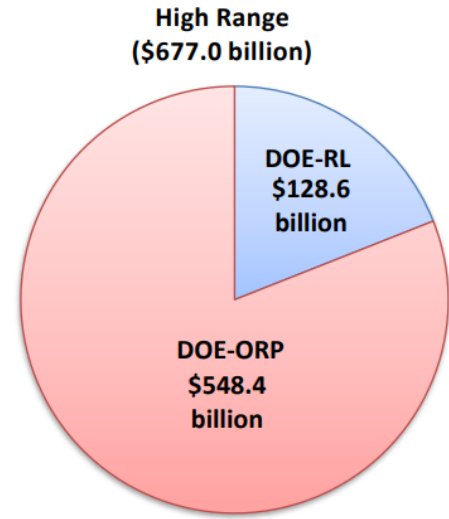
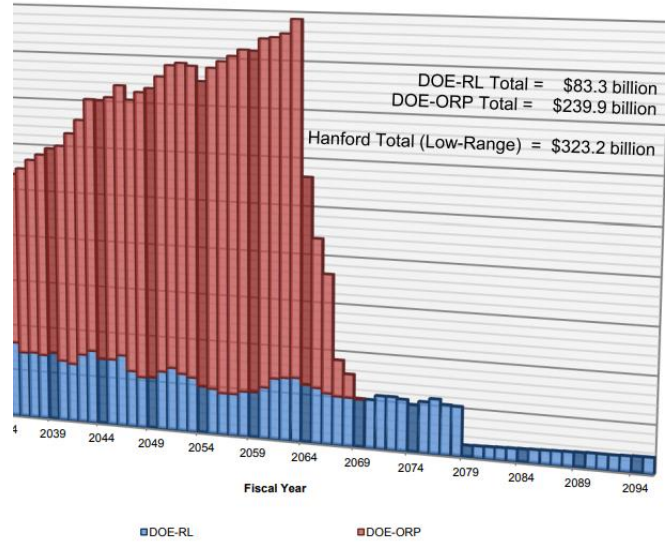
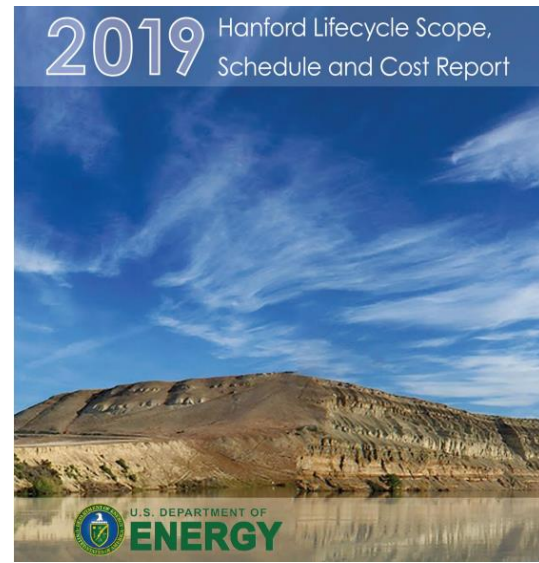


# You'd best sit down for this: 2019 Hanford Lifecycle Cost Report

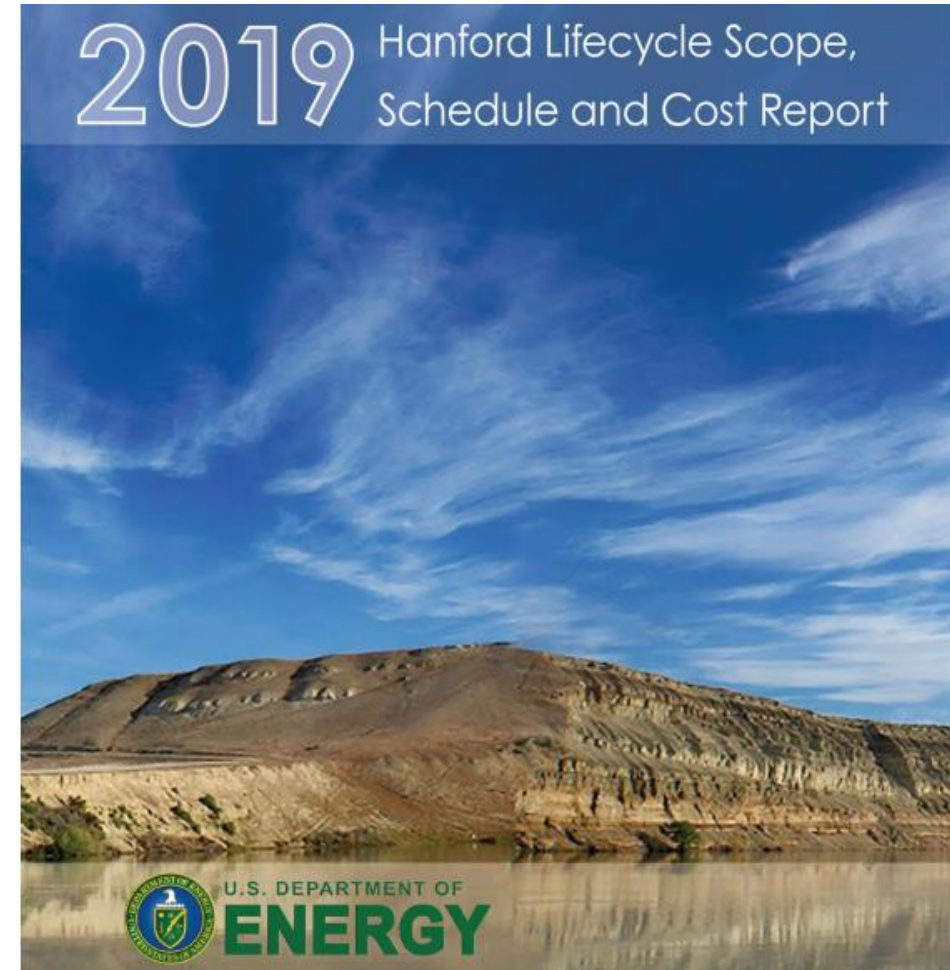
Jeff Burrig  
Oregon Department of Energy

Oregon Hanford  
Cleanup Board  
March 2019 Meeting



# Purpose of the Lifecycle Report

- Provides an agreed-upon foundation for preparing budget requests.
- Supports informational briefings to affected Tribal Nations, Oregon, and Hanford stakeholders.
- Supports discussions with EPA and Ecology on how and when DOE will complete cleanup and how milestone changes will affect lifecycle scope, schedule, and cost.



# Lifecycle Report and Budget Planning

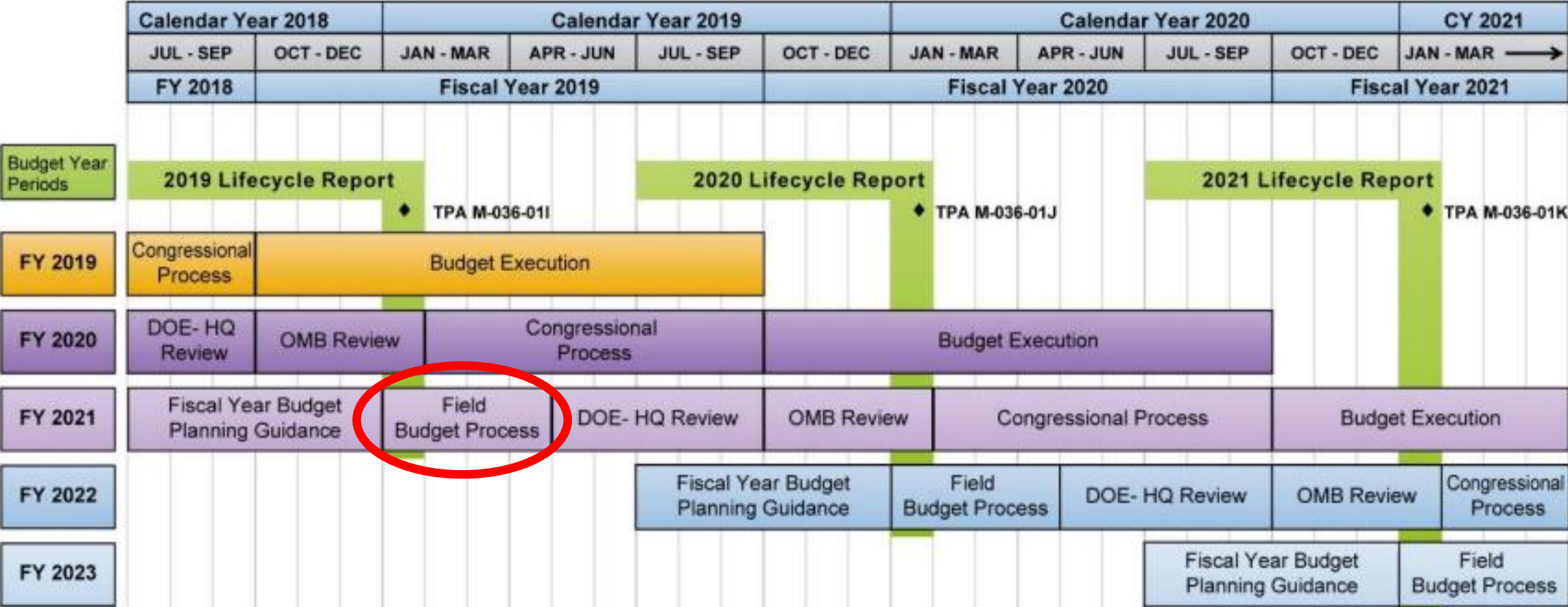


Figure 1-2. Relationship Between DOE Budget Planning and LCR Schedule.

# Lifecycle Report Methodology Key Facts

---

- The ORP low-range estimate is based on the baseline case in System Plan 8.
  - Doesn't include tank vapor delays, TSCR plans.
  - Cost includes the results of the US Army Corps evaluation of WTP
- Where cleanup decisions are not known or not final, the low-range estimate assumes a reasonable upper cost bound for a range of plausible alternatives.
- The high-range cost estimate incorporates an unconstrained estimate for identified risks (i.e., “worst case” scenario).
- Escalation rate of 2-4% per year (time value of money).

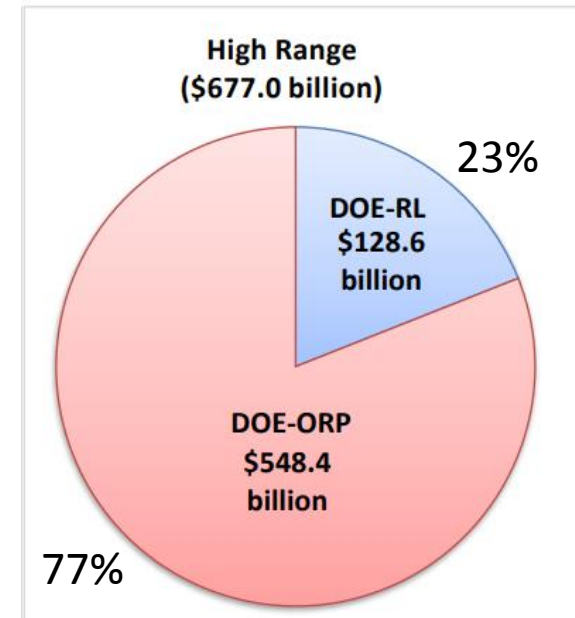
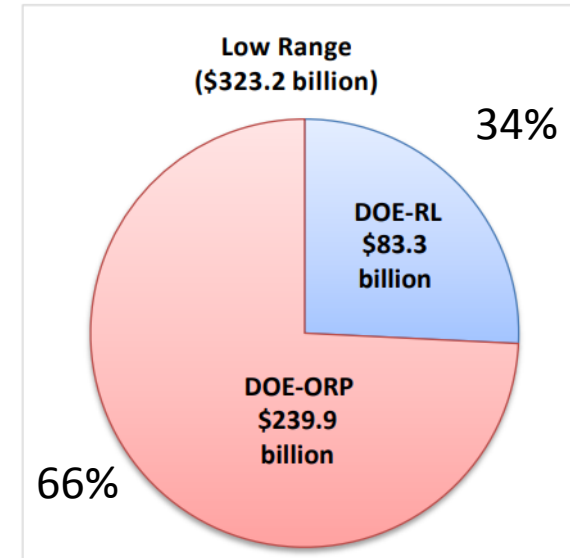
# Essential Findings

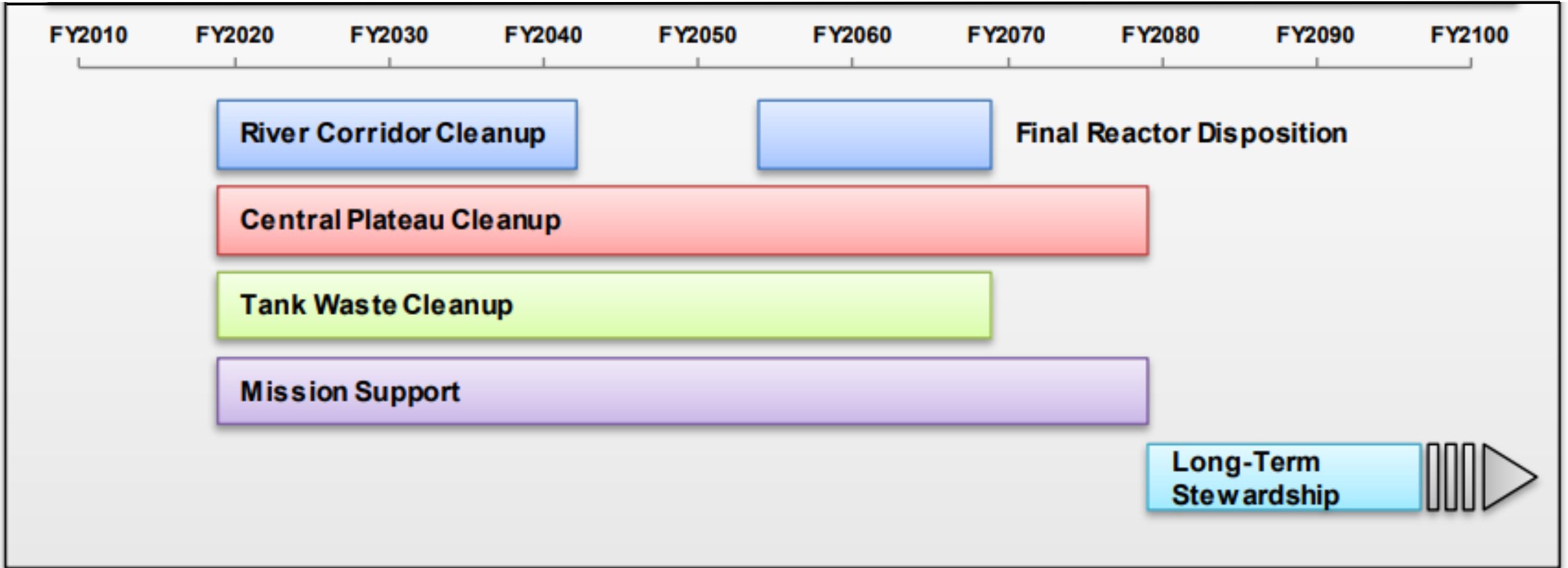
Low-range estimate: **\$323.2 billion**

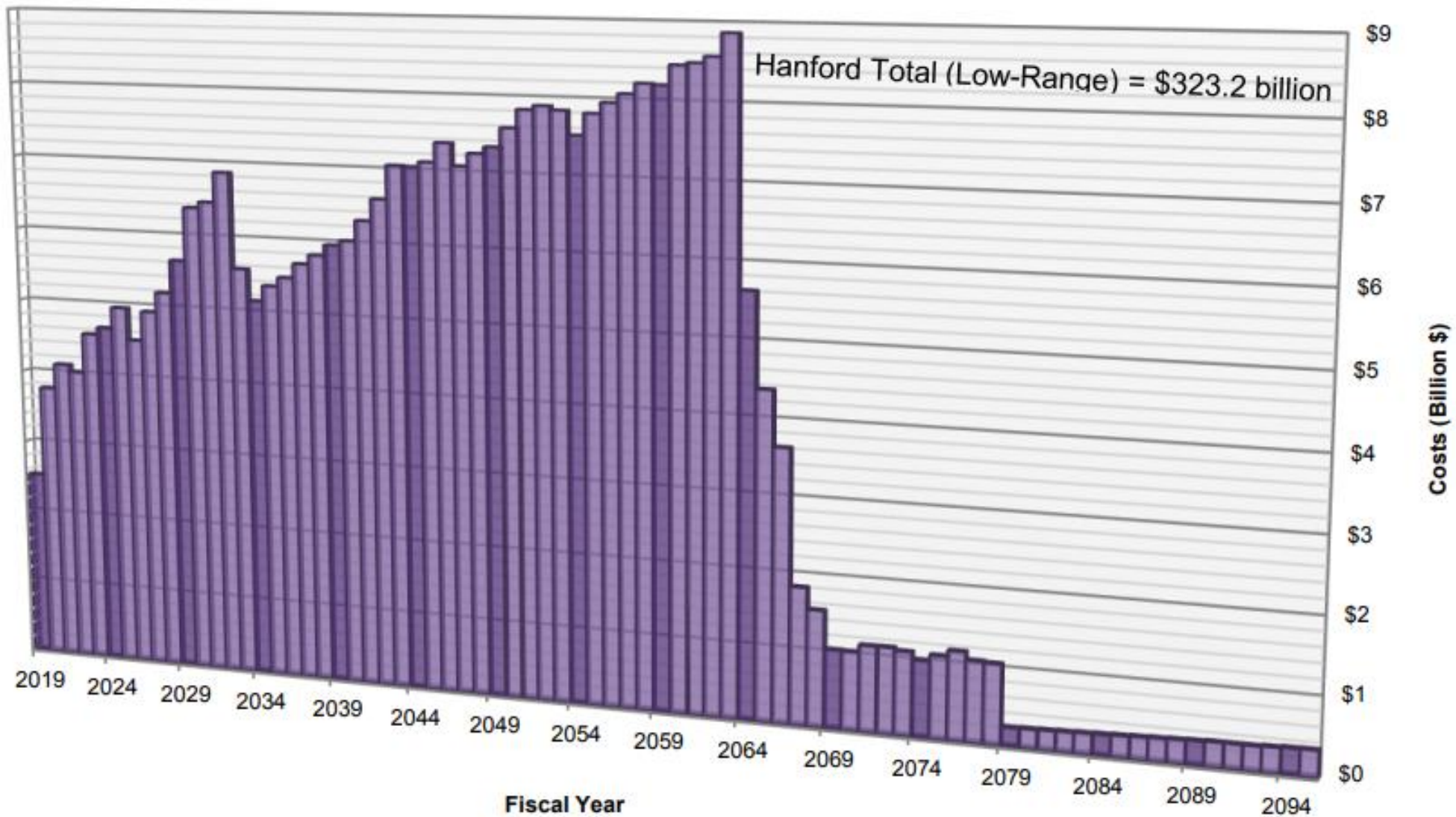
- \$83.3 billion from RL
- \$239.9 billion from ORP

High-range estimate: **\$677 billion**

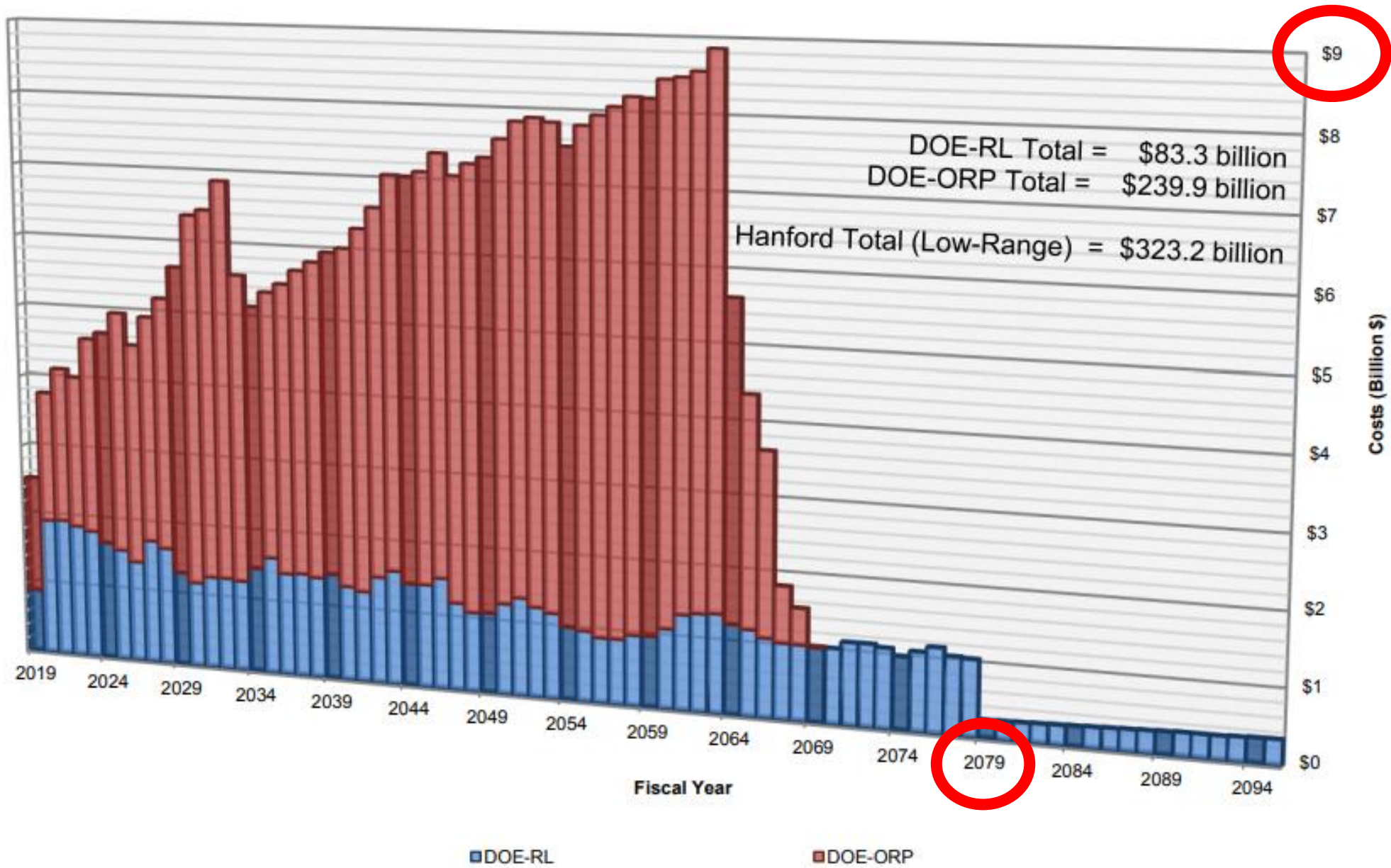
- \$128.6 billion from RL (54% increase)
- \$548.4 billion from ORP (129% increase)



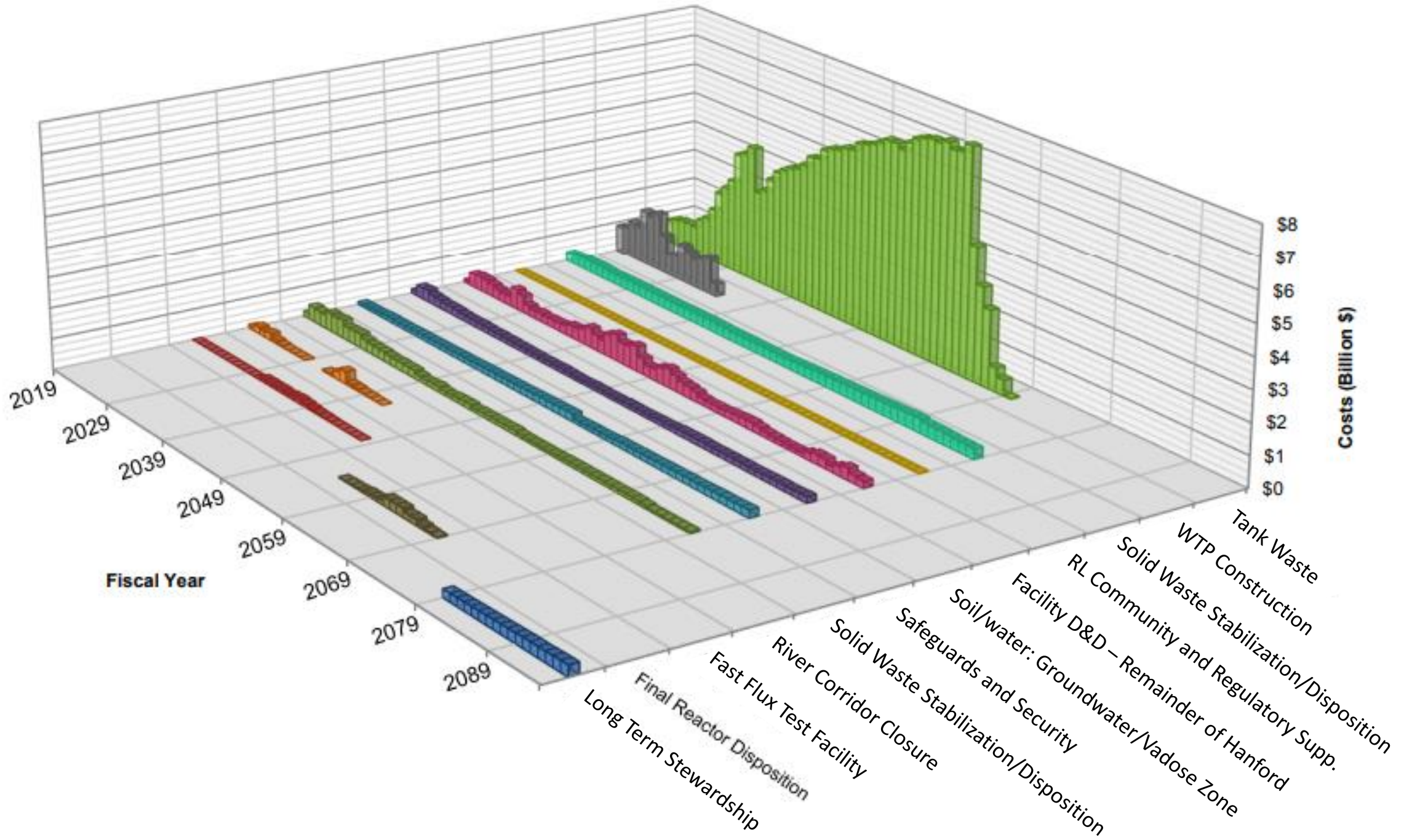




Hanford Site Remaining Estimated Cleanup Costs (Low-Range) by Fiscal Year (includes both RL and ORP).







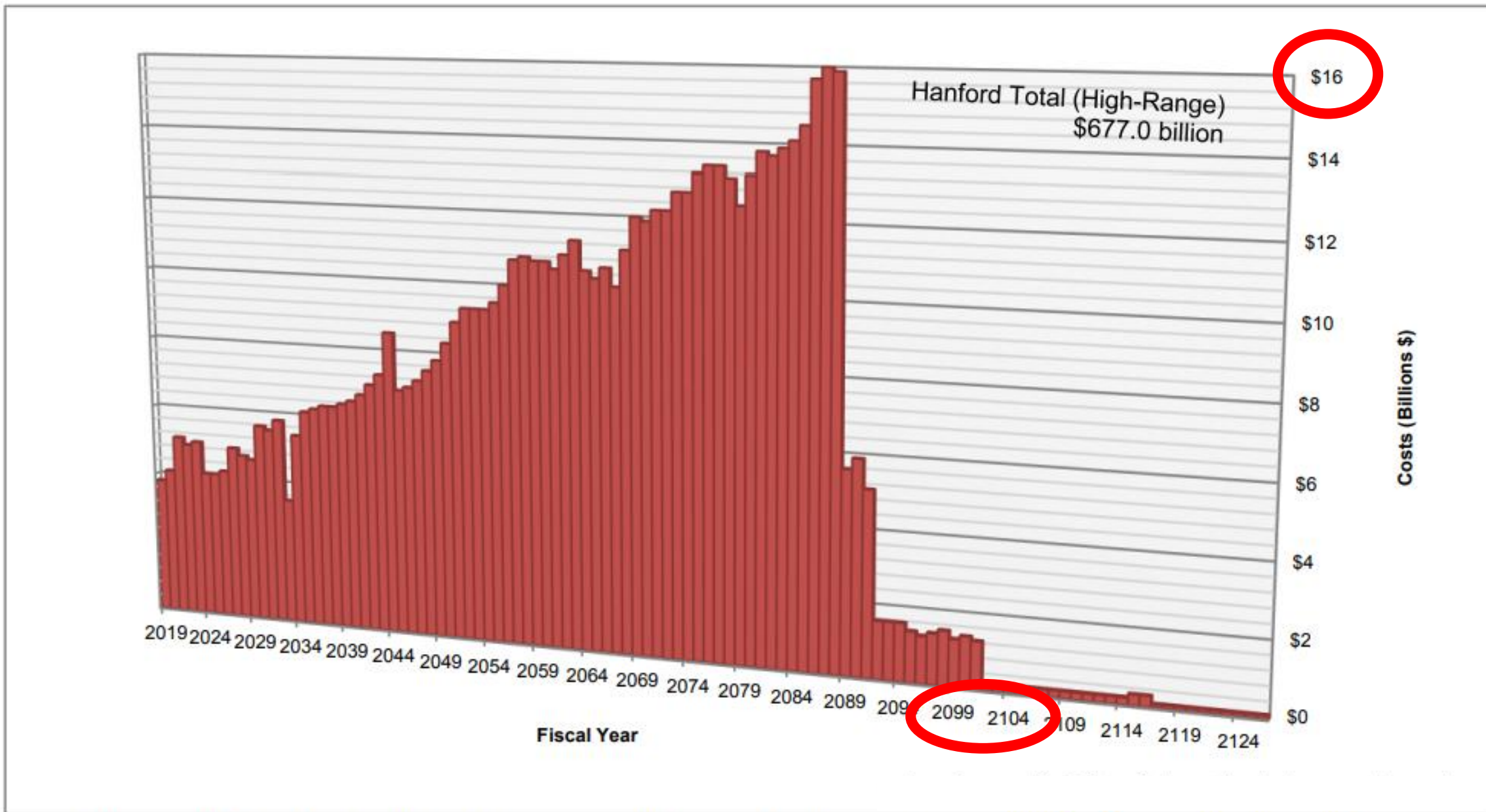


Figure ES-2. Hanford Site Remaining Estimated Cleanup Costs (High-Range) by Fiscal Year (includes both RL and ORP).

Table ES-1. Hanford Site Remaining Cleanup Cost Estimated Ranges by PBS.

Project Work Scope	Estimated Cleanup Costs <sup>1</sup> (Billion \$)
NM Stabilization and Disposition - PFP (PBS RL-0011)	\$0 <sup>2</sup>
SNF Stabilization and Disposition (PBS RL-0012)	\$0 <sup>3</sup>
Solid Waste Stabilization and Disposition - 200 Area (PBS RL-0013C)	\$11.5 - \$15.1
Safeguards and Security (PBS RL-0020)	\$10.1 - \$23.9
Soil and Water Remediation - Groundwater/Vadose Zone (PBS RL-0030)	\$9.6 - \$10.5
Nuclear Facility D&D - Remainder of Hanford (PBS RL-0040)	\$20.6 - \$26.8
Nuclear Facility D&D - River Corridor Closure Project (PBS RL-0041)	\$1.8 - \$2.0
Nuclear Facility D&D - Fast Flux Test Facility Project (PBS RL-0042)	\$1.0 - \$1.1
Richland Community and Regulatory Support (PBS RL-0100)	\$1.1 - \$1.7
Hanford Sitewide Services (PBS RL-0201)	\$20.4 - \$32.8
Radioactive Liquid Tank Waste Stabilization and Disposition (PBS ORP-0014)	\$221.4 - \$518.1
Major Construction - Waste Treatment Plant (PBS ORP-0060)	\$18.5 - \$30.3
Waste Treatment Plant Operations (PBS ORP-0070)	\$0 <sup>4</sup>
<b>Hanford Site Total Remaining Estimated Cleanup Costs</b>	<b>\$316.1 - \$662.4</b>
Long-Term Stewardship (PBS RL-LTS) <sup>5</sup>	\$5.2 - \$12.7
Final Reactor Disposition <sup>5</sup>	\$1.9
<b>DOE-Office of Environmental Management Total Remaining Estimated Cleanup Costs</b>	<b>\$323.2 - \$677.0</b>

# Comparing 2019 to 2016

---

	<u>2016</u>		<u>2019</u>
Major Construction of WTP	\$1.5 B	→	\$18.5 B

# Comparing 2019 to 2016

---

	<u>2016</u>		<u>2019</u>
Major Construction of WTP	\$1.5 B	→	\$18.5 B
Radioactive Liquid Tank Waste Stabilization and Disposition	\$53.5 B	→	\$221 B

# Comparing 2019 to 2016

---

	<u>2016</u>		<u>2019</u>
Major Construction of WTP	\$1.5 B	→	\$18.5 B
Radioactive Liquid Tank Waste Stabilization and Disposition	\$53.5 B	→	\$221 B
Hanford Sitewide Services	\$1.2 B	→	\$20.4 B

# Comparing 2016 to 2019

	<u>2016</u>		<u>2019</u>
Major Construction of WTP	\$1.5 B	→	\$18.5 B
Radioactive Liquid Tank Waste Stabilization and Disposition	\$53.5 B	→	\$221 B
Hanford Sitewide Services	\$1.2 B	→	\$20.4 B
Total Estimated Cleanup Cost	\$103-107 B	→	\$323-677 B

# Decisions Still to be Made

Table 1-3. Cleanup Actions for which Final Decisions Have Not Been Made.

<b>River Corridor Cleanup Actions</b>	
<ul style="list-style-type: none"> <li>• Disposition N Reactor</li> <li>• Disposition 100 Area K West Basin</li> <li>• Remediate 100 Area Contaminated Soil Sites</li> <li>• Restore 100-BC-5 Groundwater OU to Beneficial Use</li> <li>• Restore 100-KR-4 Groundwater OU to Beneficial Use</li> </ul>	<ul style="list-style-type: none"> <li>• Restore 100-NR-2 Groundwater OU to Beneficial Use</li> <li>• Disposition 300 Area Facilities Retained by PNNL</li> <li>• Disposition 100 Area former Orchard Contaminated Soil Sites (100-OL-1 OU)</li> </ul>
<b>Central Plateau Cleanup Actions</b>	
<ul style="list-style-type: none"> <li>• Disposition Remaining Outer Area Buildings and Facilities (200-OA-1 OU)</li> <li>• Remediate Remaining Outer Area Contaminated Soil Sites (200-OA-1, 200-CW-1, 200-CW-3 OUs)</li> <li>• Disposition Below-Grade Portions of Plutonium Finishing Plant</li> <li>• Disposition B Plant Canyon Building/Associated Waste Sites (200-CB-1 OU)</li> <li>• Disposition PUREX Canyon Building/Associated Waste Sites (200-CP-1 OU)</li> <li>• Disposition PUREX Storage Tunnels (200-CP-1 OU)</li> <li>• Disposition REDOX Canyon Building/Associated Waste Sites (200-CR-1 OU)</li> <li>• Disposition T Plant Canyon Building/Associated Waste Sites</li> <li>• Disposition Cesium/Strontium Capsules</li> <li>• Remediate Solid Waste Landfill and Non-Radioactive Dangerous Waste Landfill (200-SW-1 OU)</li> <li>• Disposition Remaining Liquid Waste Disposal Facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Disposition Remaining Waste Treatment, Storage, and Disposal Facilities</li> <li>• Remediate Pipelines, Pits, Diversion Boxes and Associated Tanks (200-IS-1 OU)</li> <li>• Remediate Land Disposal Units (200-SW-2 OU)</li> <li>• Remediate Remaining 200 West Inner Area Contaminated Soil Sites (200-WA-1 OU)</li> <li>• Remediate Remaining 200 East Inner Area Contaminated Soil Sites (200-EA-1 OU)</li> <li>• Disposition Remaining Inner Area Buildings and Facilities</li> <li>• Remediate Contaminated Deep Vadose Zone (200-DV-1 OU)</li> <li>• Restore 200 West Groundwater (200-UP-1 OU) to Beneficial Use</li> <li>• Restore 200 East Groundwater (200-PO-1/200-BP-5 OUs) to Beneficial Use</li> </ul>
<b>Tank Waste Cleanup Actions</b>	
<ul style="list-style-type: none"> <li>• Tank Retrieval and Single-Shell Tank Farm Closure</li> <li>• Tank Waste Treatment</li> <li>• Secondary Waste Treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Double-Shell Tank Closure</li> <li>• Waste Treatment and Immobilization Plant Closure</li> </ul>



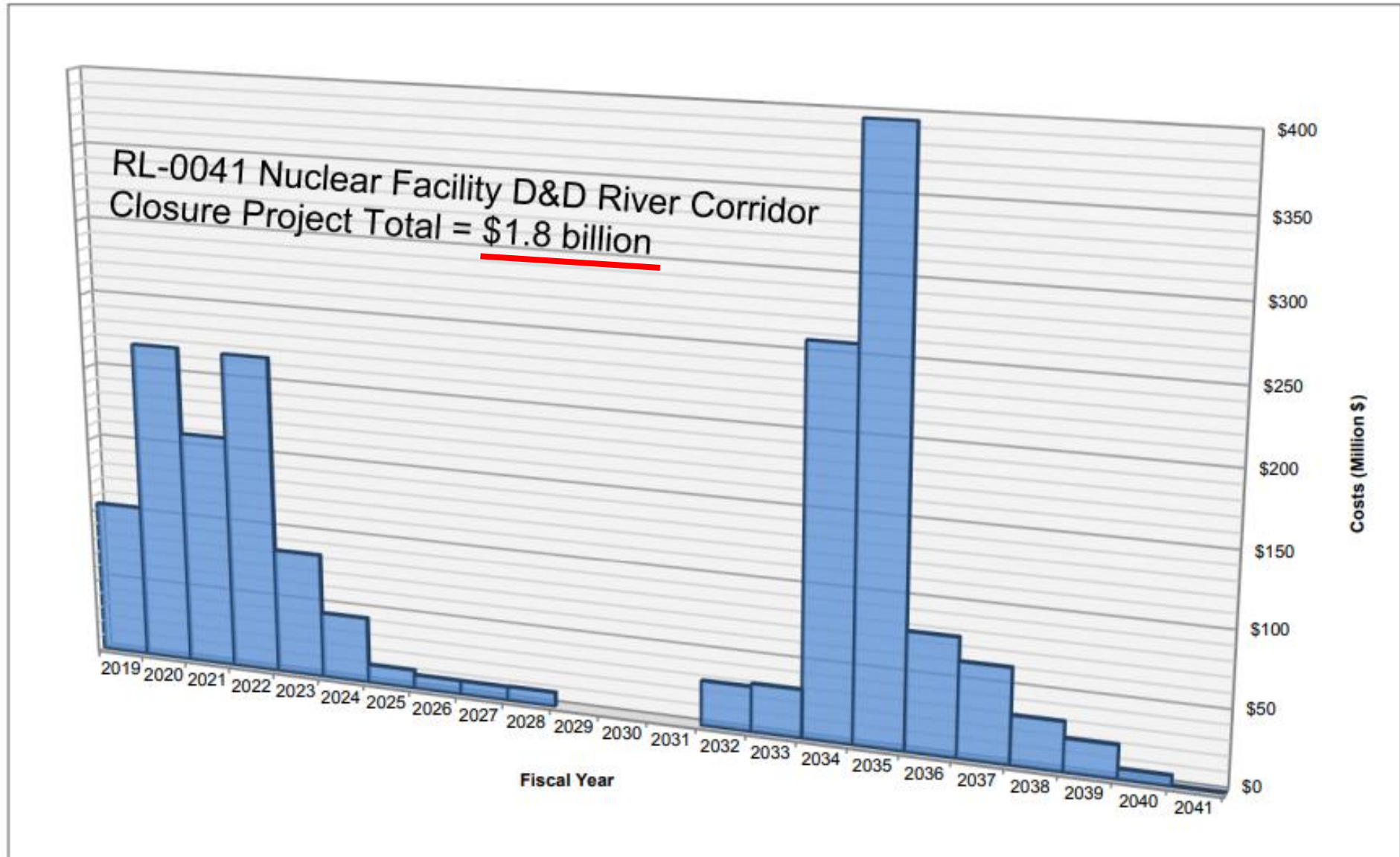
# River Corridor Cleanup

- 100-K Area and 100-N Area remediation.
  - demolition of K West Basin
  - disposition of K East and K West Reactors
- Remediation of the 618-11 burial ground and waste site 300-296 (contaminated soil below the 324 Building B Hot Cell).
- D&D of support structures.



*K West and K East Reactors and Basins*

# River Corridor Cleanup Costs



# River Corridor: Uncertainties and Assumptions

---

## Low Range Estimate (\$1.8B)

- Regulatory changes will not require significant additional activities (e.g., document revisions, additional sampling).
- Remaining costs for completion of the NRDAR process range from \$5 million to \$10 million.
- Any significant settlement funds for the NRDAR case would be obtained through the U.S. Judgement Settlement Fund.

## High Range Estimate (\$2B)

- Contamination spread during 618-11 burial ground remediation.
- Remediation more extensive than planned.
- Building/system degradation and failures during S&M.
- Total volume of high-dose 324 Building soil exceeds hot cell space.
- K-West Basin has residual TRU waste requiring remote handling.

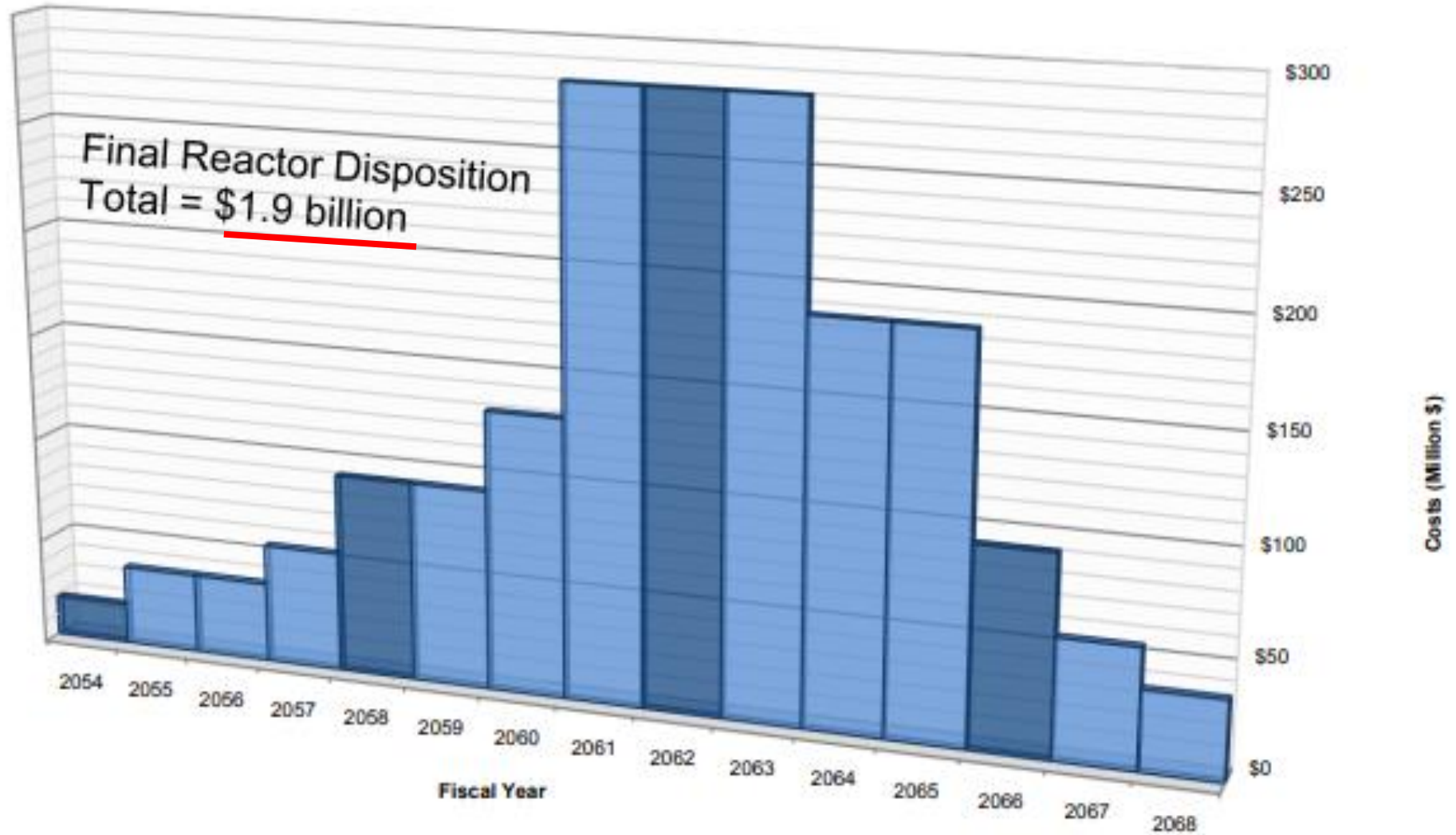
# Reactor Dispositioning

- Six reactors (C, D, DR, F, H, and N) have been placed in ISS configuration.
- KE Reactor and KW Reactor are scheduled to complete ISS by FY 2024.
- Reactors will undergo surveillance, monitoring, and maintenance for up to 75 years to allow radionuclides to decay.
- From 2054-2068, plan is to remove the reactor blocks from their current locations and transported to the Central Plateau Inner Area for disposal.



*C Reactor in Interim Safe Storage*

# Reactor Dispositioning Costs



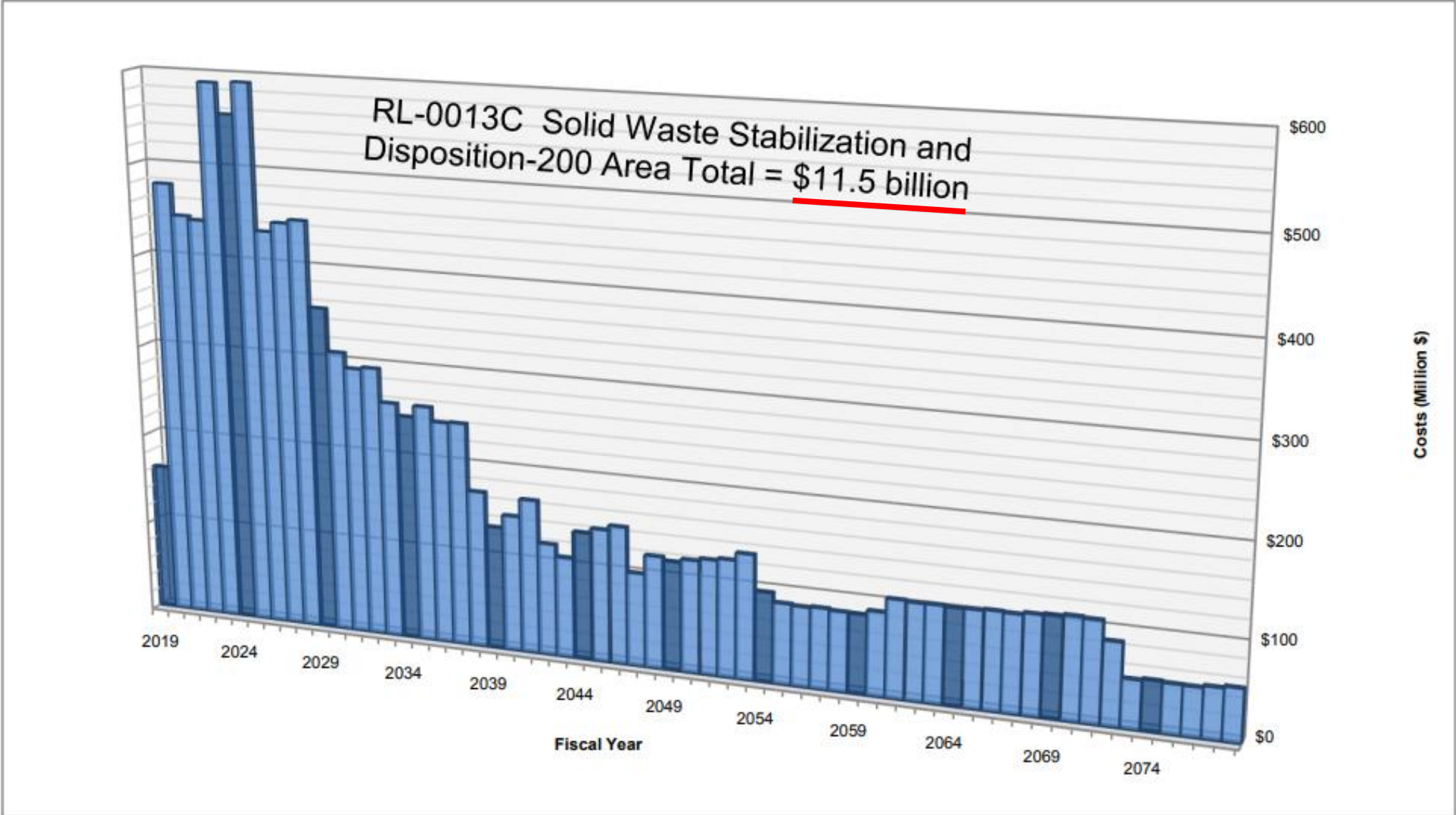
# Central Plateau Cleanup: Solid Waste Stabilization and Disposition

- PFP expected to cost another \$46.2M and be completed by September 2019.
- Solid waste stabilization and disposition includes activities at ERDF, IDF, WESF, low level burial grounds, and mixed waste disposal trenches.
- Includes shipment of TRU waste to WIPP, processing remote-handled wastes, and management of orphan waste (e.g., cesium/strontium capsules).
- Includes expanding IDF and ERDF.



*Environmental Restoration Disposal Facility (ERDF)*

# Central Plateau Solid Waste Cost Estimate



# Central Plateau Solid Waste: Estimate Assumptions

---

## Low Range Estimate (\$11.5B)

- New treatment facilities not required to support longer WTP operations.
- T Plant will be available for managing Hanford RCRA transuranic mixed (TRUM) waste.
- WIPP remains operational through the end of cleanup operations that could generate TRU waste (2037).

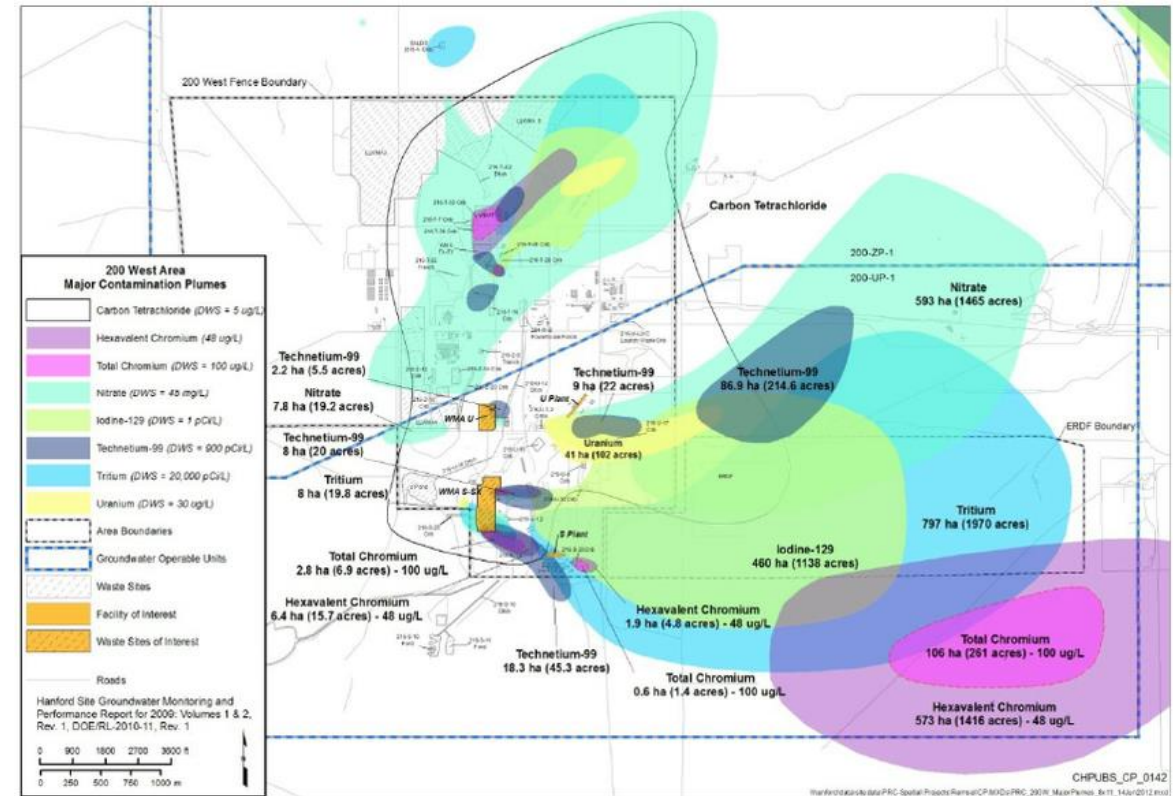
## High Range Estimate (\$15.1B)

- Receipt of non-compliant waste from other projects.
- Spent fuel found in alpha caissons.
- Delays in receiving regulatory approvals (contact-handled retrieval, alpha caisson retrieval and processing).

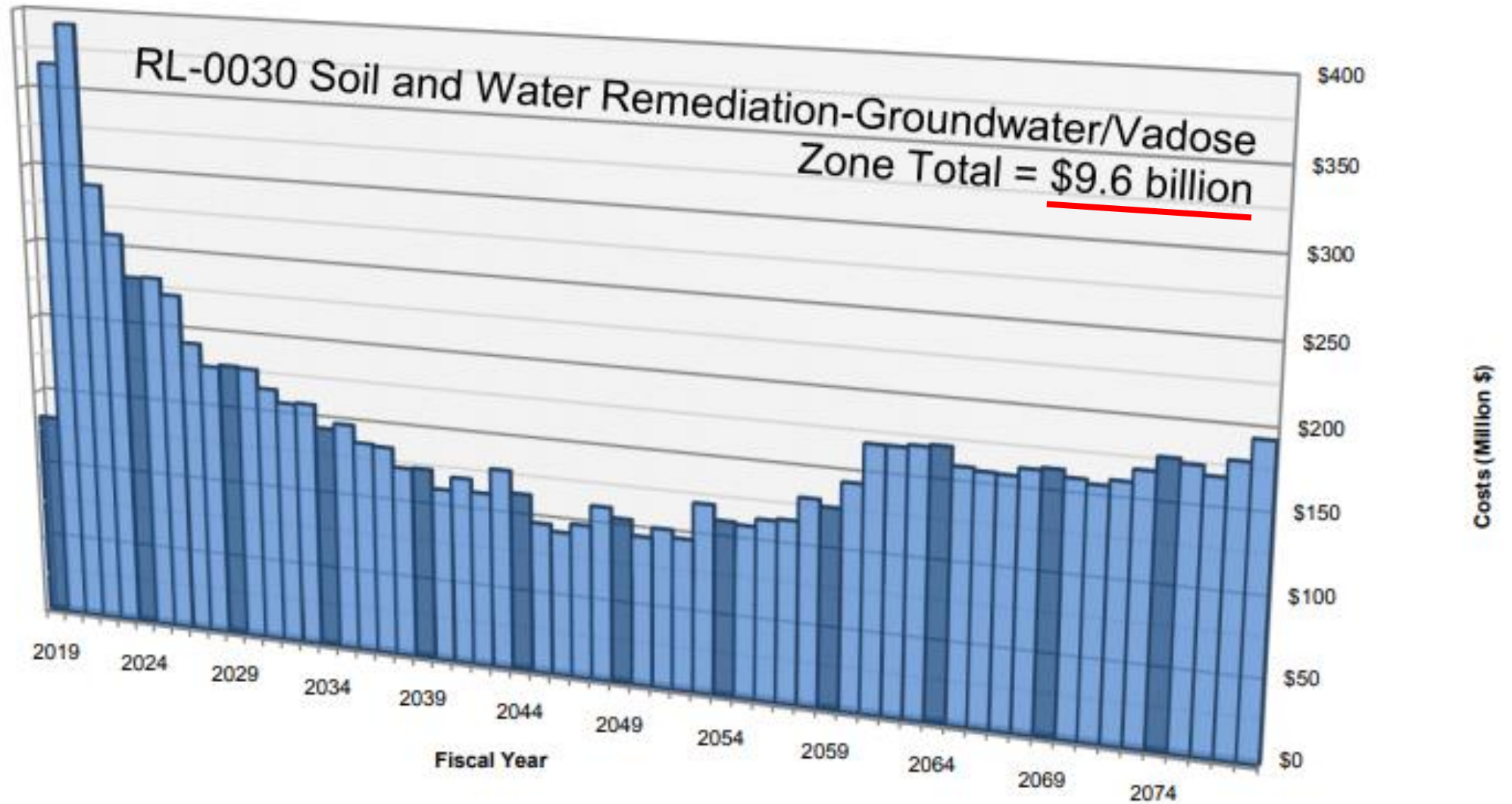


# Central Plateau: Soil and Water Remediation – Groundwater/Vadose Zone

- Complete regulatory process for all groundwater units.
- Remediation of all groundwater, including characterization and monitoring activities, treatability testing, documentation, and groundwater treatment.
- Complete regulatory process for central plateau waste sites.
- Deep vadose zone contamination remediation in the Central Plateau.



# Central Plateau Groundwater/Vadose Cost



# Groundwater/Vadose Zone: Estimate Assumptions

---

## Low Range Estimate (\$9.6B)

- Planned characterization of the vadose zone below the HLW tanks will be sufficient to evaluate remedies for protection of groundwater.
- No substantial new requirements will be added to meet the state's implementation of RCRA.

## High Range Estimate (\$10.5B)

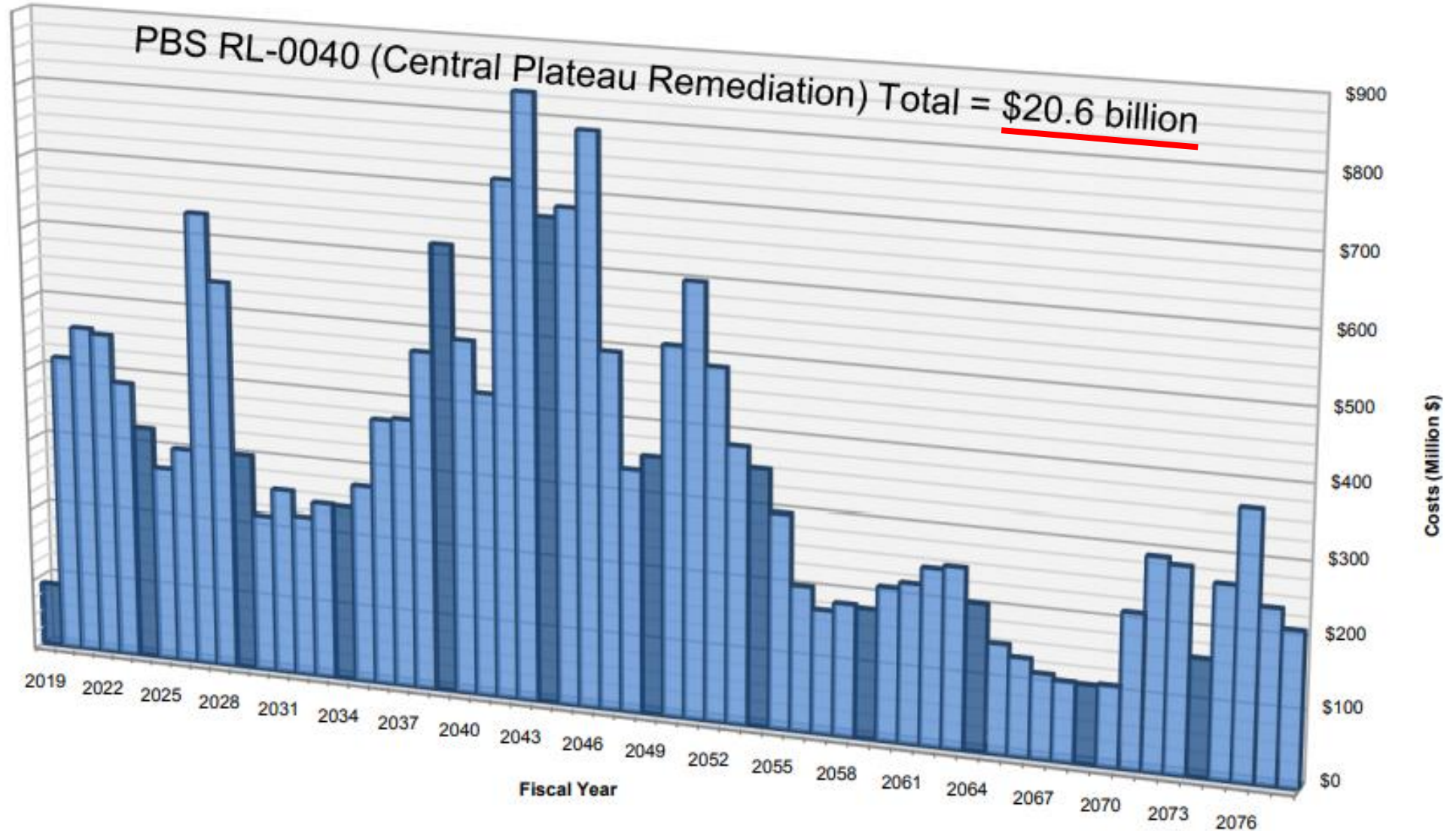
- RCRA/CERCLA issues delay records of decision.
- Significant contamination is interpreted or discovered that requires further investigation and/or remediation.
- Pump and treat operations require extended duration.

# Central Plateau: Nuclear Facility D&D – Remainder of Hanford

- Includes physical cleanup of canyon facilities, buildings and structures, waste sites, pipelines, miscellaneous sites (e.g., debris piles), and utilities.
  - Surveillance & Maintenance of facilities and waste sites pending remediation
  - Integrate planning and execution activities with other Central Plateau projects
  - Remediate waste sites and pipelines
  - D&D canyons
  - D&D excess facilities



# Central Plateau D&D Cost Estimate



# Central Plateau D&D: Estimate Assumptions

---

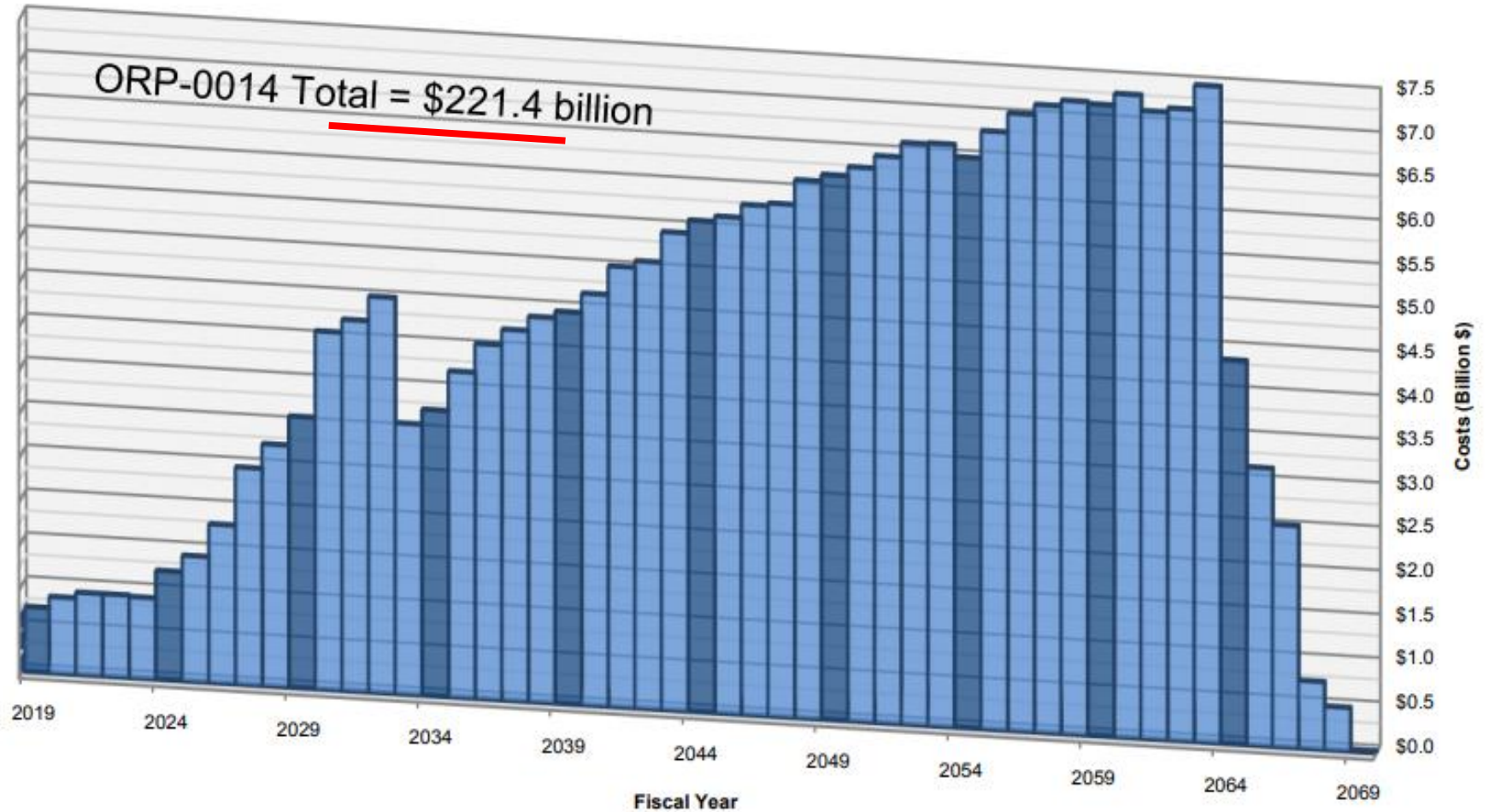
## Low Range Estimate (\$20.6B)

- An industrial worker scenario used to define exposure scenarios and cleanup levels for the Inner Area.
- Cleanup levels for the Outer Area based on future land use of conservation/mining.
- The Central Plateau area will remain under Federal control for the foreseeable future.
- All low-level legacy waste will be managed and treated and disposed onsite.
- Planning assumes that geographic aggregate barriers will be utilized. Barriers assumed to cover facilities and adjacent waste sites or multiple adjacent waste sites.
- Removal excavations are assumed to be 15 feet below grade.

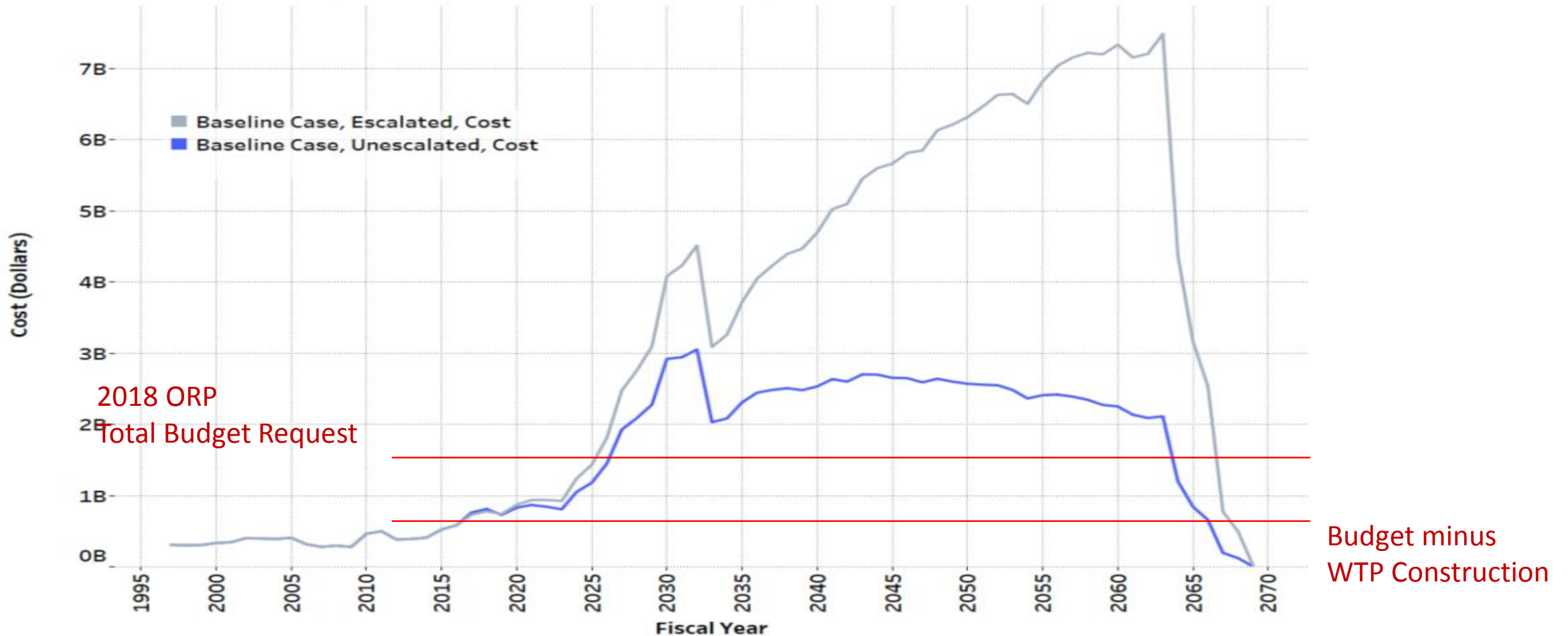
## High Range Estimate (\$26.8B)

- Records of decisions for implementation areas are not consistent with planned assumptions.
- New waste sites are discovered in implementation areas after records of decisions are issued.
- Radioactive material is considered to be contaminated waste that must be removed (rather than hold-up material).
- The nature and extent of contamination is substantially greater than the baseline assumptions for implementation areas.

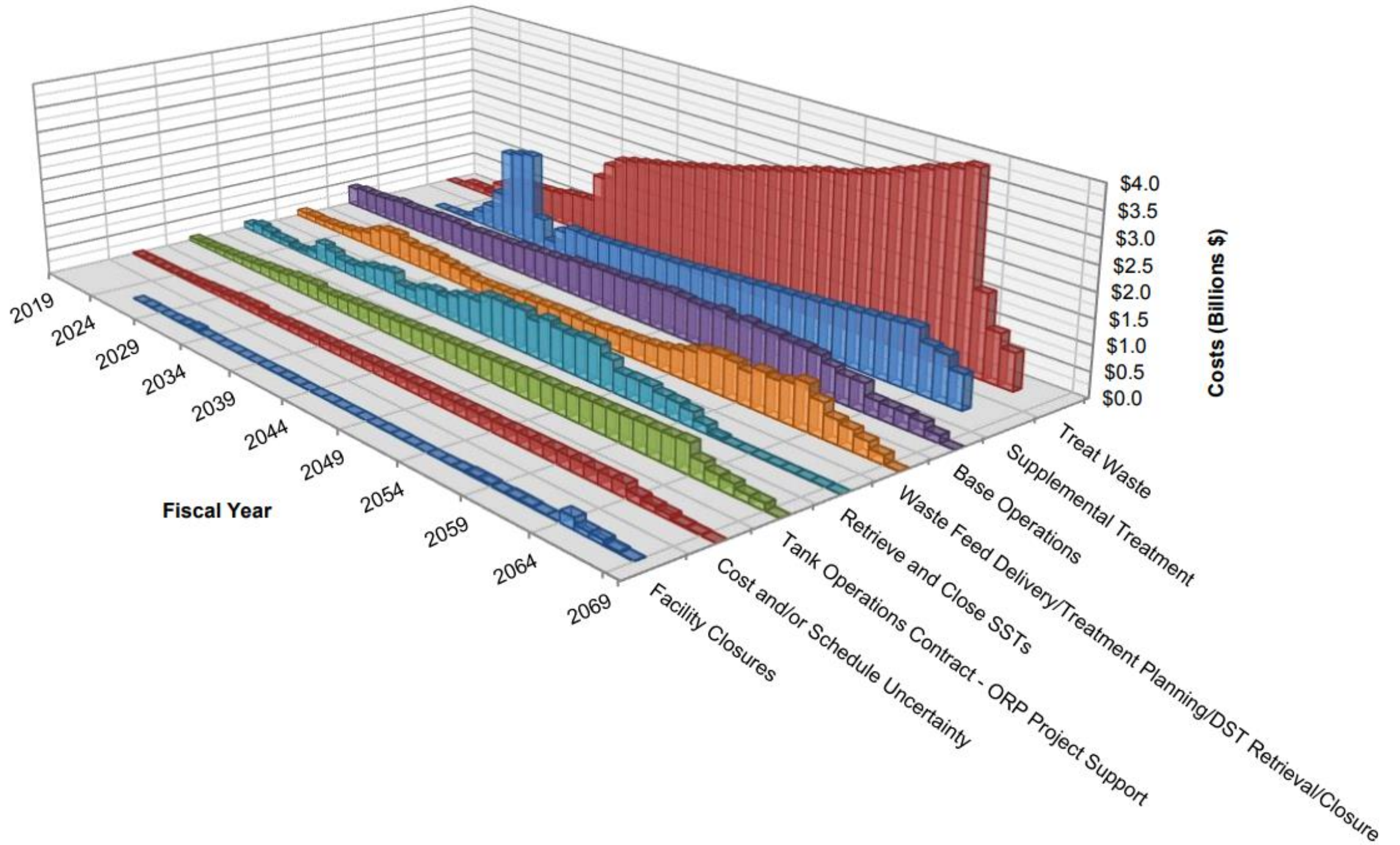
# Tank Waste Treatment and Tank Closure



# Baseline Cost Profile – System Plan 8

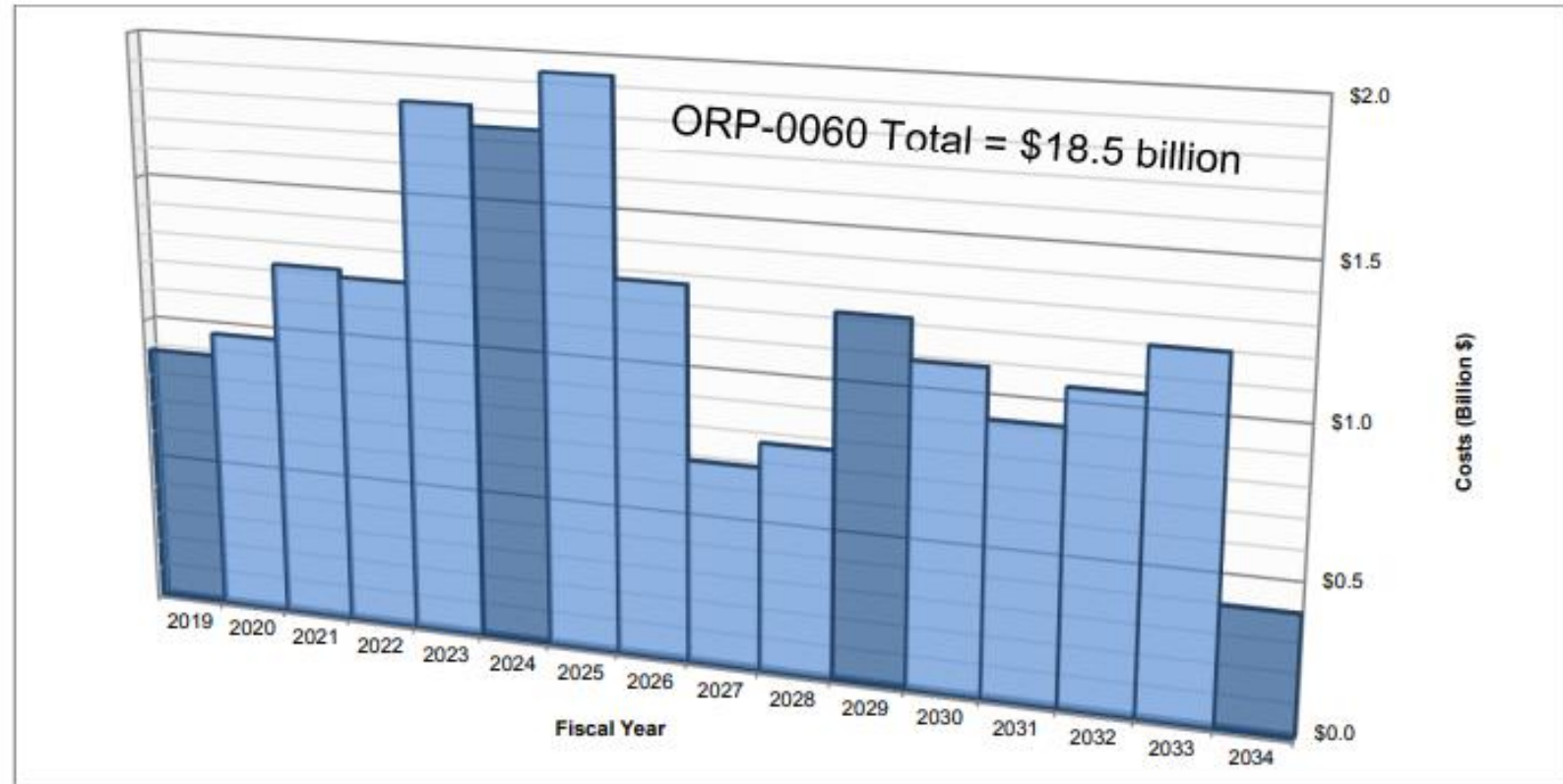




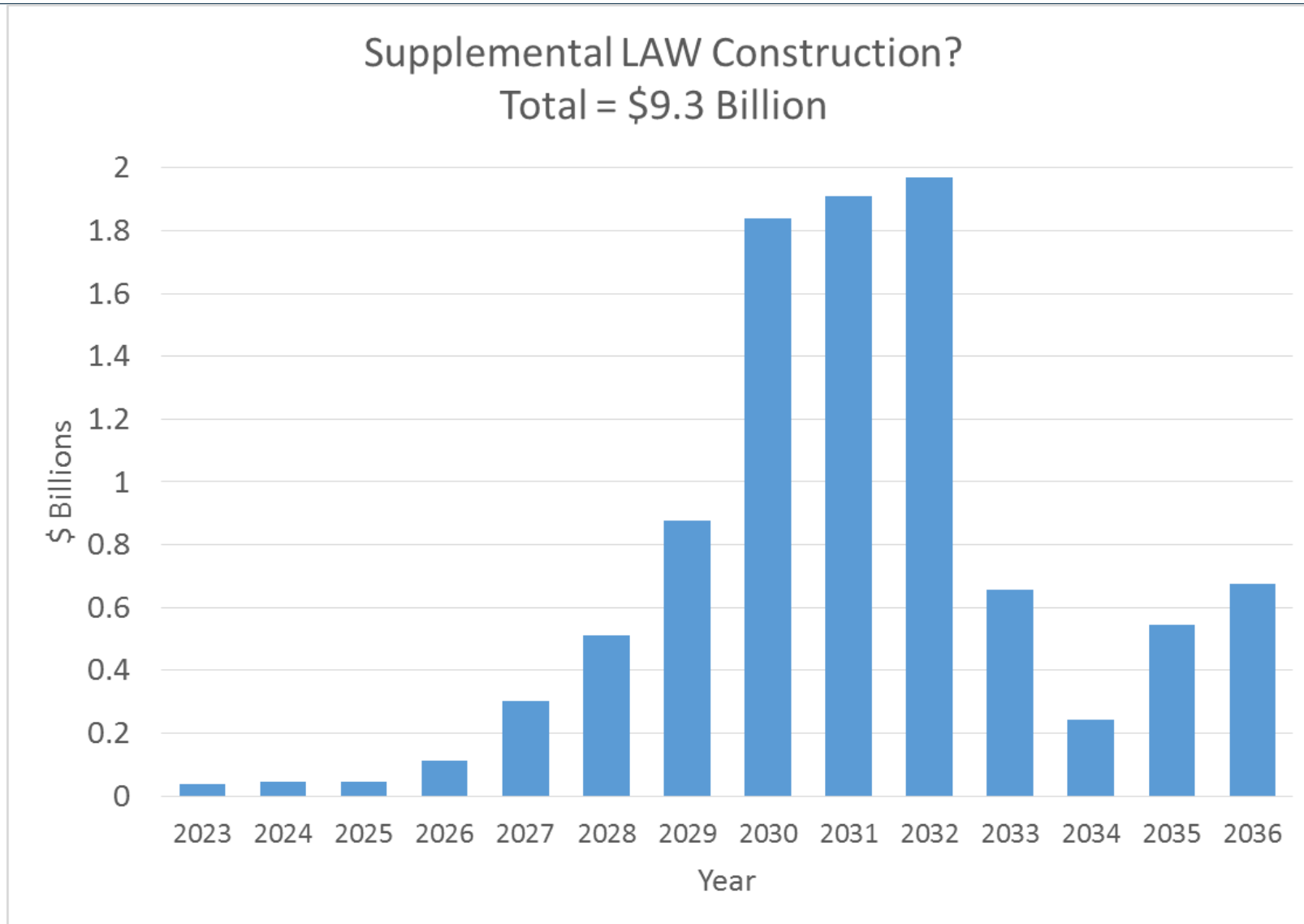


# WTP Construction Completion

- \$18.5 billion from TODAY.
- Generally consistent with Army Corps evaluation.
- Supplemental LAW infrastructure spending not included.



# Supplemental LAW Construction Estimate?



# Low-Range Assumptions and Uncertainties

---

- Low-range estimate is built on the assumptions that went into System Plan 8 Baseline, such as:
  - All DSTs except AY-102 will remain fully operational.
  - Treatment facilities start “on time.”
  - The 242-A Evaporator will remain operational for the duration.\*\*
  - WTP can be upgraded to extend beyond 40 year design life if necessary.
  - The Pretreatment Facility will be completed and operate as envisioned.
  - The final HLW repository will have the same waste acceptance criteria as Yucca.
  - Cesium and Strontium capsules are not sent through the WTP.
- No explicit assumption about Supplemental LAW waste form (i.e., glass vs. grout vs. steam reforming).

# High-Range Uncertainties and Assumptions (\$221 billion vs \$518 billion)\*

---

- Partial or full replacement of TWCS and the WTP HLW Facility considered very likely (40 year design lives).
- High likelihood that LAW facility throughput can't meet 70% operating efficiency as planned.
- High likelihood that PT Facility throughput does not meet 70%.
- PT Facility rendered inoperable due to black cell failure and must be completely replaced.
- High likelihood that HLW facility does not meet 70% efficiency.
- SST retrieval rates too optimistic.
- Additional DSTs “could” leak.

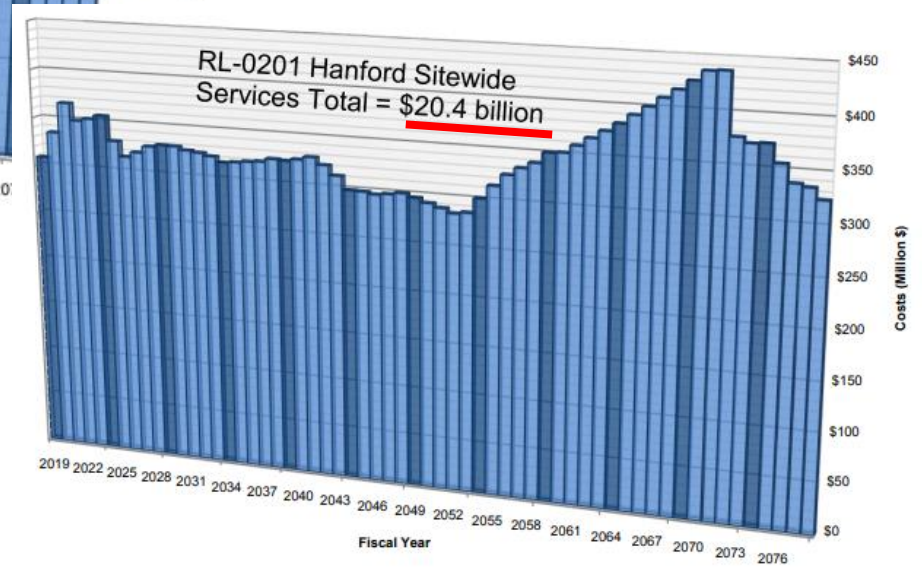
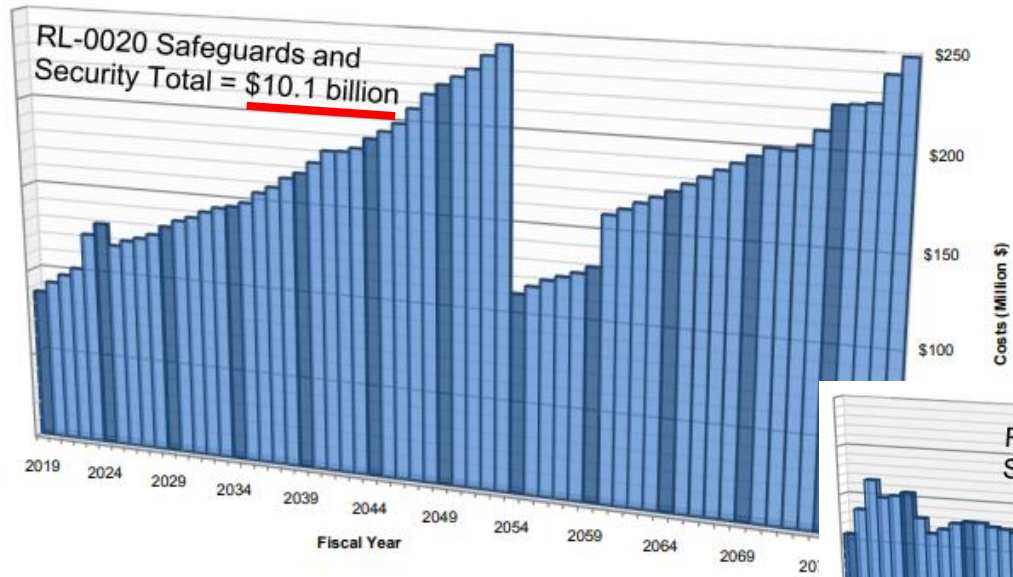
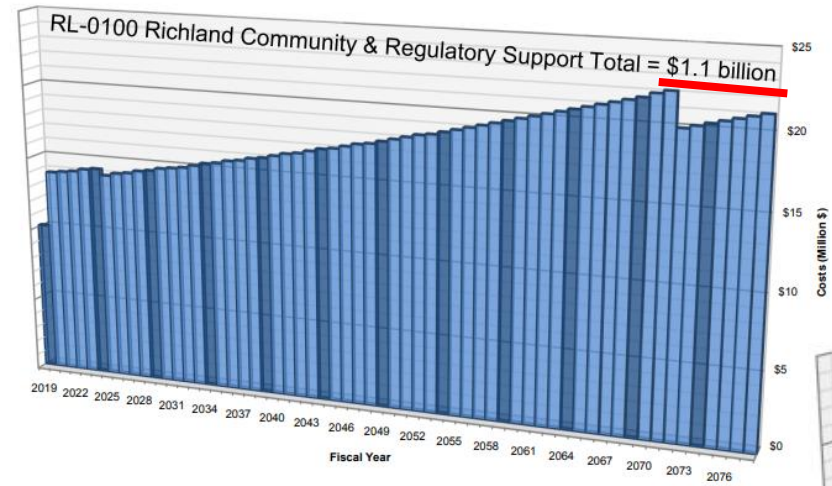
# High-Range Uncertainties and Assumptions (\$221 billion vs \$518 billion)\*

- High likelihood that 242-A Evaporator fails and must be replaced.
- Possible that facilities and equipment become obsolete.
- High likelihood that PT facility produces “orphan” TRU secondary waste.
- High likelihood that PT facility completion is delayed.
- WIR determinations required for newly generated waste forms.
- Spent ion exchange media from TSCR do not have a disposition path.
- Cross site transfer system not operational when needed.



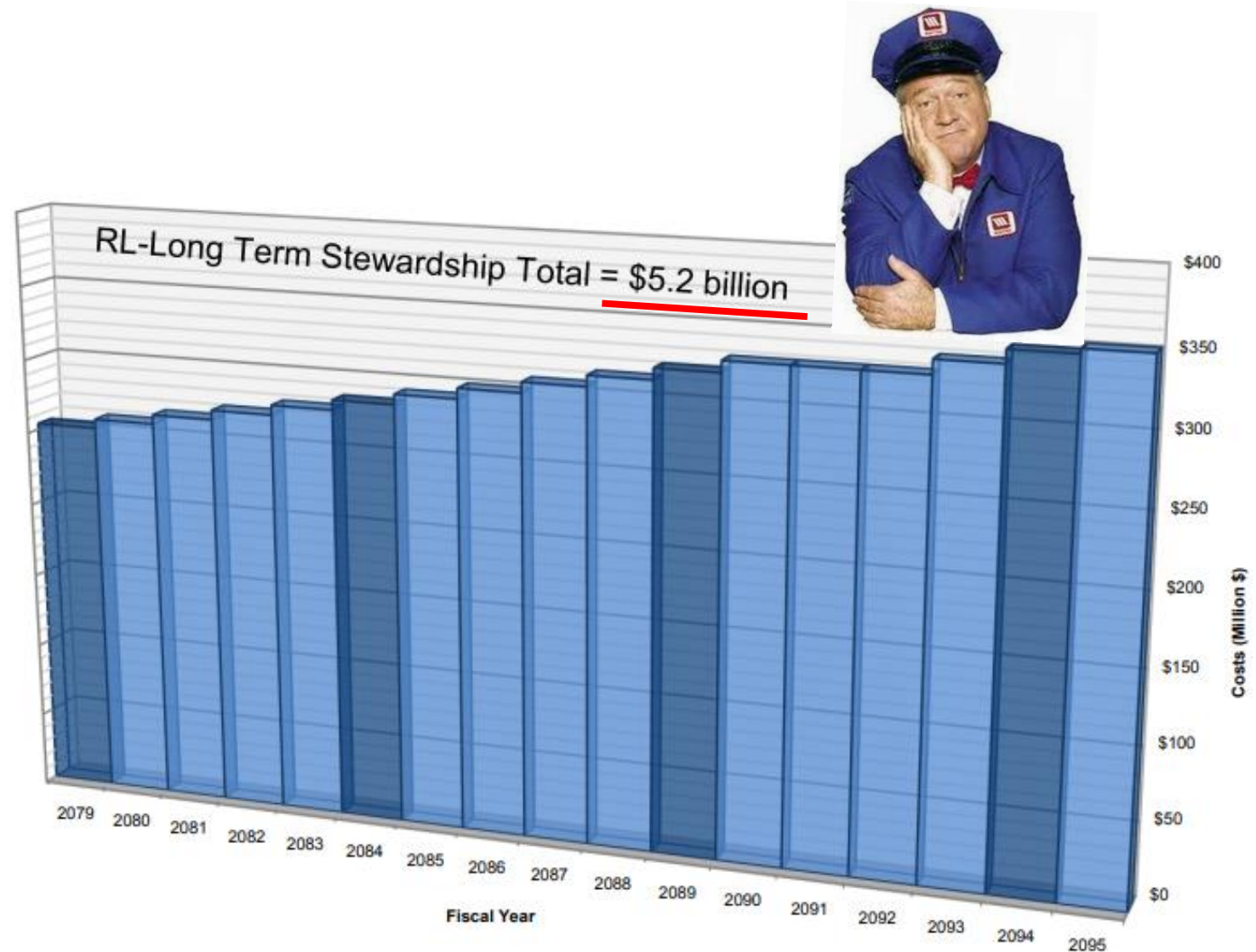
*Lesson from System Plan 8:  
Be careful what you wish for.*

# Mission Support Cost



# Long Term Stewardship Cost

- Covers long term monitoring, surveillance, and maintenance following completion of cleanup activities.
- Costs don't actually stop in 2095.
- Cleanup decisions generally assume 100 years of institutional control, but it could continue indefinitely.





# Questions Remain

---

- Will DOE request \$4 billion in their next budget request? If not, why?
- How were cost estimates for WTP operation developed? Why will it cost over \$1B per year to run the WTP once it's completed?
- How did DOE estimate the extremely large cost of the high-range estimate for the tank mission?
- Why are the costs of long-term stewardship so high?

# What Could This Mean for Cleanup?

---

- The next several months will test all of our will to fund cleanup as we know it.
- The Lifecycle Report is part of a “pivot anchor”:
  - System Plan 8 scenarios
  - Recent GAO reports on DOE financial liability and waste classification
  - National Academies of Science study on Supplemental LAW
  - Army Corps report on cost/schedule to complete the WTP
  - CRESF final report on risk-based end states
  - Test Bed Initiative
  - HLW definition reinterpretation
- Expect attempts at a New Grand Bargain™ for Hanford.

# Next Steps

---

- Feedback regarding the 2019 Lifecycle Report will be considered as future reports are developed. Feedback can be emailed to [lcssc@rl.gov](mailto:lcssc@rl.gov).
- DOE and Ecology continue to negotiate tank treatment milestones (initiated October 2017).
- DOE at Hanford will prepare their budget request this spring to send to HQ. HQ will send a budget request to OMB for assembling President's budget request, then onto Congress for final appropriation.

# If you can stand a little more . . .

---

A sobering 10-minute explanation of Hanford spending on WTP so far and funding needs over the next 15 years:

(from the November 2018 National Academies of Sciences meeting)

[www.tinyurl.com/hanfordmoney](http://www.tinyurl.com/hanfordmoney)

(starting right before the 30 minute mark, but the really good stuff starts at 32 minutes)