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Looking Ahead to the Future: The Role for RemPlex

November 16, 2023

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2023 Global Summit
on Environmental Remediation
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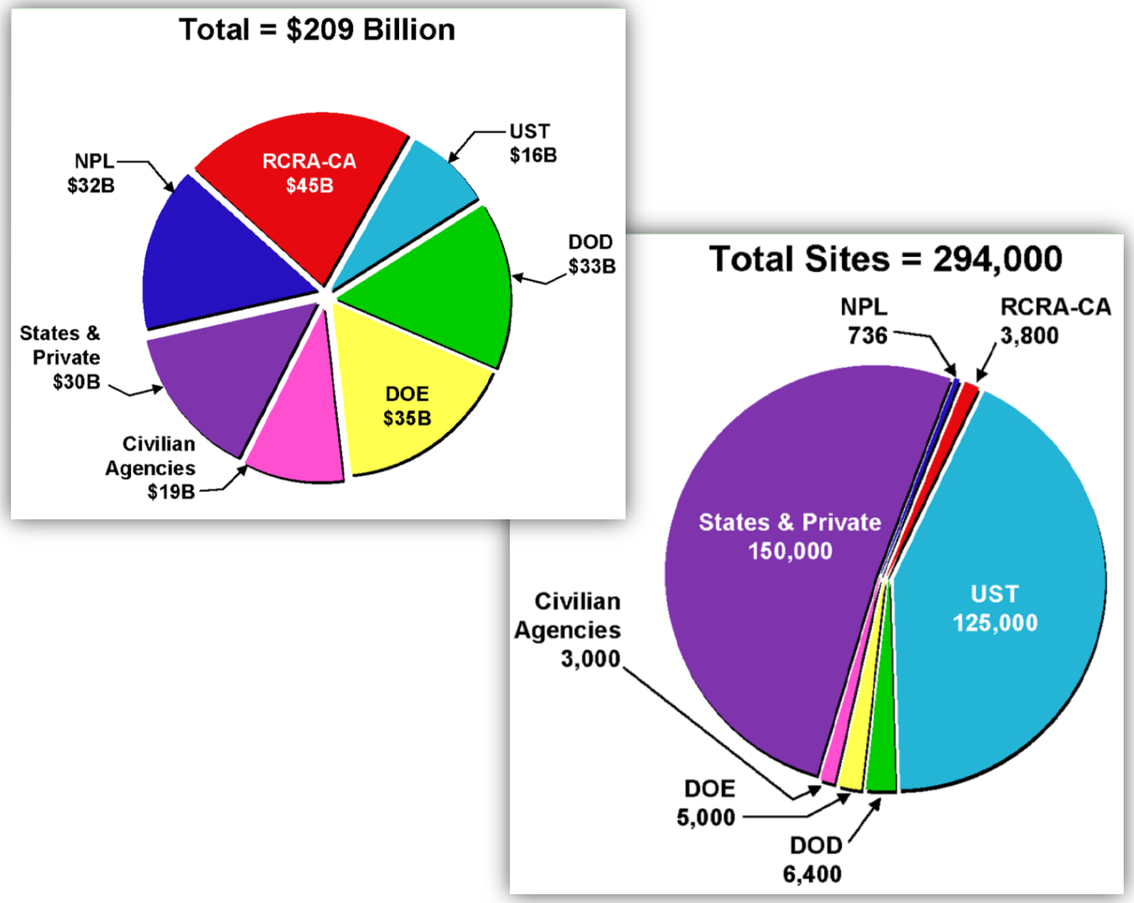
Complex Site Challenges



- EPA, 2004
  - Technical complexities limiting remediation and closure of ~300,000 sites and ~$200B
- National Research Council, 2013
  - Technical complexities preventing closure of ~13,000 Sites 50-100 years
  - "*…extensive groundwater contamination, heterogeneous geology, large releases and/or source zones, multiple and/or recalcitrant contaminants, heterogeneous contaminant distribution in the subsurface, and long time frames since releases occurred*."
- Interstate Technology & Regulatory Council, 2017
  - "*Sites where remediation progress is uncertain, and remediation is not anticipated to achieve closure or even long-term management within a reasonable timeframe*."

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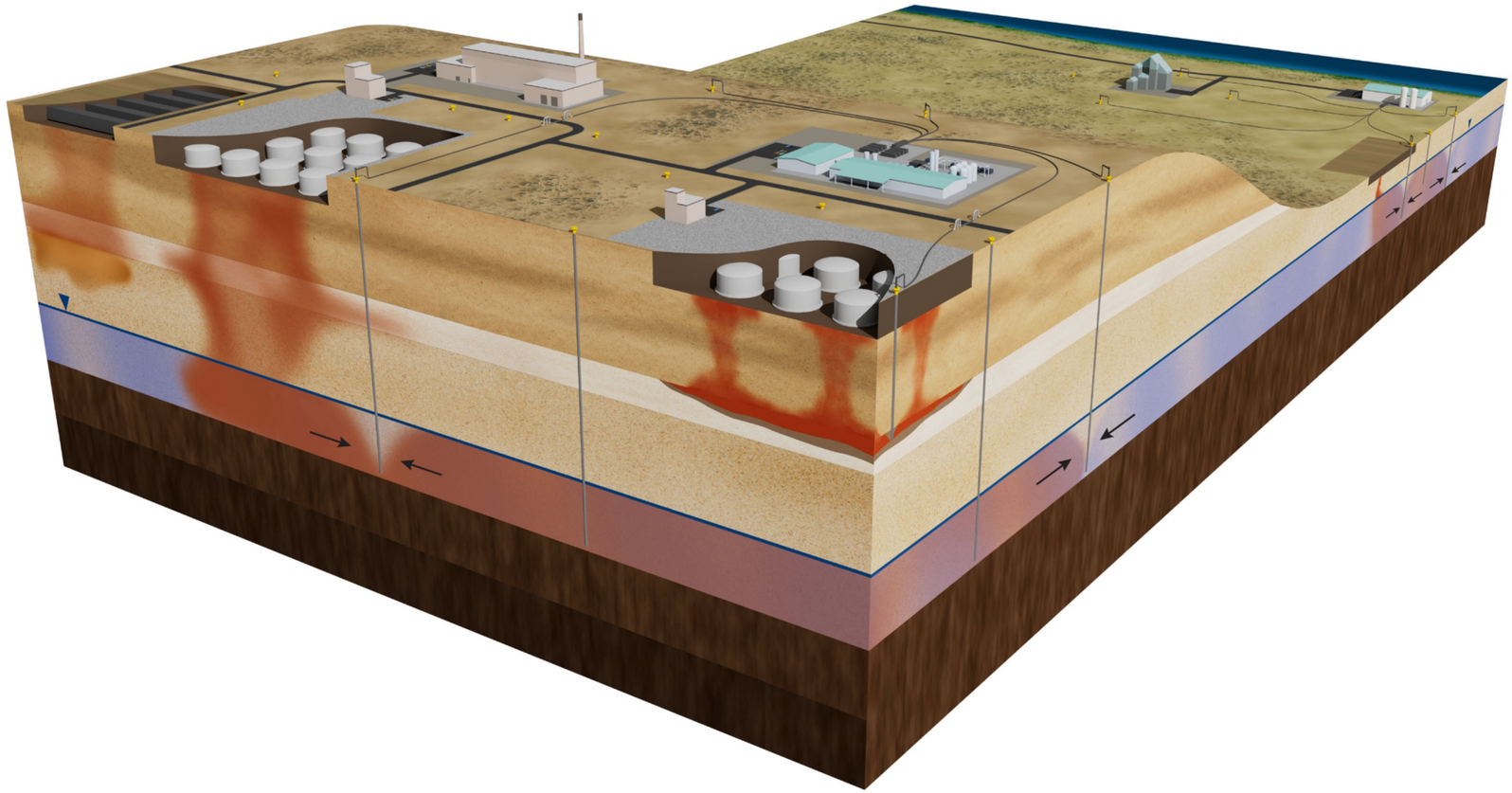
What Makes a Site Complex?

- Multiple sources and contaminants
- Comingled plumes
- Complex geology



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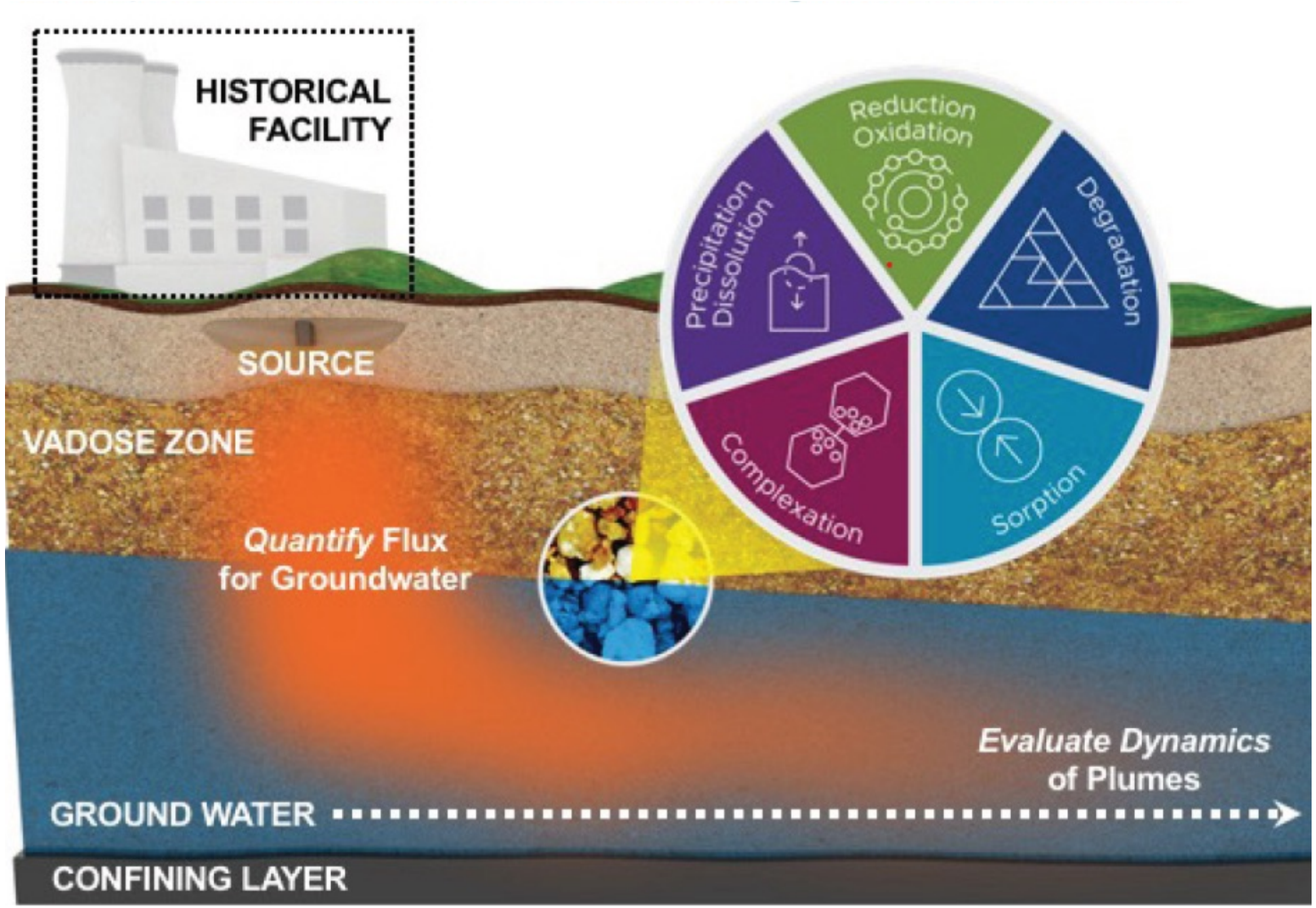
What Makes a Site Complex?

- Multiple sources and contaminants
- Comingled plumes
- Complex geology
- Impact of biogeochemical processes on fate and transport



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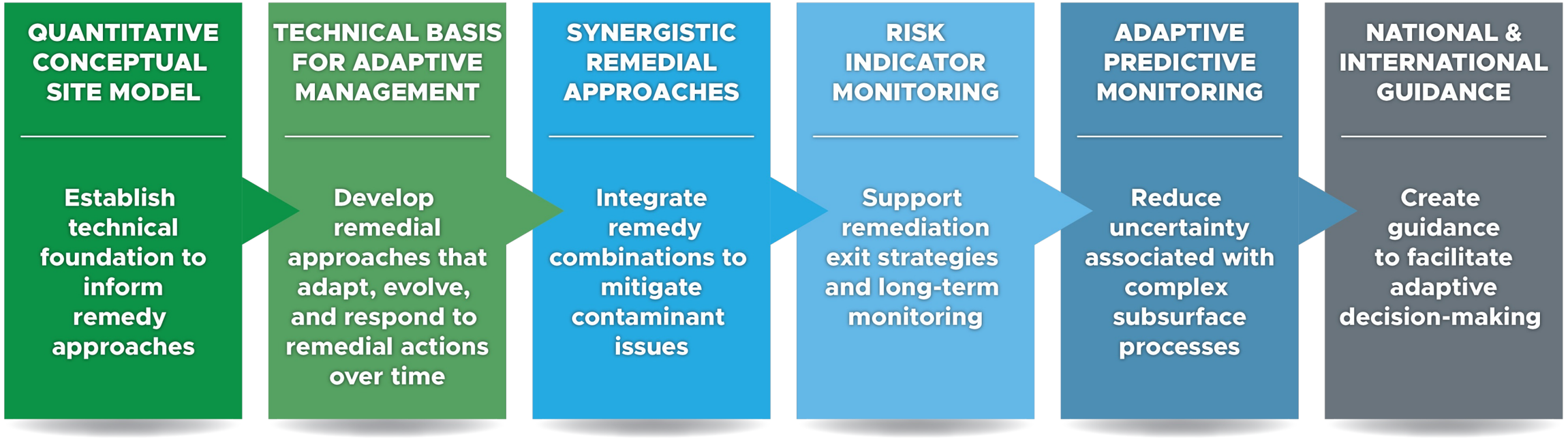
Considerations for Tackling Complex Sites

- Adaptive Site Management
  - Refine the conceptual site model
  - Set or revisit site objectives
  - Develop interim objectives and adaptive remedial strategy

"iterative refinement over the project life cycle"

https://rmcs-1.itrcweb.org/4-adaptive-site-management/



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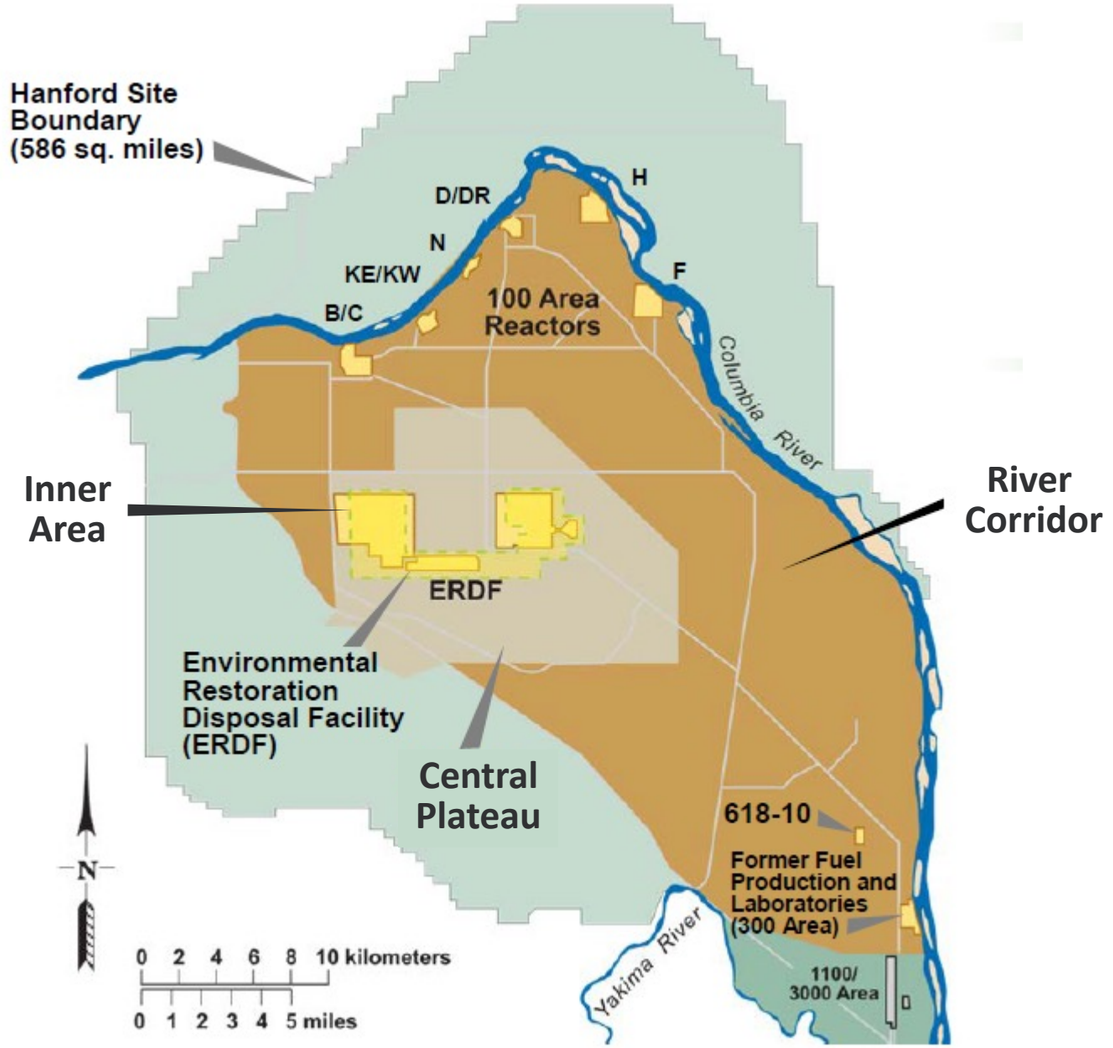
Hanford Example – Cleanup Mission – Challenges

- 2,000+ poorly characterized cleanup sites
  - Dispersed soil and groundwater plumes
  - Highly concentrated stored wastes
- Future land use
- Complex environmental challenges not addressed previously at this scale
- Three components
  - River Corridor
  - Central Plateau
  - Inner Area



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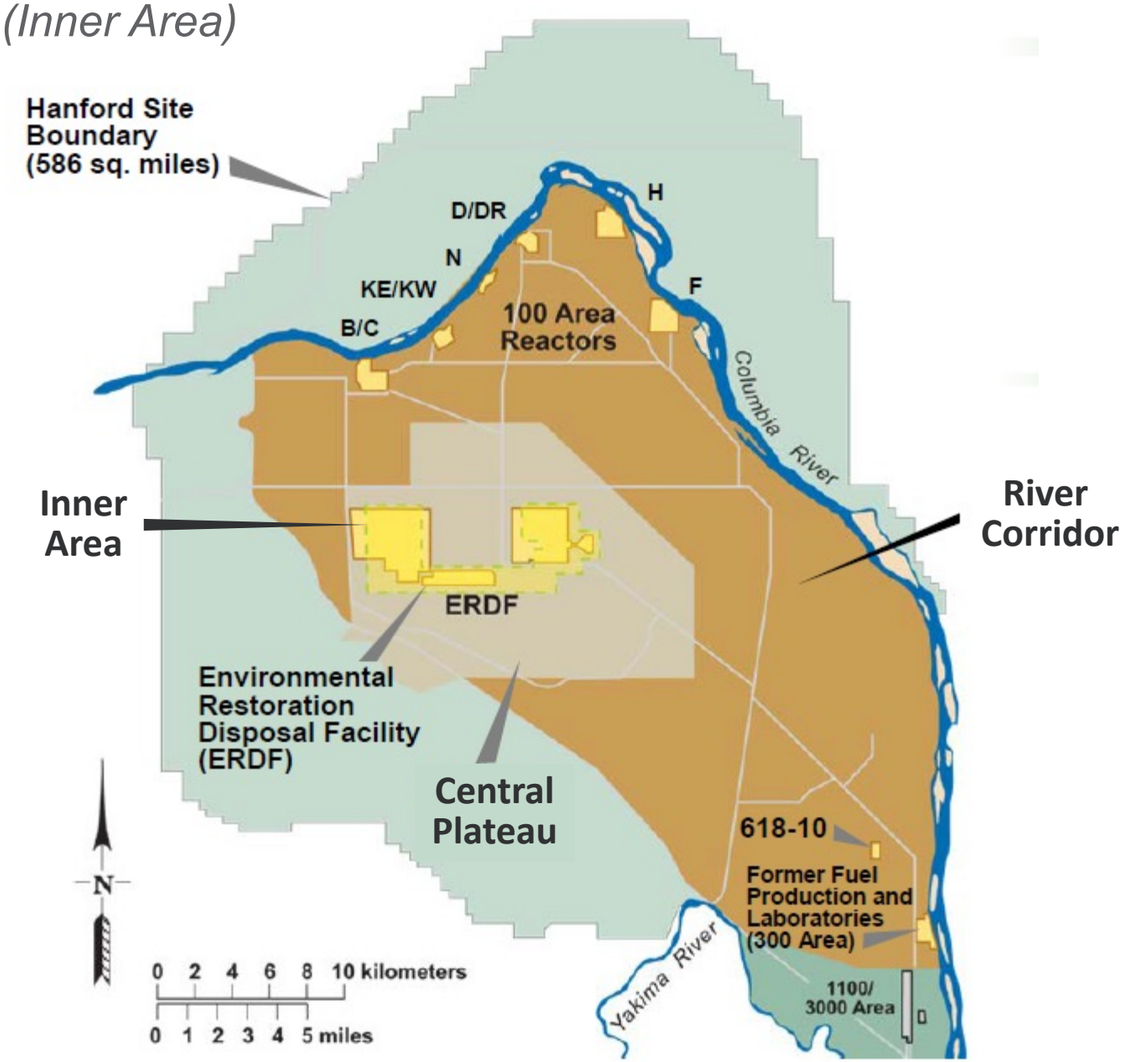
The Cleanup Mission – Shrinking the Footprint

Shrink to the extent practical from 586 square miles to about 10 square miles – or 98 percent (Inner Area)

- Priority Strategy: Protect the Columbia River
  - Remove (excavate) waste sites and contaminated structures close to the river
  - Groundwater treatment to halt plumes from entering river
  - Stabilize reactors for long-term isolation
  - Develop disposal facility in Central Plateau / Inner Area for excavated soil and building rubble



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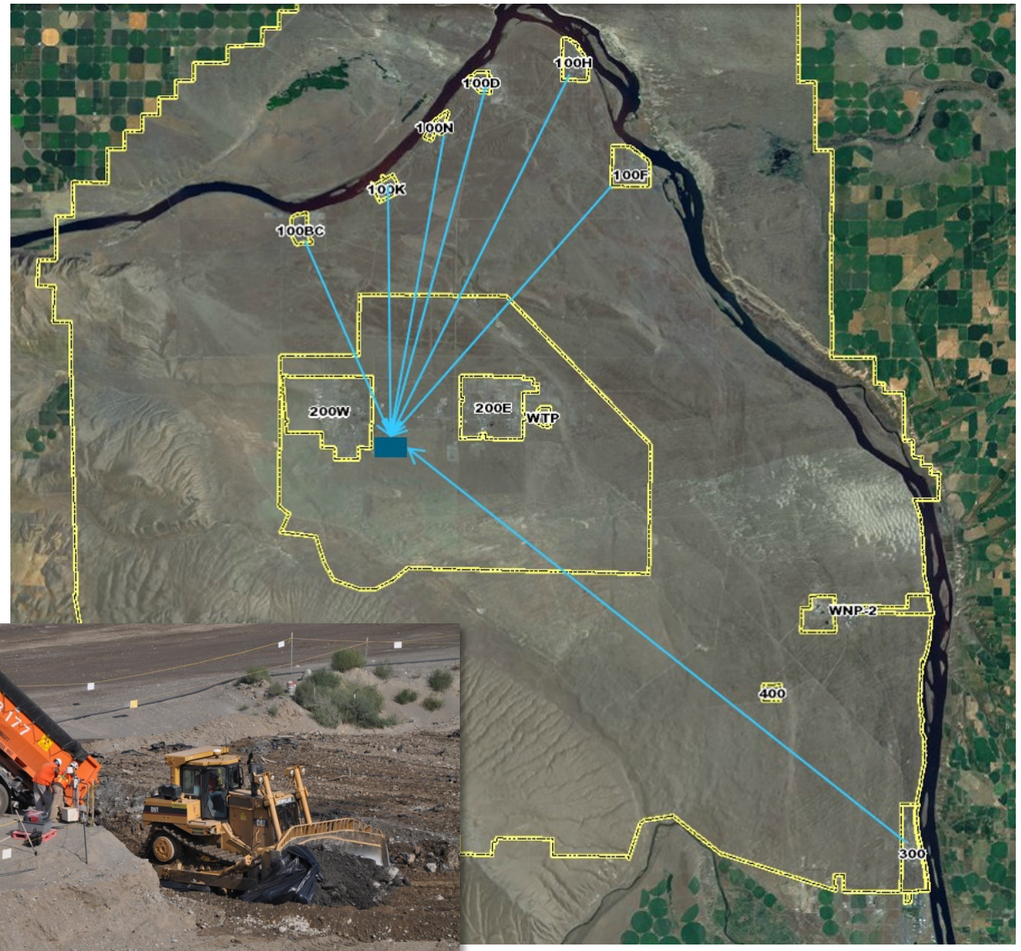
Key Strategies for Success

Dedicated Disposal Facility Enables Cleanup and Visible Progress

- Early discussions on future site uses (1992)
  - Broad public consensus recognized the necessity for a dedicated waste disposal facility
  - “Use the Central Plateau Wisely for Waste Management”
- Developed large “ERDF” disposal facility in Central Plateau



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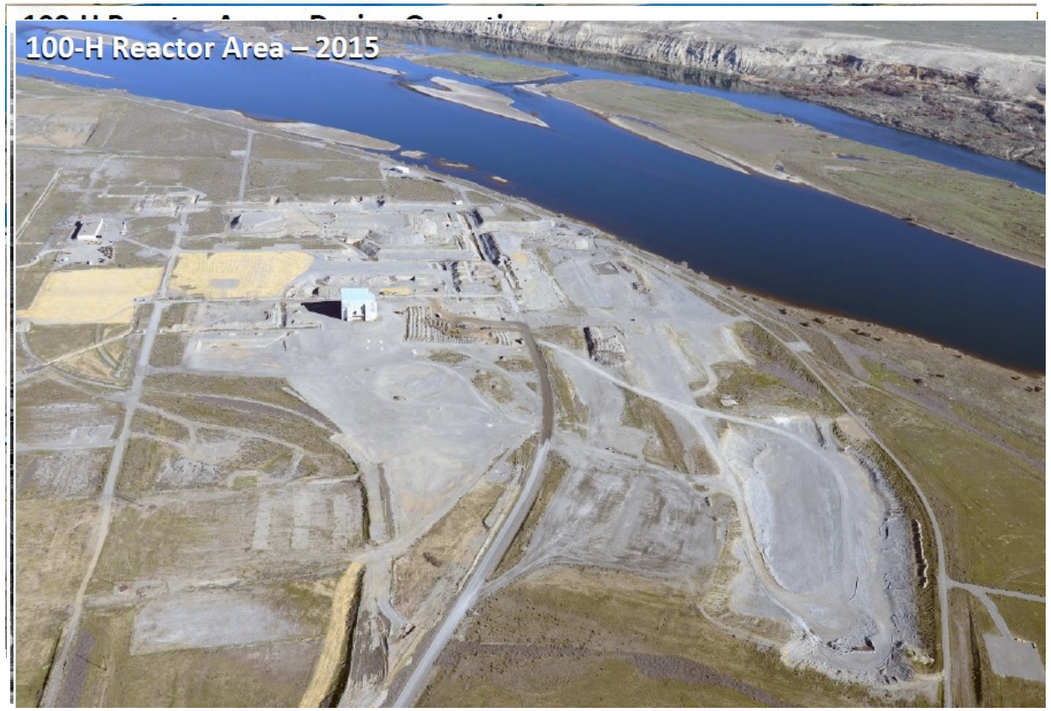
Key Strategies for Success

Agreement on Soil Cleanup Criteria / Approach Enables Steady Progress

- Depth of excavation and soil radionuclide cleanup levels established early
  - Provided certainty on cleanup action levels
  - Ease of rad detection with standard instrumentation (gamma)

Contain Groundwater Plumes

- Address 12 plumes by operating 6 pump and treat facilities to hydraulically contain and remove contamination



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Trends in Complex Site Remediation (examples)

- Advances in characterization and monitoring
  - Integrating measurement data – sample/point data with volumetric data
  - Real-time (or right-time) monitoring
  - Quantitative Conceptual Site Model (QCSM)
  - Automation, drones, robotics
- Integrated remedies
  - Interim measures (e.g. plume containment/hydraulic control and mass removal)
  - Subsequent / final measures (e.g., residual source treatment, natural attenuation, etc.)
  - Exit strategies for interim and final remedies
  - Remedy optimization (including AI/ML, data analytics, etc.)
- Emerging contaminants
- Sustainability and resilience

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RemPlex – where do we go from here?

- Global Summit survey will be sent to attendees – encourage feedback
  - Summit – topics, format?
  - Seminars – 3-4 / year, topics, format?
  - Other?

- Welcome your feedback on this week's Summit!
- How best can we collectively advance RemPlex collaborations and communications?

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Thank You

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