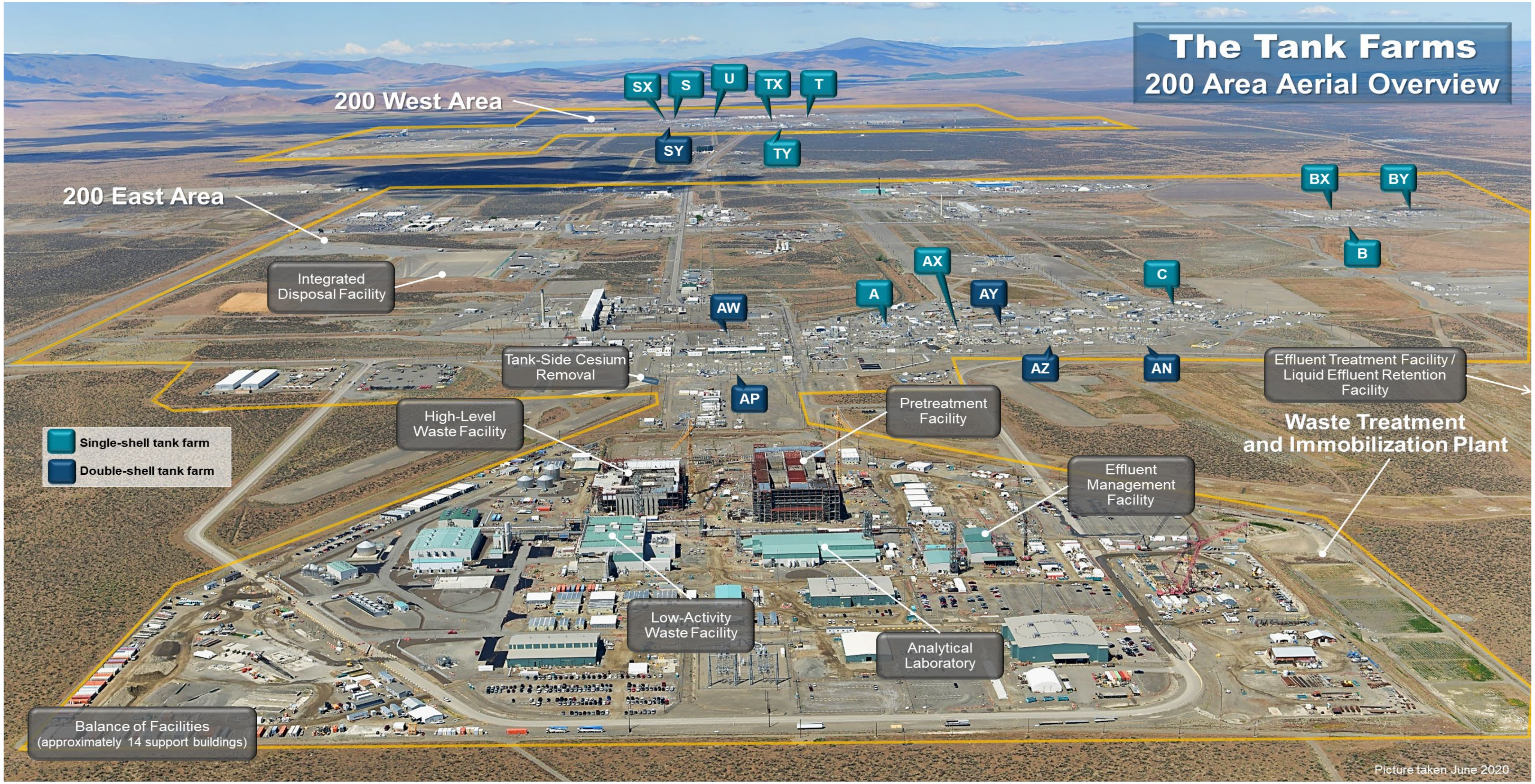
Agenda – Site Cleanup Overview

Site and History, Cleanup Progress	–	Elaine Porcaro, Chief Engineer, DOE Hanford Karthik Subramanian, Chief Engineer, WRPS
The Tanks and the Groundwater	–	Elaine Porcaro, Chief Engineer, DOE Hanford Naomi Jaschke, Soil and Groundwater Division Supervisor, DOE Hanford
Tank Integrity	–	Karthik Subramanian, Chief Engineer, WRPS Erik Nelson, Tank Integrity Lead, DOE Hanford
Treatment and System Planning	**–**	**Todd Wagnon, Flowsheet Integration Manager, WRPS** **Richard Valle, Tank Farms Program Manager, DOE Hanford**
Other Impacts of Treatment Options	–	Laura Cree, Flowsheet Definition and Analysis Manager, WRPS
Summary	–	Ricky Bang, Tank Farms Program Division Director, DOE Hanford

Groundwater Risk Reduction Steps



Hanford's Central Plateau, Looking West



Direct-Feed Low-Activity Waste Progress: Tank Waste Treatment

Effluent Treatment Facility

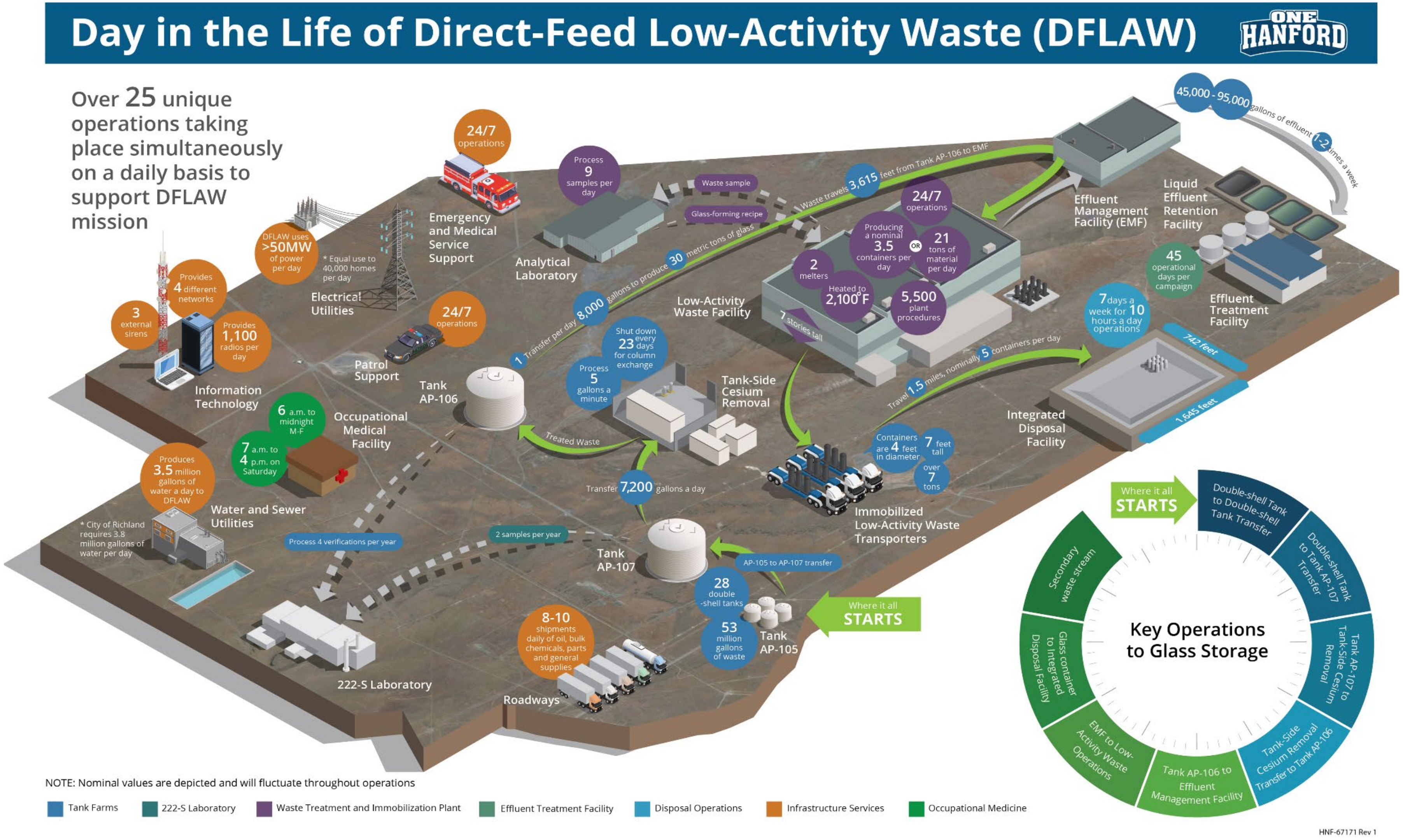
Liquid Effluent Retention Facility Basin and Effluent Treatment Facility

242-A Evaporator

222-S Laboratory

AP Tank Farm and Tank-Side Cesium Removal System

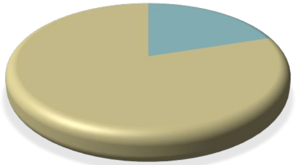
Direct-Fee Low-Activity Waste Process



First Step: Tank-Side Cesium Removal

Tank-Side Cesium Removal and
AP Tank Farm

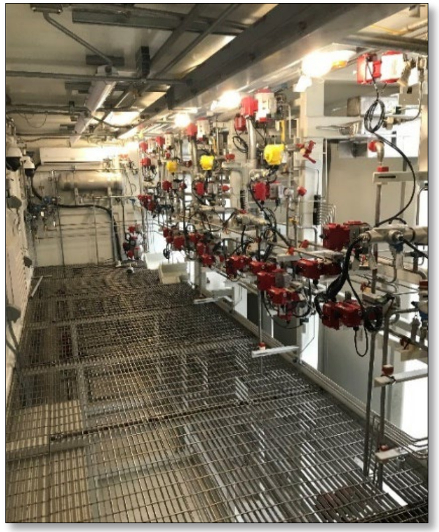
Tank AP-106 contents: Tank-side cesium removal (TSCR) treated Waste Treatment and Immobilization Plant (WTP) low-activity waste (LAW) feed



Approximately 200,000 gallons

Modified Forklift to Safely Lift and Transport 27,000-pound Self-Shielded Ion Exchange Columns

Installing Ion Exchange Columns



Interior of Tank-Side Cesium Removal Process Enclosure

First Two Loaded Ion Exchange Columns on Storage Pad

Waste Treatment and Immobilization Plant

- Building the world's largest radioactive waste treatment plant
- Waste will be turned into glass using vitrification process
- Top priority is startup of Direct-feed Low-activity Waste (DFLAW) Program

Low-Activity Waste Facility

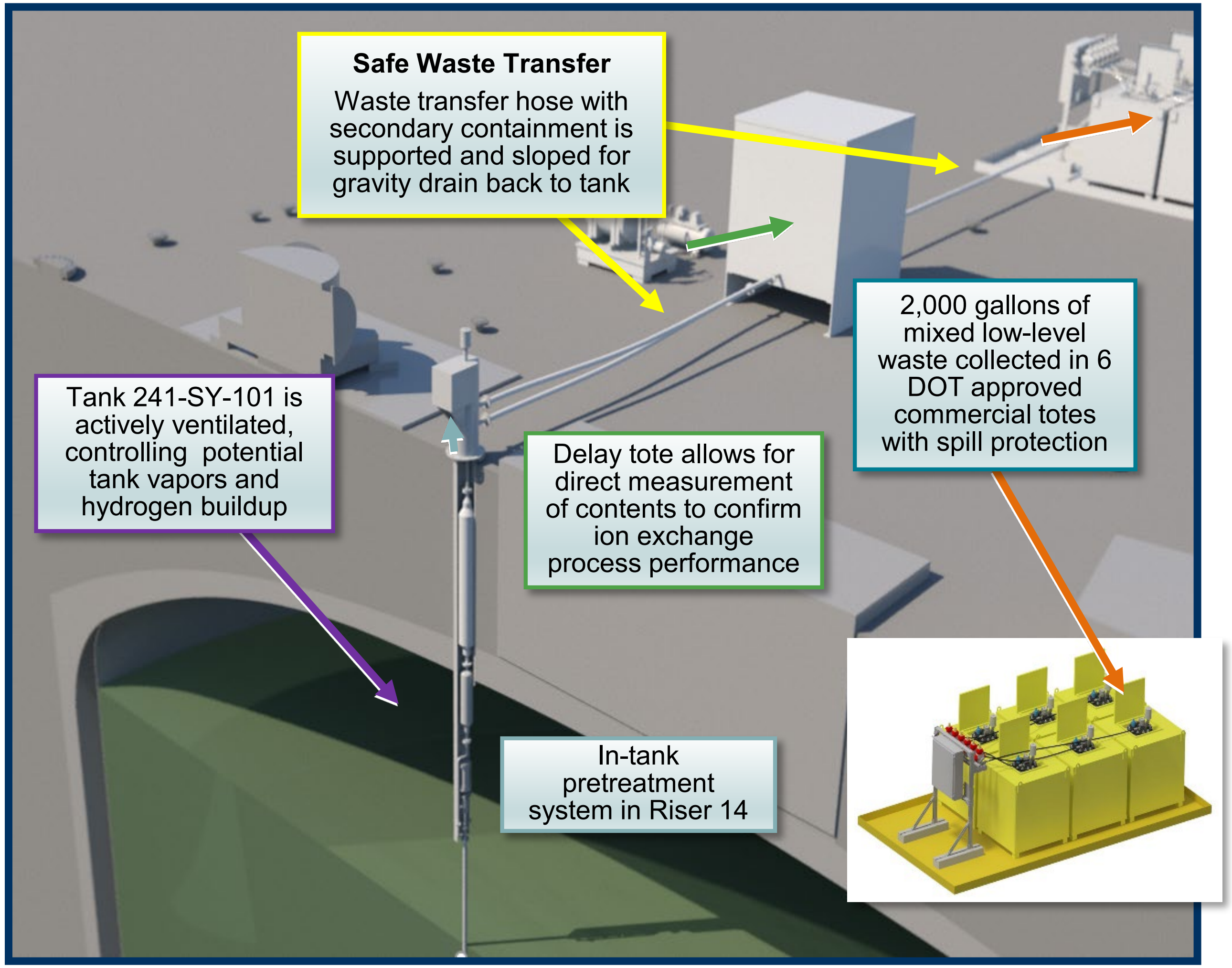
High-Level Waste Facility

Pretreatment Facility

Test Bed Initiative, 2,000 Gallons

Status

- February 5, 2021, DOE published a Federal Register Notice to make the draft Waste Incidental to Reprocessing (WIR) Evaluation available to the public and begin a 90-day comment period through February 2, 2022
- DOE submitted a request for consultation with the Nuclear Regulatory Commission (NRC) on October 29, 2021, and sent the draft WIR Evaluation (DOE-ORP-2021-01, Rev. 0) for review
- After considering NRC consultation advice (expected by end of July 2022) and public comments, DOE plans to prepare a final WIR Evaluation (DOE-ORP-2021-01, Rev. 1), and – based on the final WIR Evaluation – a potential WIR Determination
- Commencement of the proposed Test Bed Initiative (TBI) demonstration is contingent upon completion of a final WIR Evaluation, a WIR Determination, and analysis and documentation required by the National Environmental Policy Act
- DOE submitted a request for comments with Tribes and State Agencies on August 17, 2021, and sent the draft Environmental Assessment (EA) of the TBI Demonstration (DOE/EA-2086) for review
- DOE is currently evaluating Tribe and State Agency comments (received through September 3, 2021) in finalizing the EA of the TBI Demonstration
- If the DOE decides to proceed with the proposed TBI Demonstration, a Research, Development and Demonstration permit under RCRA would be requested from the Washington State Department of Ecology



Tank 241-SY-101 Field Deployment Concept

Tank Farms Continuing Mission

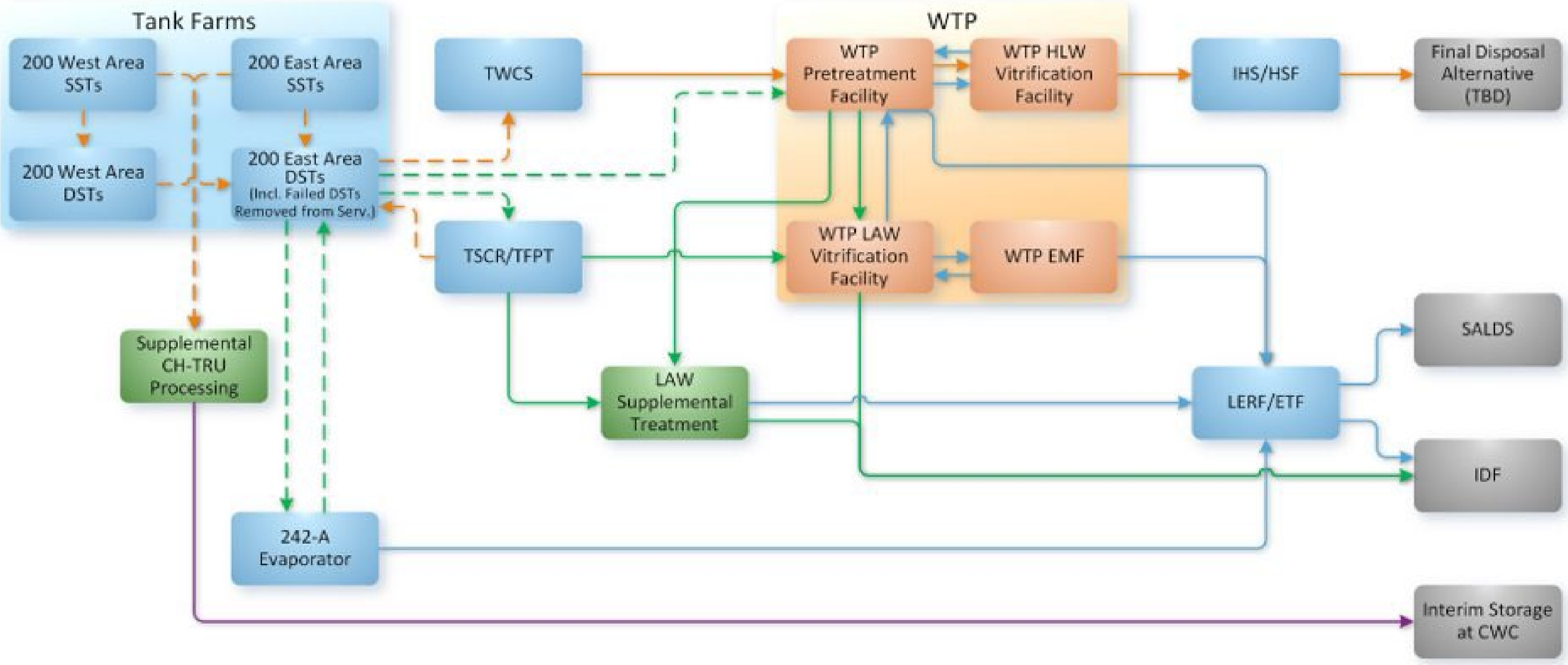
- For decades to come, the tank farms will continue to:
  - Safely store waste
  - Treat tank waste
  - Process waste for treatment and disposal
  - Close tanks
  - Prepare the area for final closure

System planning helps us evaluate different mission profiles and plan for the future

- Modeling tools are utilized to compare numerous scenarios for mission execution
  - Multiple scenarios are performed as part of each system plan
  - Annual updates to baseline planning and near-term picture

Tank Farms Mission

- Execution of the River Protection Program mission requires execution of the following key functions:
  - Safely store waste
  - Treat tank waste
  - Process waste for stabilization and disposal
  - Close tanks
  - Prepare the area for final closure



Legend

Streams
- Supernate
- Slurry
- Treated LAW/ILAW
- Treated HLW/IHLW
- Secondary Effluent/Offgas
- CH-TRU (Potential)

Systems
- Tank Farms
- WTP
- Supp. Treatment
- Other

Acronyms

CH-TRU	contact-handled transuranic
CWC	Central Waste Complex
DST	double-shell tank
EMF	Effluent Management Facility
ETF	Effluent Treatment Facility
HLW	high-level waste
HSF	Hanford Shipping Facility
IDF	Integrated Disposal Facility
IHS	Interim Hanford Storage
LAW	low-activity waste
LERF	Liquid Effluent Retention Facility
SALDS	state-approved land disposal site
SST	single-shell tank
TBD	to be determined
TSCR	tank-side cesium removal
TFPT	tank farm pretreatment
TWCS	tank waste characterization and staging
WTP	Hanford Tank Waste Treatment and Immobilization Plant

For illustrative purposes only: The flowsheet presented here has been simplified for presentation purposes.

SP9_Scenario_5_R1.png

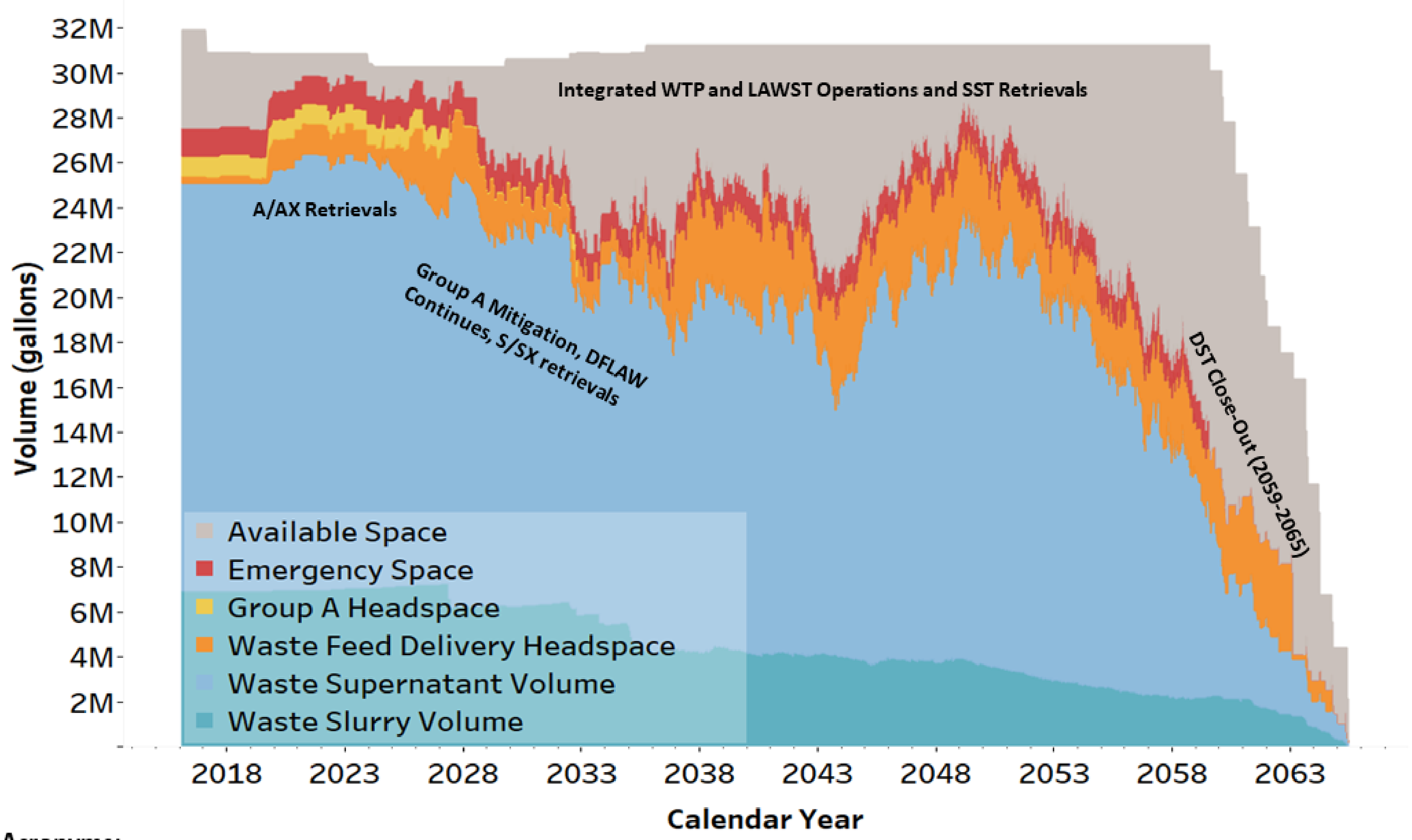
System Plan 9 Baseline Case Metrics

- Treats all tank waste by 2066
- Generates approximately 600 Mgal of Secondary Liquid Waste
- Life-cycle cost of $107 billion unescalated
- Peak funding need of more than $3 billion (nearly double current funding levels)

Treatment	Start Date	Completion Date	Immobilized Product Quantity	Metric Tons of Product	Waste Loading
WTP ILAW	2023	2066	52,000 containers	287,000	26% Na_2O
LAW Supplemental Treatment (4 melter vitrification)	2034	2066	37,000 containers	203,000	20% Na_2O
TRU Drums	2040	2045	8,800 drums	2,300	80%
WTP IHLW	2033	2066	7,300 canisters	22,000	44%

IHLW = immobilized high-level waste
ILAW = immobilized low-activity waste.
LAW = low-activity waste.
TRU = transuranic (waste).
WTP = Waste Treatment and Immobilization Plant.

System Plan 9 – Double-Shell Tank Space Utilization



Acronyms:

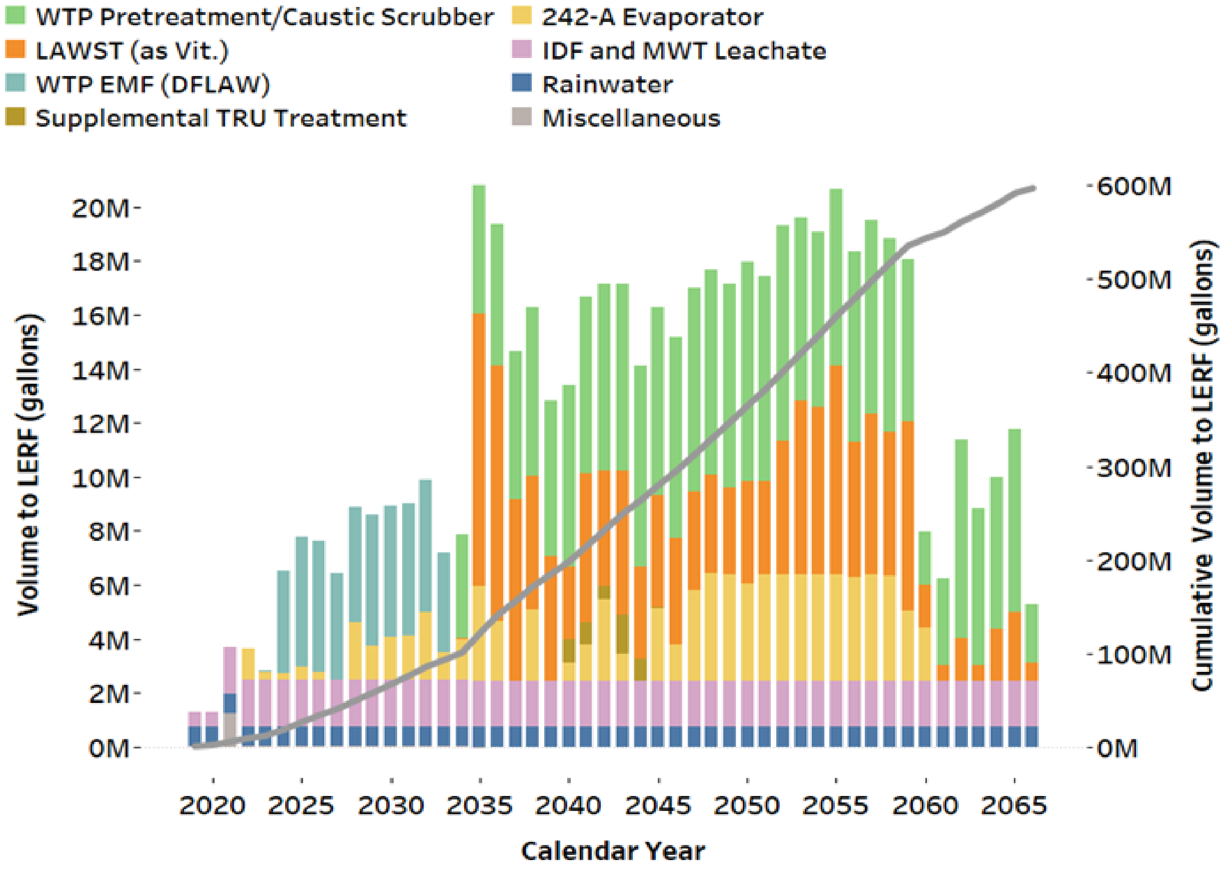
DFLAW = direct feed low-activity waste.
DST = double-shell tank.
LAWST = low-activity waste supplemental treatment.
SST = single-shell tank.
WTP = Waste Treatment and Immobilization Plant.

- Near term DST space is challenged by continued retrieval of single-shell tanks (SST) and limited outlet pathways
- DFLAW generates DST space to enable ongoing SST retrievals
- Mission and DST space generation accelerate in mid 2030s with start up of high-level waste (HLW) and low-activity waste supplemental treatment (LAWST)
- Assumes no additional loss of DST space for remainder of the mission until operationally closed

System Plan 9 – Liquid Effluent Retention Facility/Effluent Treatment Facility Demand

THE HANFORD SITE

- Liquid Effluent Retention Facility (LERF) receives greater than or equal to 600 Mgal of effluents over the mission
- Greater than or equal to 6 Mgal per year from the start of DFLAW through 2034
- 12 –20 Mgal per year between 2034-2060 (at or above Effluent Treatment Facility [ETF] design capacity)
- LAWST and WTP pretreatment contribute nearly 60 percent of demand

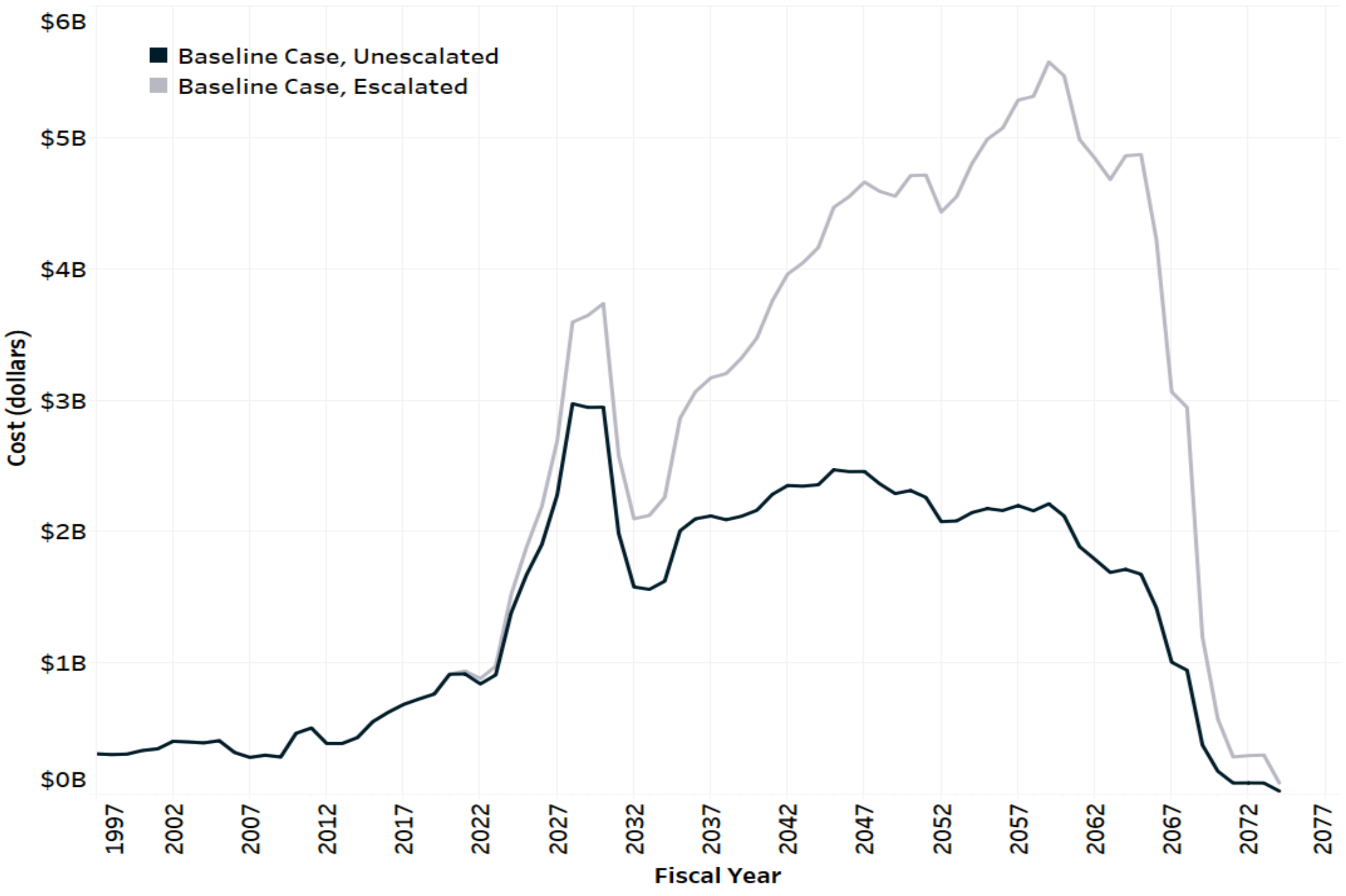


Acronyms:

DFLAW	=	direct-feed low-activity waste.
EMF	=	Effluent Management Facility.
IDF	=	Integrated Disposal Facility.
LAWST	=	low-activity waste supplemental treatment.
LERF	=	Liquid Effluent Retention Facility.
MWT	=	mixed waste trench.
TRU	=	transuranic.
Vit.	=	vitrification.
WTP	=	Waste Treatment and Immobilization Plant.

Scenario Cost Comparison

- Baseline funding does not include WTP capital project costs
  - LAW supplemental treatment as vitrification cost drives $2 billion cost increase in late 2020s
  - Cost estimates for WTP operations optimistic based on DFLAW projections
- Flat funding scenarios were performed as part of System Plan 8
  - Assumed level funding of $2 billion per year unescalated
  - Mission duration extended to 2106
  - Halted SST retrievals until 2041 to provide funding for additional facilities (HLW)



System Plan 9 Baseline Case Funding Demands

System Planning Risks

- System planning is performed using deterministic models
- Built on logical set of assumptions and requirements
- Sensitivity scenarios used to capture critical risk elements:
  - DST failures
  - Flat funding
  - Reduced treatment facility throughput (40 percent total operational efficiency for WTP)
- Does not include detailed risk analysis
  - Failure of critical infrastructure (e.g., 242-A Evaporator, cross-site transfer line)
  - Interconnected treatment facilities unable to match demand (TSCR/TFPT to WTP and WTP to LERF/ETF

Liquid Effluent Retention Facility/Effluent Treatment Facility

242-A Evaporator

LIKELIHOOD	OPPORTUNITY LEVEL					THREAT LEVEL				
Very Likely	High	High	High	Med	Low	Low	Med	High	High	High
Likely	High	High	Med	Med	Low	Low	Med	Med	High	High
Somewhat Likely	High	Med	Med	Low	Low	Low	Low	Med	Med	High
Unlikely	High	Med	Low	Low	Low	Low	Low	Low	Med	High
Very Unlikely	Med	Med	Low	Low	Low	Low	Low	Low	Med	Med
	Exceptional	Excellent	Significant	Marginal	Negligible	Negligible	Marginal	Significant	Critical	Crisis
	BENEFIT					CONSEQUENCE				

Lessons Learned in System Planning

- Cost profiles have annual values greater than three times current funding levels
- Schedule is the primary lifecycle cost driver
- Earlier capital investments incur the greatest benefit
- Changing sequence of retrievals has little impact on lifecycle mission
- Optimizing waste feed reduces schedule
- Maximizing treatment capability is the only way to reduce mission life

Questions?

THE HANFORD SITE

Agenda – Site Cleanup Overview

Site and History, Cleanup Progress	–	Elaine Porcaro, Chief Engineer, DOE Hanford Karthik Subramanian, Chief Engineer, WRPS
The Tanks and the Groundwater	–	Elaine Porcaro, Chief Engineer, DOE Hanford Naomi Jaschke, Soil and Groundwater Division Supervisor, DOE Hanford
Tank Integrity	–	Karthik Subramanian, Chief Engineer, WRPS Erik Nelson, Tank Integrity Lead, DOE Hanford
Treatment and System Planning	–	Todd Wagnon, Flowsheet Integration Manager, WRPS Richard Valle, Tank Farms Program Manager, DOE Hanford
Other Impacts of Treatment Options	**–**	**Laura Cree, Flowsheet Definition and Analysis Manager, WRPS**
Summary	–	Ricky Bang, Tank Farms Program Division Director, DOE Hanford

Other Impacts of Treatment Options

Beyond Schedule and Cost, Aside from Groundwater Impacts: Inputs and Outputs and Worker Hazards

- Calculations performed to support Federally Funded Research and Development Center (FFRDC) analysis
  - Inputs – power, clean water, fuel, process chemicals, waste formers
  - Outputs – stack emissions, liquid effluents, primary and secondary wastes
  - Worker hazards – chemical and physical hazards
- Numbers pulled from actual facility flowsheets
  - WTP LAW Facility
  - Savannah River Site saltstone
  - Integrated waste treatment unit
- Converted to same scale (1 million gallons TSCR treated feed) and to LAW feed
- Tank waste mission has more than 200 million gallons of LAW feed

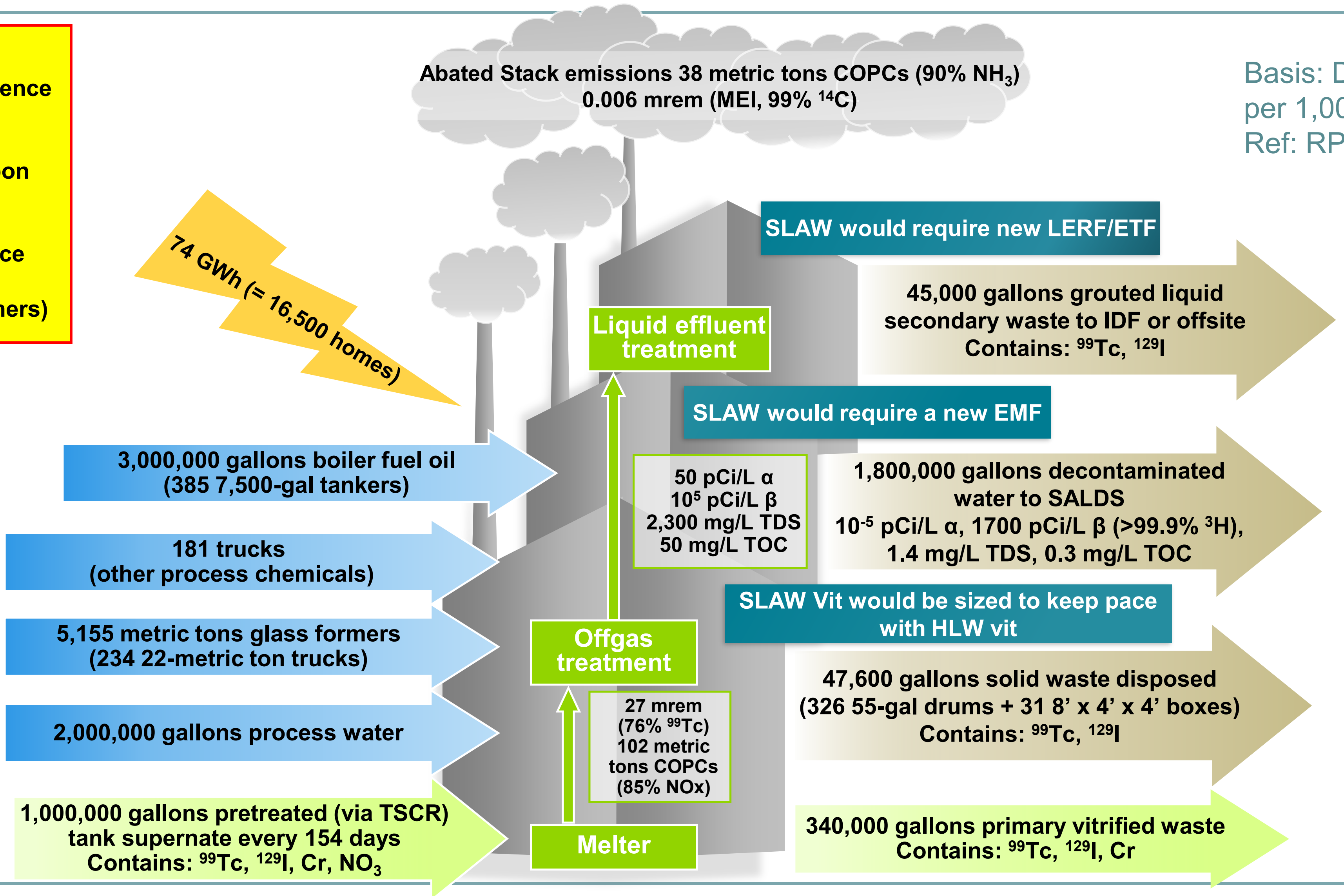
THE HANFORD SITE

Glass Mass and Energy Flow

Safety Picture:
2 medium-consequence public hazards (anhydrous NH_3 vessels, spent carbon bed media)

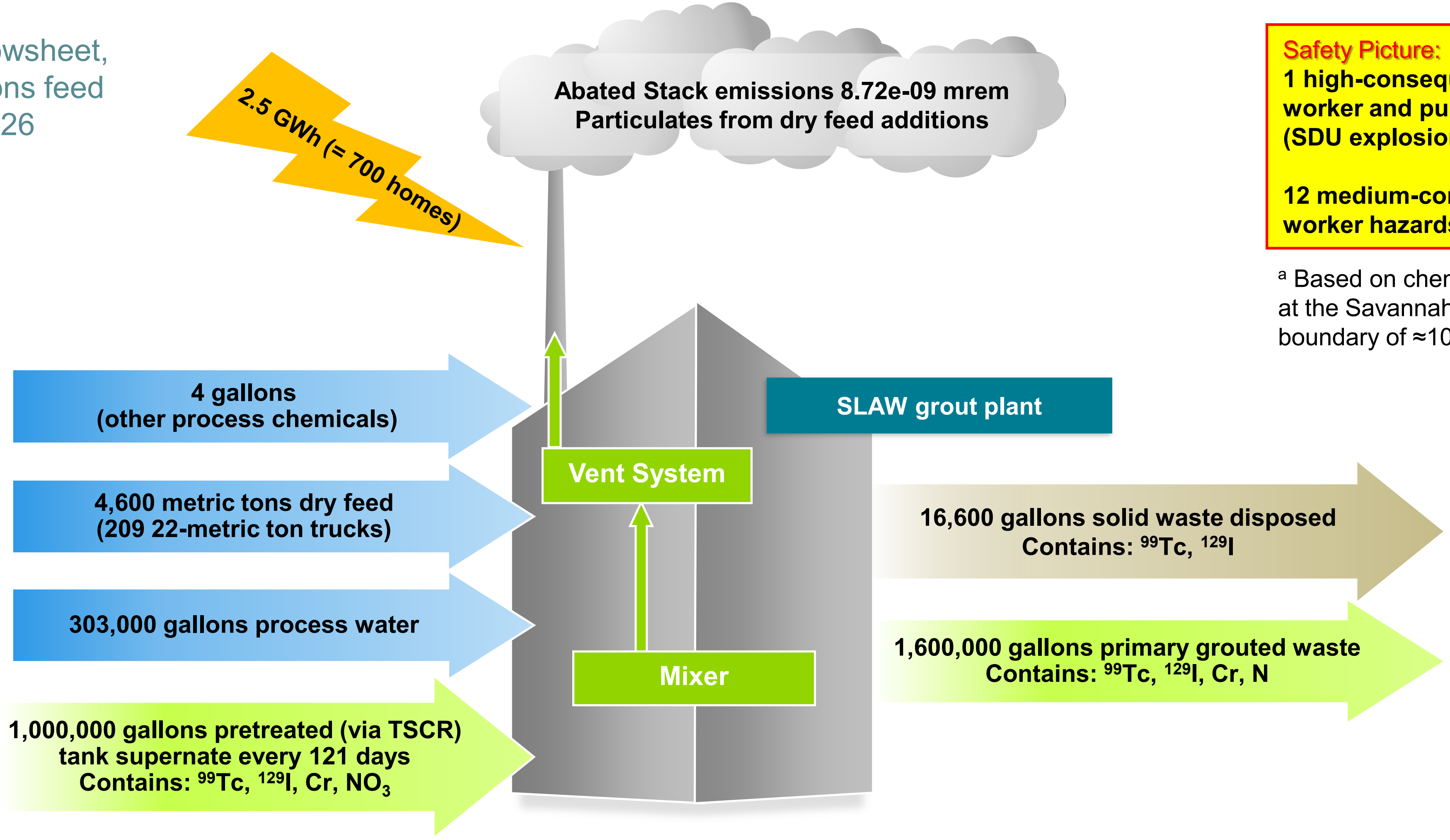
38 high-consequence worker hazards (NO_x, NH_3, ACN, others)

Basis: DFLAW flowsheet, per 1,000,000 gallons feed
Ref: RPP-RPT-63328



Grout Mass and Energy Flow

Basis: Saltstone flowsheet, per 1,000,000 gallons feed
Ref: RPP-RPT-63426



Safety Picture:
1 high-consequence worker and public[a] hazard (SDU explosion)

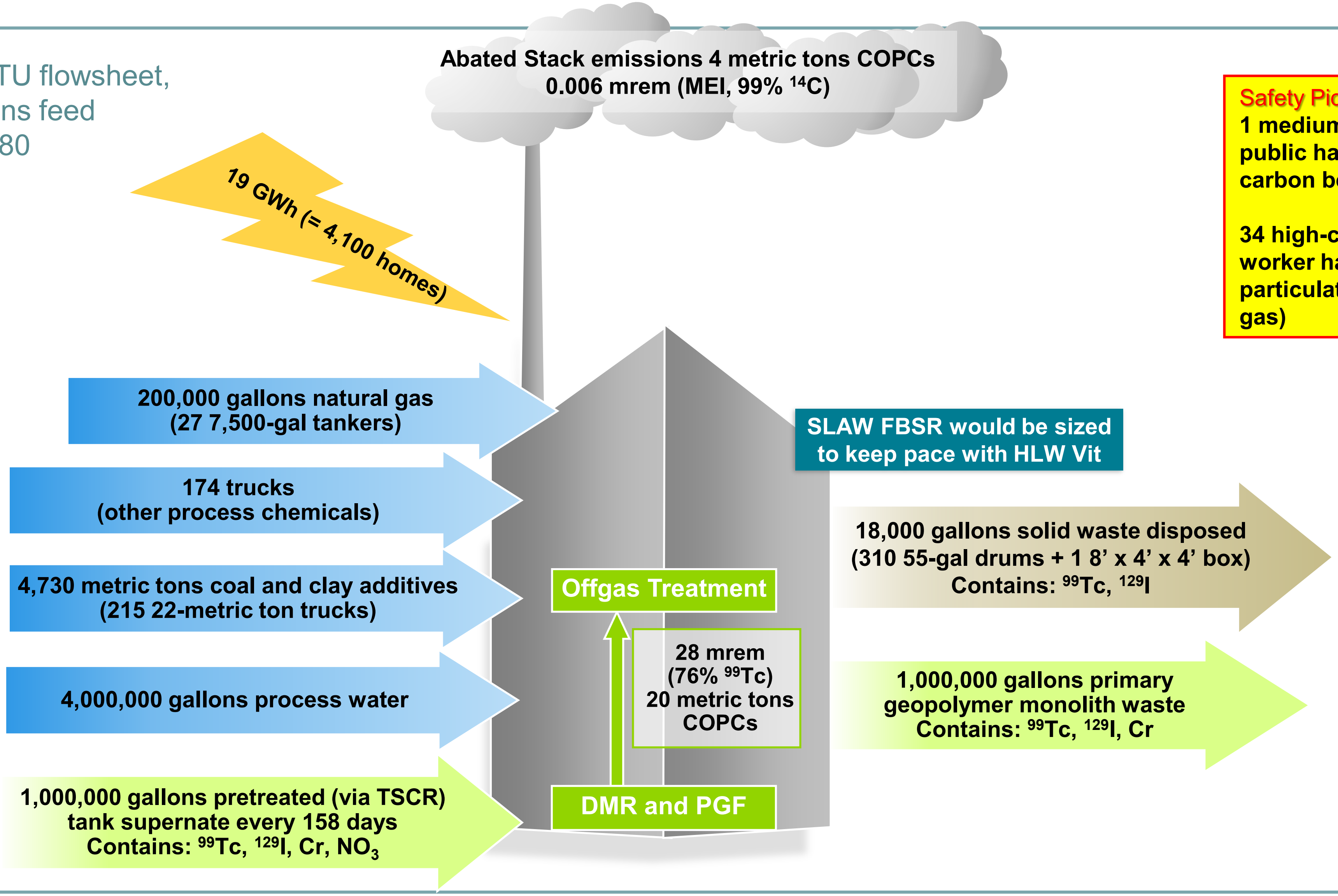
12 medium-consequence worker hazards

[a] Based on chemical exposure at the Savannah River Site boundary of ≈10 km.

THE HANFORD SITE

FBSR Mass and Energy Flow

Basis: Modified IWTU flowsheet,
per 1,000,000 gallons feed
Ref: RPP-RPT-63580



Safety Picture:
1 medium-consequence public hazard (spent carbon bed media)

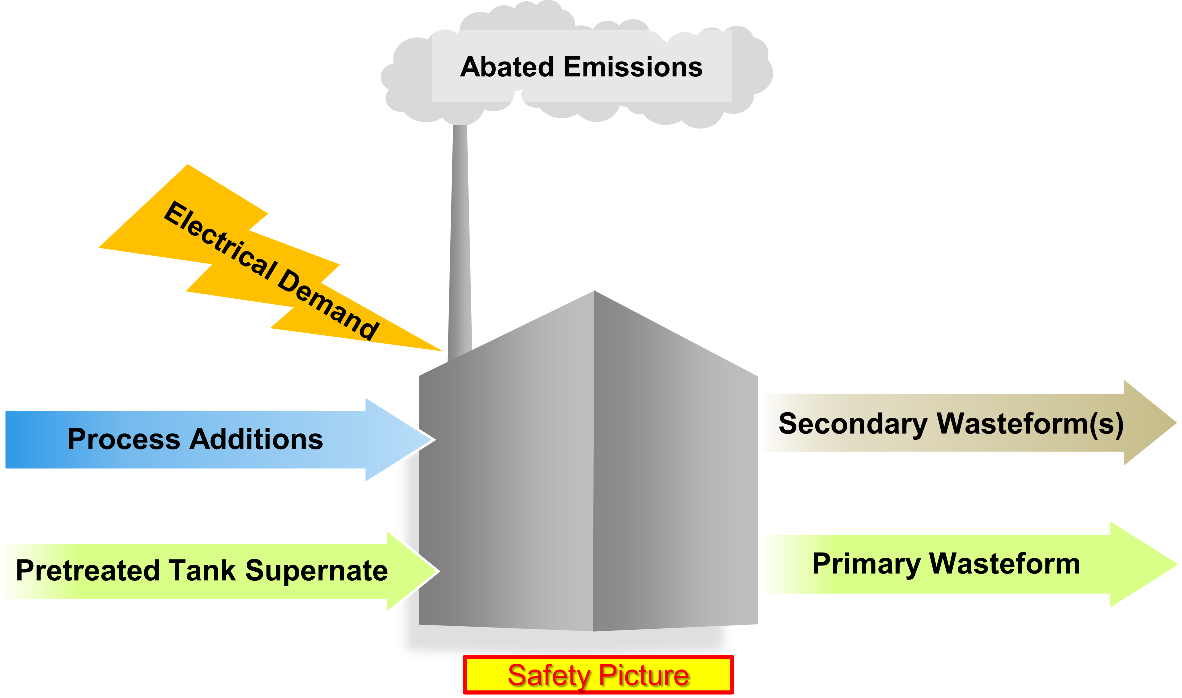
34 high-consequence worker hazards (e.g., coal particulates, compressed gas)

U.S. DEPARTMENT OF ENERGY

ONE HANFORD

Mission Impacts

	Vitrification	Grout	Steam Reforming
	per million gallons treated feed…		
Pretreated Tank Supernate (gallons)	1,000,000	1,000,000	1,000,000
Process Water (gallons)	2,000,000	303,000	4,000,000
Process Chemicals (trucks)	181	< 1	174
Process Additives (metric tons)	5,155	4,600	4,730
Fuel (gallons)	3,000,000	--	200,000
Electrical Demand (GWh)	74	2.5	19
Abated Emissions (metric tons COPCs)	38	Particulates	4
Abated Emissions (mrem)	0.006	8.72e-09	0.006
Estimated Carbon Footprint (kg CO_2)	32,000,000	67,000	1,400,000
Grouted Liquid Secondary Waste (gallons)	45,000	--	--
Decontaminated Water (gallons)	1,800,000	--	--
Secondary Solid Waste (gallons)	47,600	16,600	18,000
Primary Wasteform (gallons)	340,000	1,600,000	1,000,000
Safety Picture – Public Hazards (consequence level, public, and worker)	2 med public	SDU only – N/A for packaged grout	1 med public
Safety Picture – Worker Hazards	38 high worker	12 med worker	34 high worker



Conclusion:
Operations of a low temperature treatment alternative for SLAW has fewer associated hazards to workers and the public, lower energy and fuel demands, and lower carbon footprint and emissions.

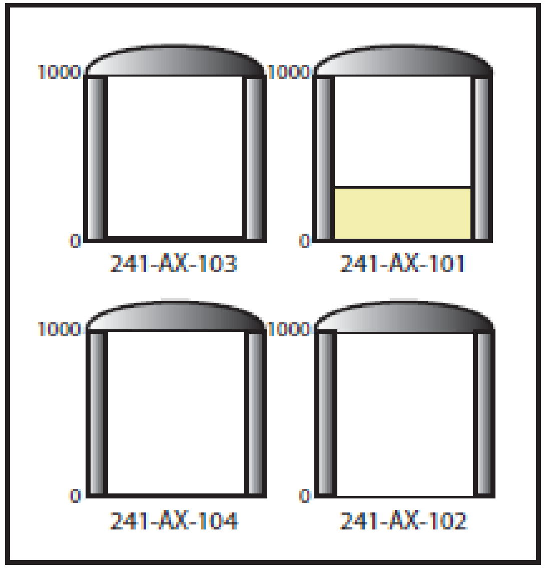

Questions?

THE HANFORD SITE | Agenda – Site Cleanup Overview

Site and History, Cleanup Progress	–	Elaine Porcaro, Chief Engineer, DOE Hanford Karthik Subramanian, Chief Engineer, WRPS
The Tanks and the Groundwater	–	Elaine Porcaro, Chief Engineer, DOE Hanford Naomi Jaschke, Soil and Groundwater Division Supervisor, DOE Hanford
Tank Integrity	–	Karthik Subramanian, Chief Engineer, WRPS Erik Nelson, Tank Integrity Lead, DOE Hanford
Treatment and System Planning	–	Todd Wagnon, Flowsheet Integration Manager, WRPS Richard Valle, Tank Farms Program Manager, DOE Hanford
Other Impacts of Treatment Options	–	Laura Cree, Flowsheet Definition and Analysis Manager, WRPS
Summary	**–**	**Ricky Bang, Tank Farms Program Division Director, DOE Hanford**

Great Progress!

- Hanford is treating tank waste
- AX Tank Farm retrievals on schedule
- WTP LAW / Balance of Facilities / Laboratory and EMF in startup



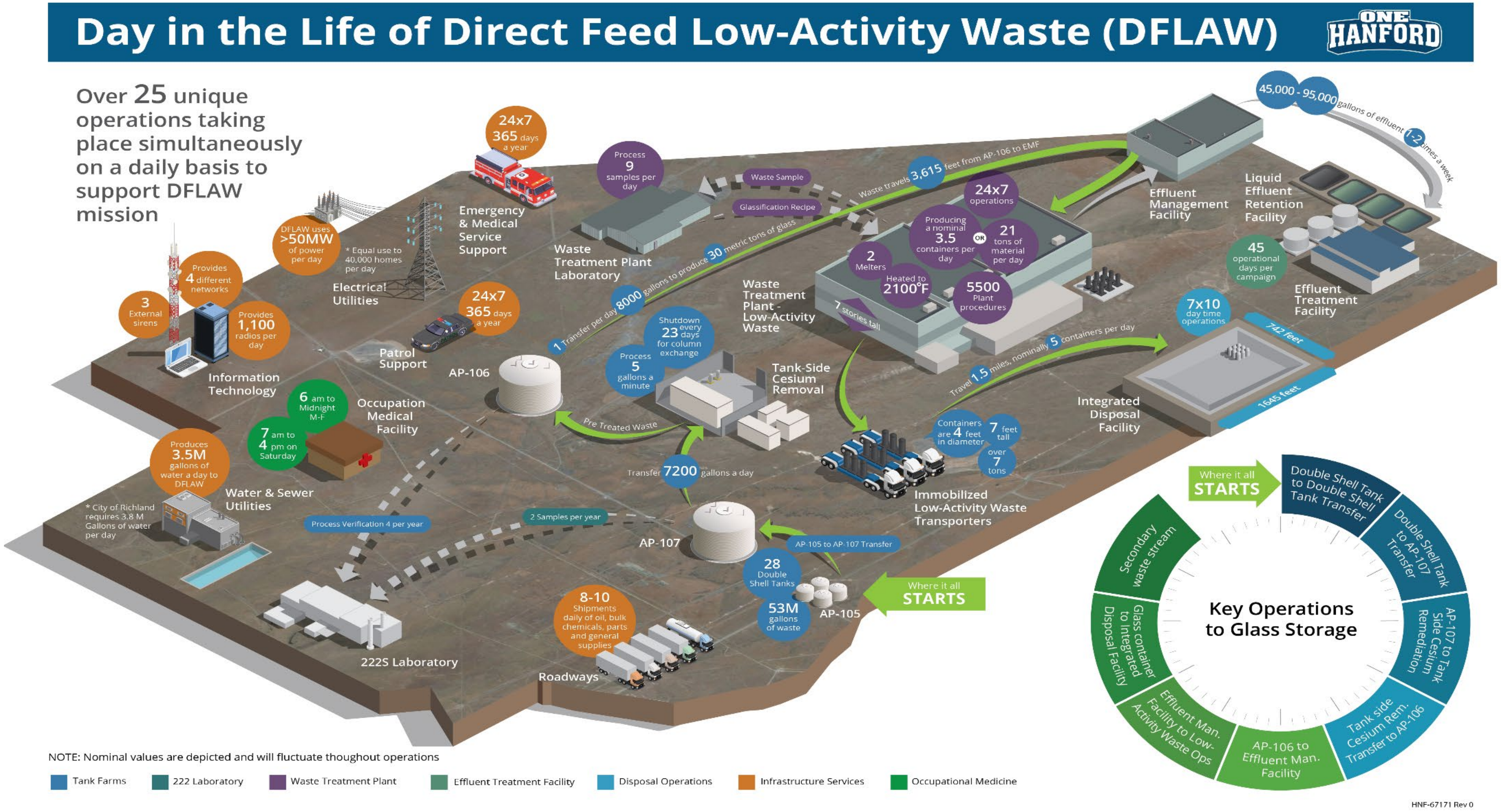
Recent Tank Waste Summary Report
AX Tank Farm Inventory Pictorial

AP Tank Farm and Tank-Side Cesium Removal System

AY Tank Farm (left), AX Tank Farm in Retrieval (right)

Aerial View of the Waste Treatment and Immobilization Plant

Direct-Feed Low-Activity Waste Process



Latest Hanford Lifecycle Cost Estimates

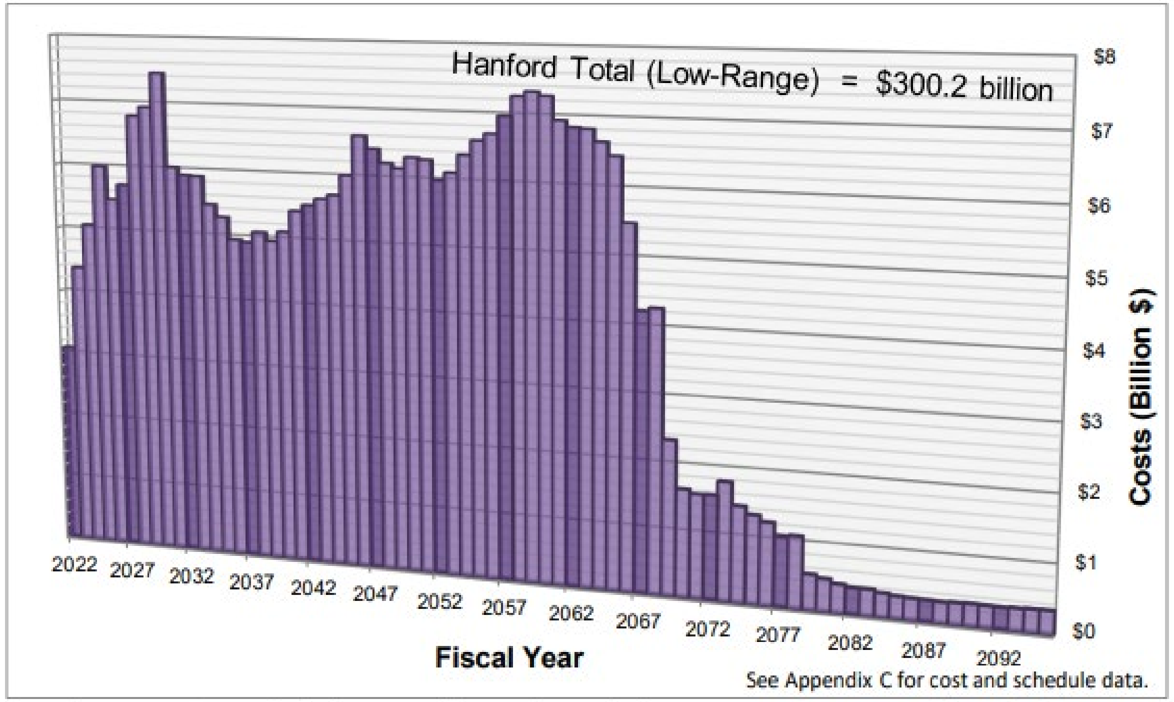


Figure ES-1. Hanford Site Remaining Estimated Cleanup Costs (Low-Range) by Fiscal Year (includes both RL and ORP).

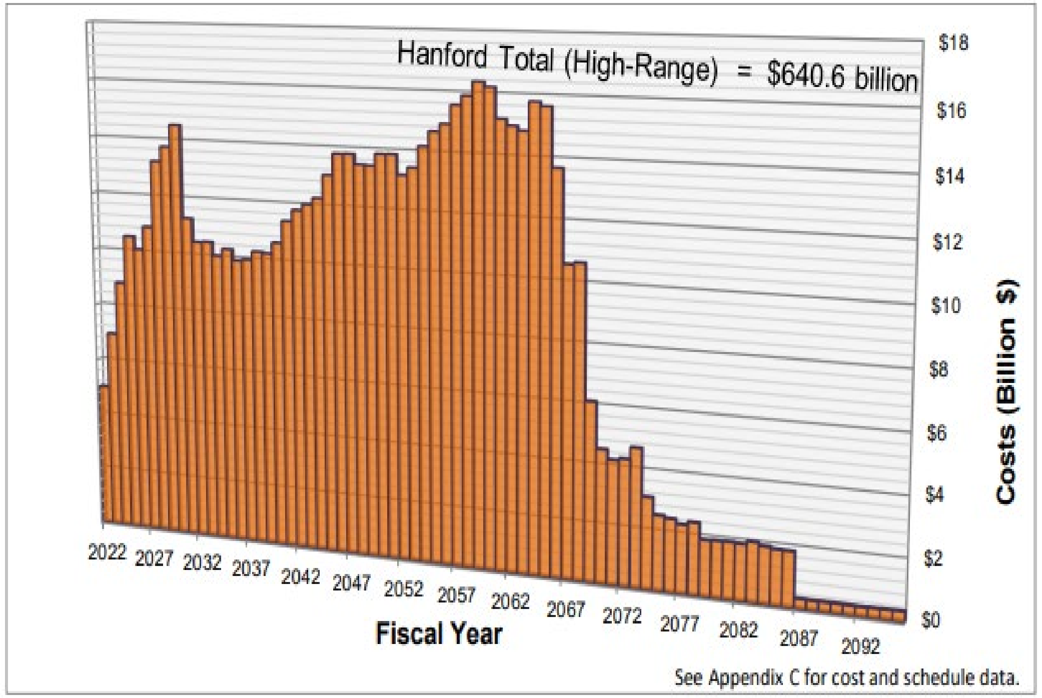


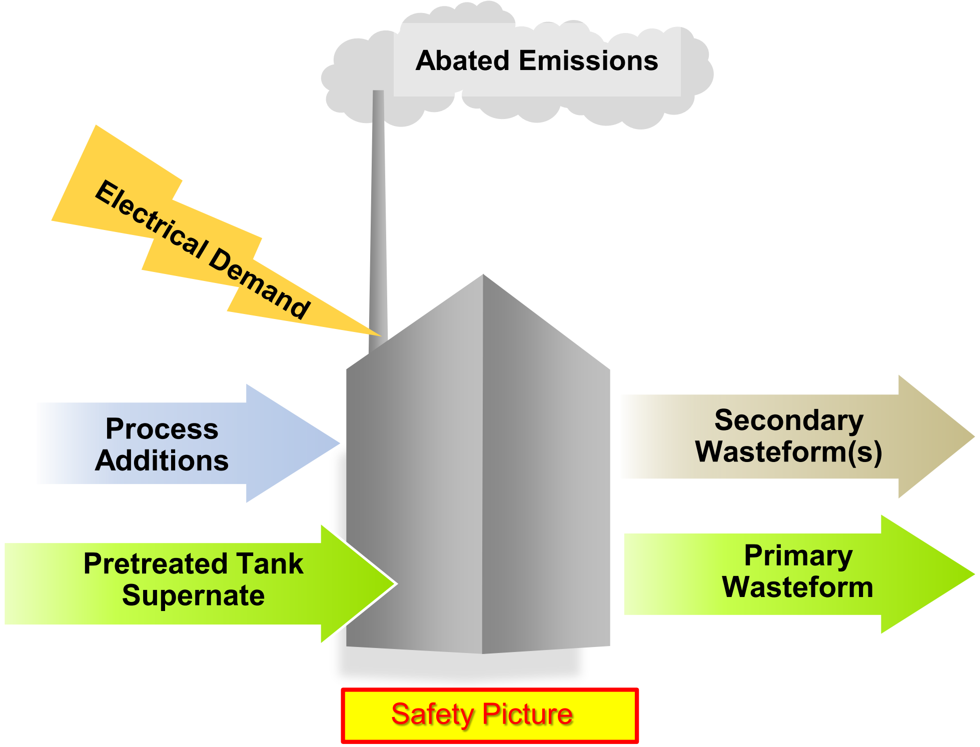
Figure ES-2. Hanford Site Remaining Estimated Cleanup Costs (High-Range) by Fiscal Year

Low and High Hanford Remaining Estimated Cleanup Costs

DOE/RL-2021-47, 2022, *Hanford Lifecycle Scope, Schedule, and Cost Report*, U.S. Department of Energy, Richland, Washington.

Challenges:

Challenges with baseline strategy



Better Flowsheet knowledge illustrates hazards, impacts and demands of high temperature processes

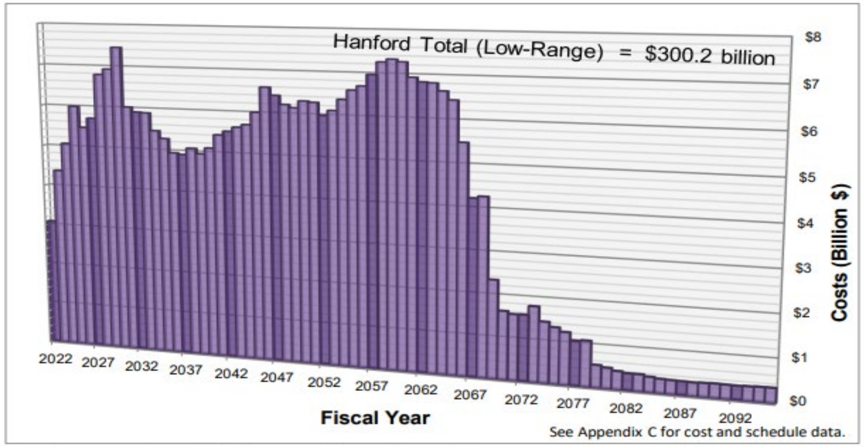


Figure ES-1. Hanford Site Remaining Estimated Cleanup Costs (Low-Range) by Fiscal Year (includes both RL and ORP).

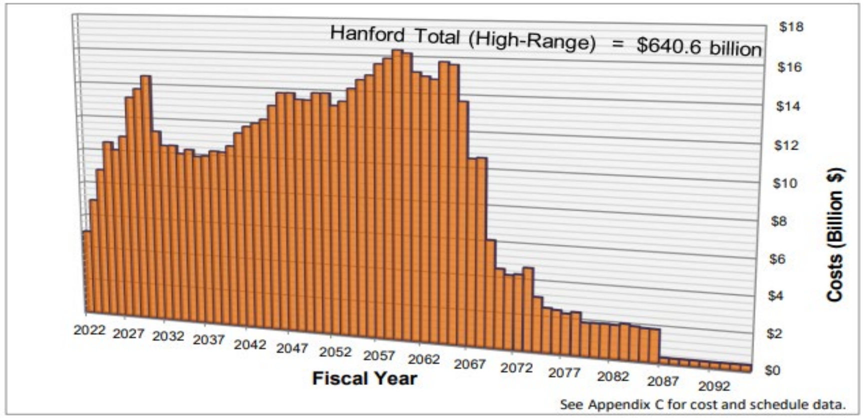


Figure ES-2. Hanford Site Remaining Estimated Cleanup Costs (High-Range) by Fiscal Year

Low and High Hanford Remaining Estimated Cleanup Costs

DOE/RL-2021-47, 2022, *Hanford Lifecycle Scope, Schedule, and Cost Report*, U.S. Department of Energy, Richland, Washington.

Future Opportunities and Realities:

- DOE needs to use limited resources to reduce risk and treat waste
  - DST space is vital to the cleanup mission
  - Tank Integrity Program – Best in Class
  - DST Refurbishment / Repair – In development

- We are looking forward to the FFRDC's final report and the National Academy of Science input and conclusions to inform the decision on SLAW

Questions?