THE HANFORD SITE

Using Remedy Implementation Information to Guide Remedy Optimization

Federal Remediation Technology Roundtable Meeting

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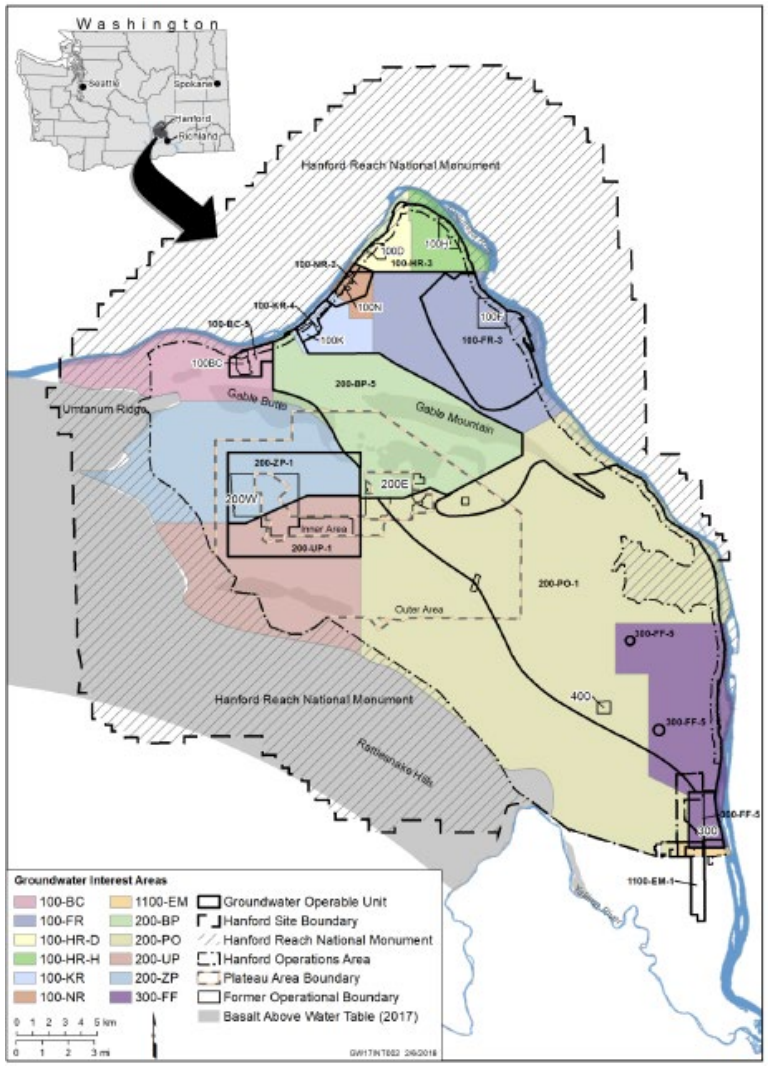
Outline

- Hanford Case Study Site Description
- Conceptual Site Model (CSM) Elements of Remedy Selection
- CSM Refinement: Input from Remedy Implementation and Performance Assessment
- Identified Remedy Optimization Targets
- Optimization Study Approach and Adaptive Site Management

THE HANFORD SITE

Hanford Site Groundwater Units



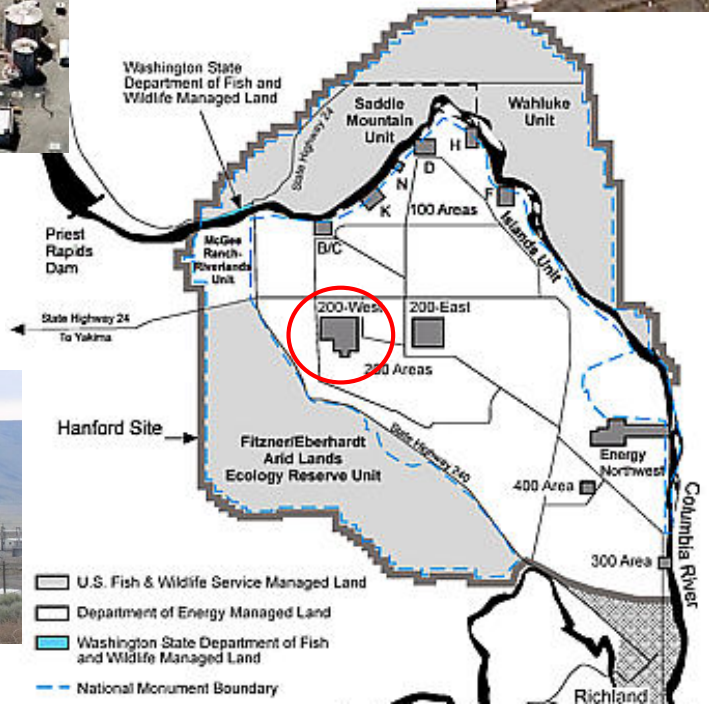
Historical Hanford Processes

Irradiate Fuel Elements

Chemical Separations

Manufacture Fuel Elements

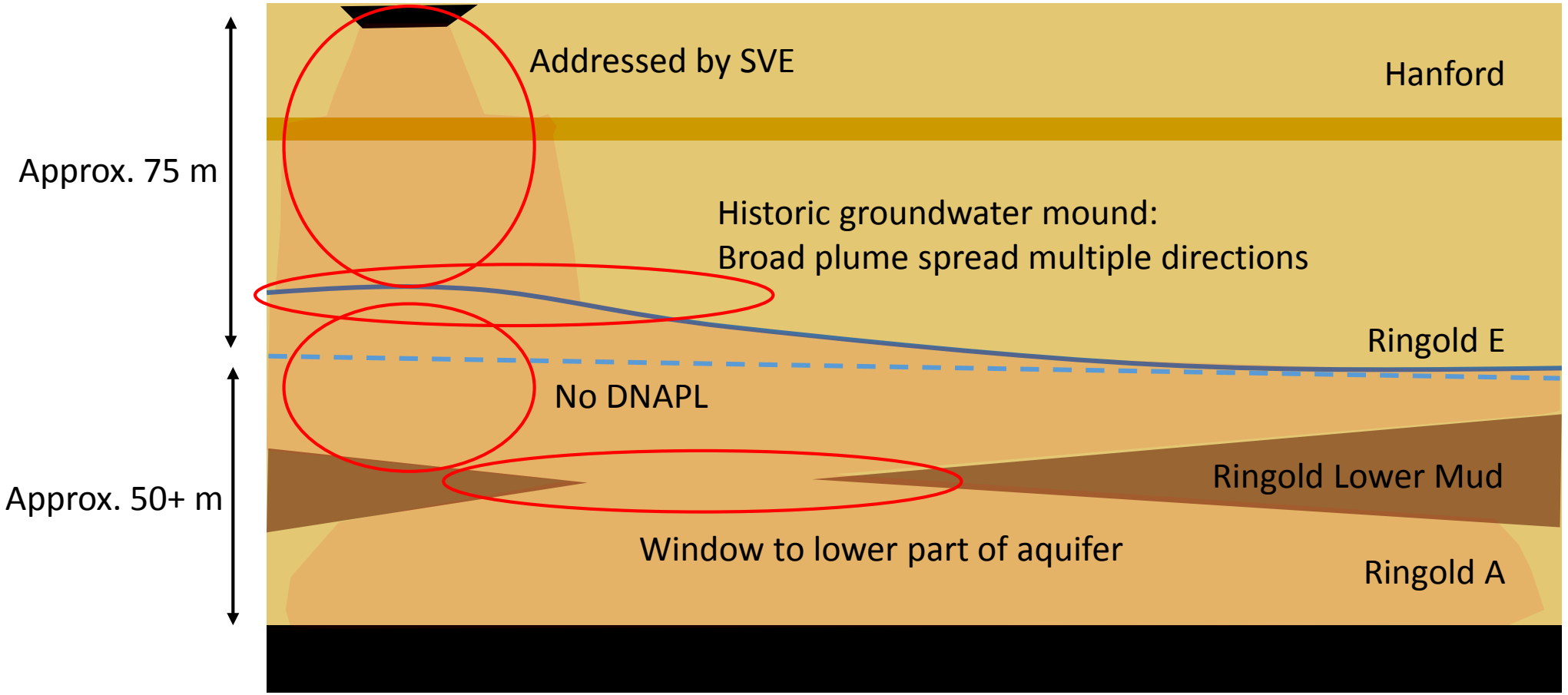
Plutonium Finishing



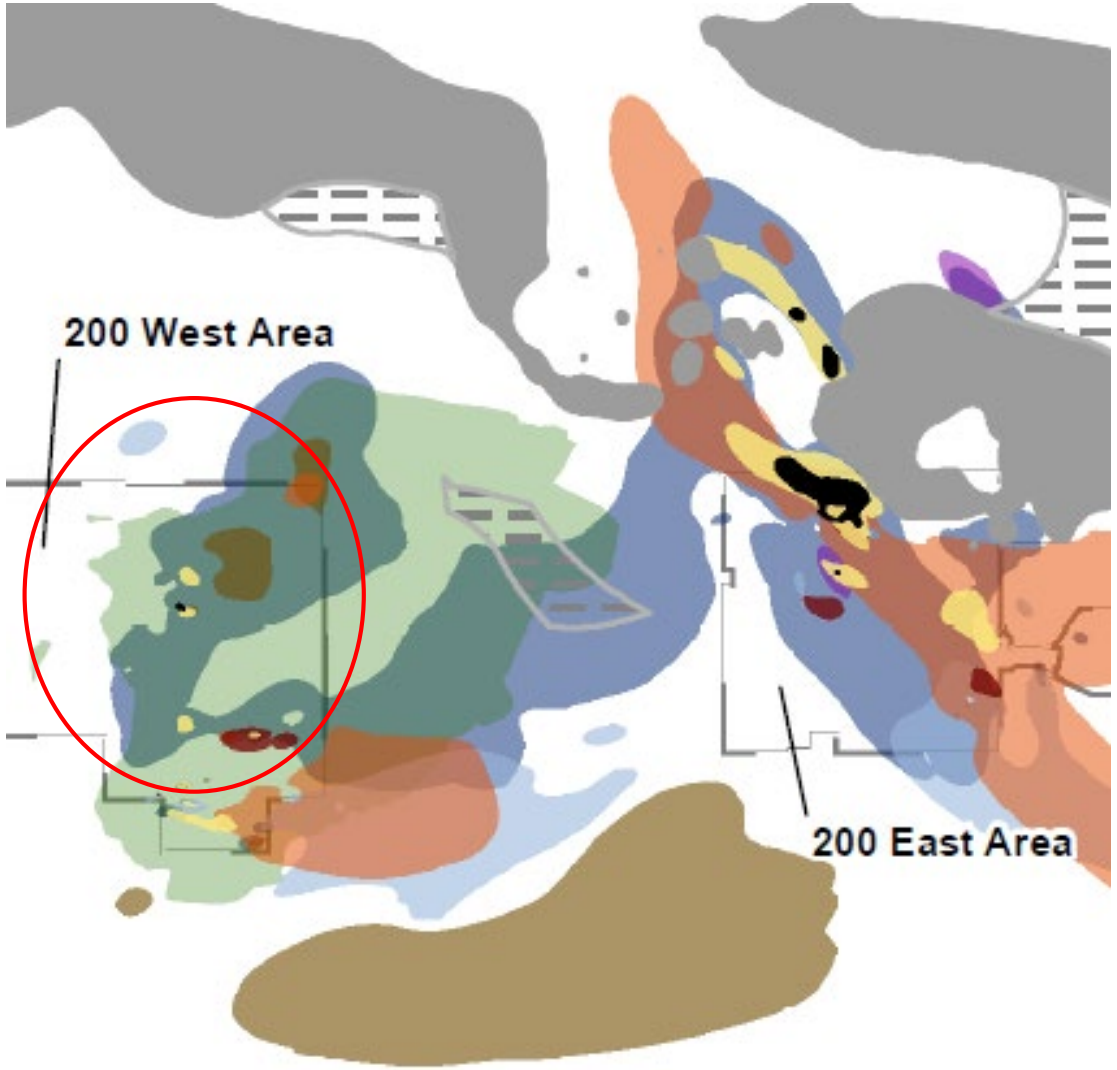
200-ZP-1 OU Conceptual Site Model

- Carbon tetrachloride (CCl_4) disposed of in three nearby locations
- Large groundwater mound spread CCl_4 in the groundwater (10-square-kilometer plume, over 50 meters thick)
- Early action of Soil Vapor Extraction (SVE) removed 80,000 kilograms; no continuing source
- No dense nonaqueous phase liquid (DNAPL) below water table
- Groundwater mound has dissipated; groundwater flow rate is slow
- Groundwater concentrations 1,000 times the remedial action objective (RAO); natural attenuation occurs, but plume is too concentrated and large for passive-only remedy
- Radionuclide and inorganic co-contaminants are present

200-ZP-1 OU Conceptual Site Model (cont.)



Co-Contaminants



2017 Groundwater Contaminants on the Central Plateau

- Carbon Tetrachloride (5 µg/L)
- Chromium (48 µg/L)
- Cyanide (200 µg/L)
- Iodine-129 (1 pCi/L)
- Nitrate (45 mg/L)
- Strontium-90 (8 pCi/L)
- Technetium-99 (900 pCi/L)
- Tritium (20,000 pCi/L)
- Uranium (30 µg/L)

- Former Operational Area
- Basalt Above Water Table
- Ringold Mud Unit Above Water Table

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GW17ES013 6/27/2018

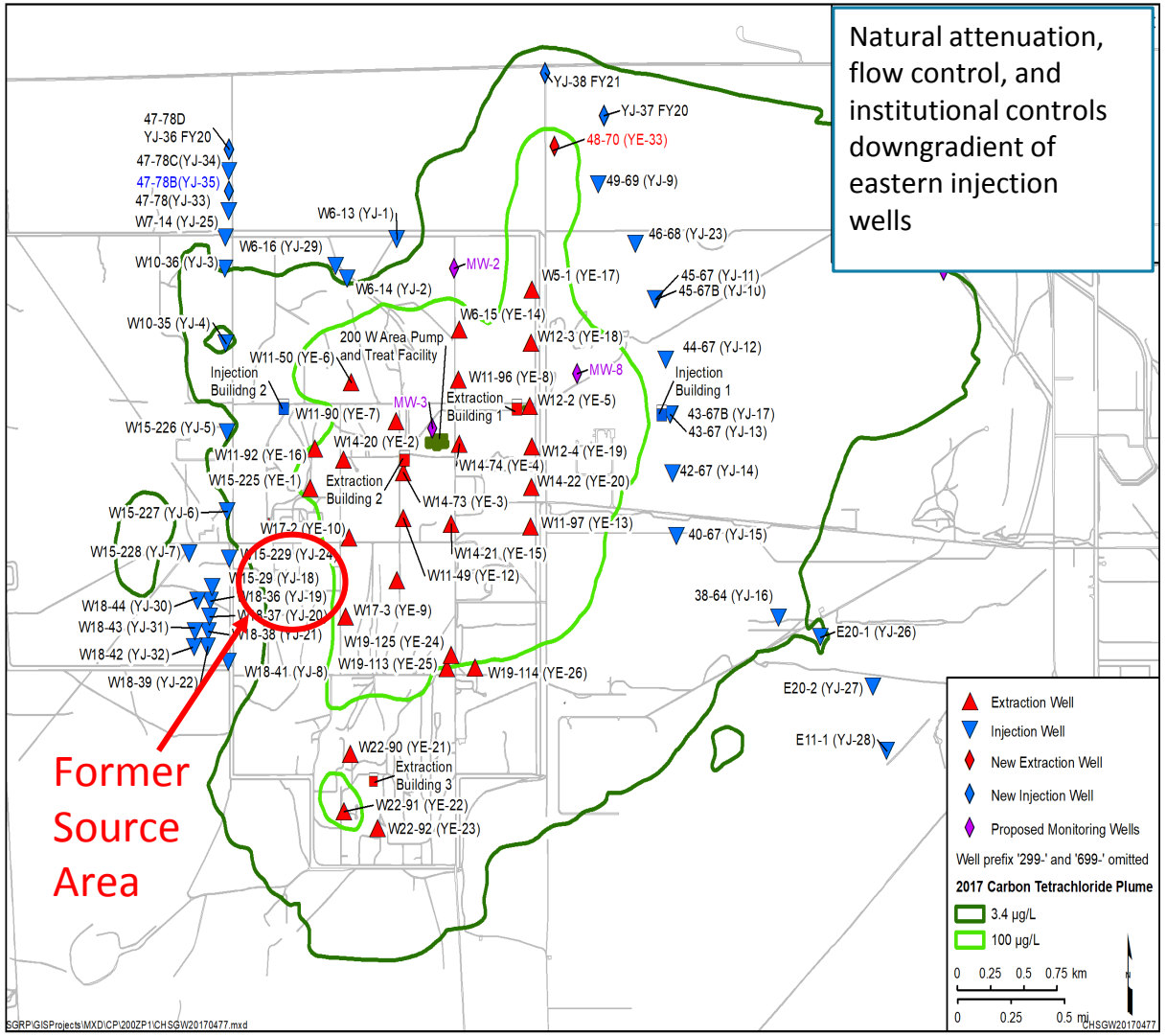
Conceptual Site Model – Remedy Selection

- RAO to restore aquifer
- Source addressed by SVE and no DNAPL present
- Large plume with co-contaminants difficult for in situ remediation
- Pump-and-treat (P&T) systems can effectively diminish plumes; difficulty in reaching RAO
- If plume is diminished, natural attenuation can reach RAO

Conceptual Site Model – Remedy Selection (cont.)

- Remedy applies P&T with transition to Monitored Natural Attenuation (MNA)
- Anticipated 25 years of P&T and 100 years of MNA to meet RAO based on Feasibility Study CSM
  - CCl_4 distribution – uncertainty in mass (collect data during remedy)
  - Attenuation rate – uncertainty est. 41–290-year half-life (implement study)

200 West P&T Well Network



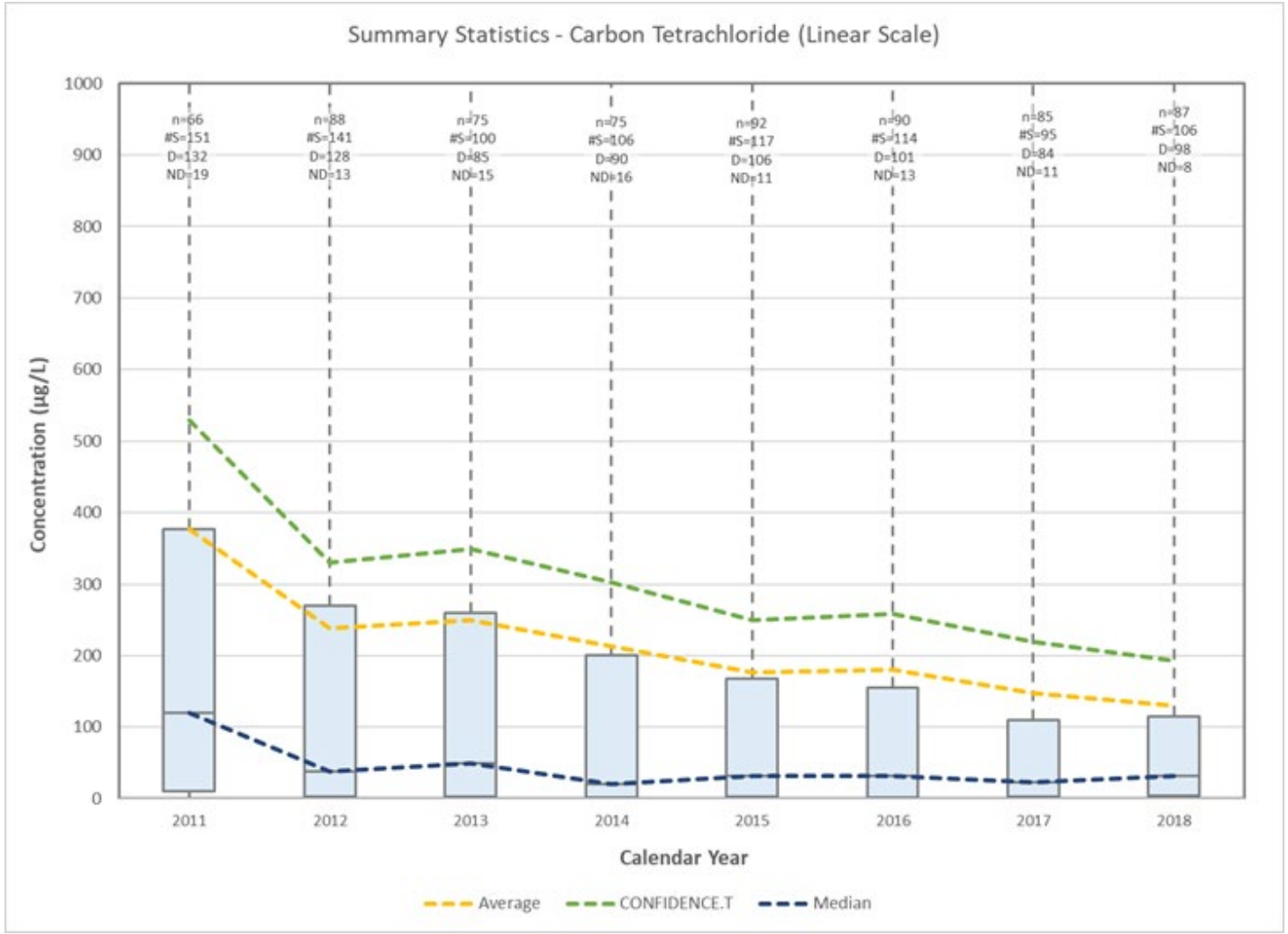
200 West P&T Well Network

- Began operations in 2012
- 33 Extraction Wells located within carbon tetrachloride plume
- 35 Injection Wells on the outer edges of the highest concentration area

Implementation and Performance Data

3-D plume mapping

- Monitoring well concentrations
- Extraction/injection concentrations
- Characterization depth profile concentrations
- Extraction mass removal rate compared to predicted mass removal rate

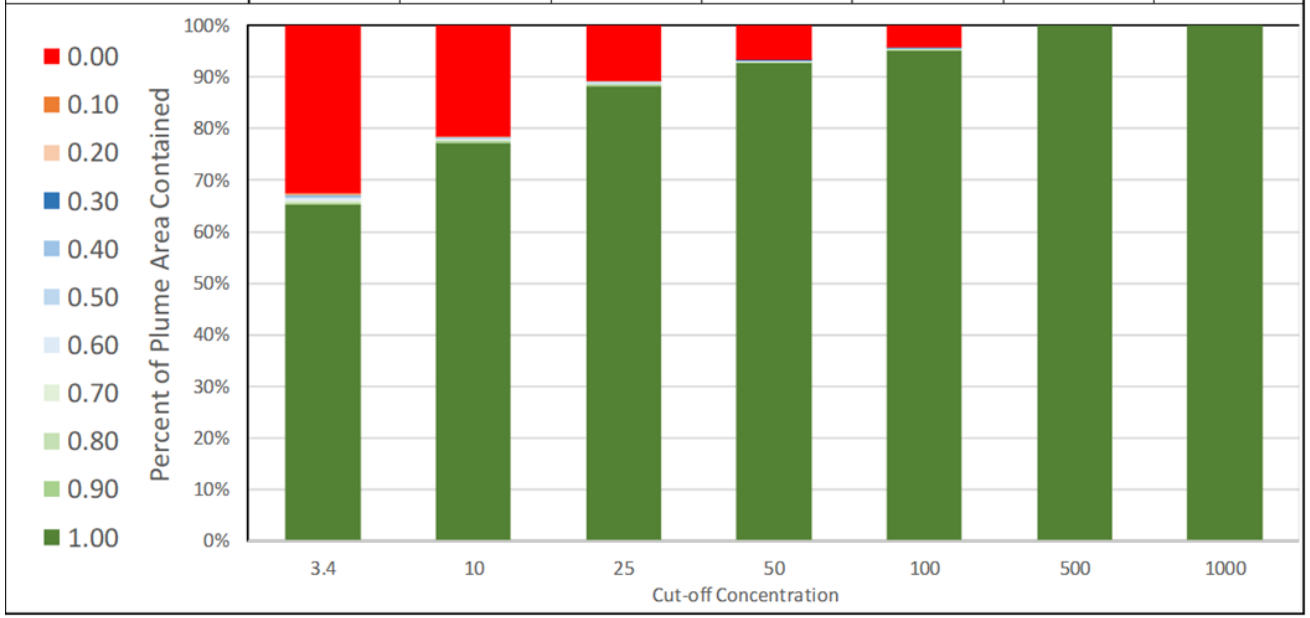


Implementation and Performance Data

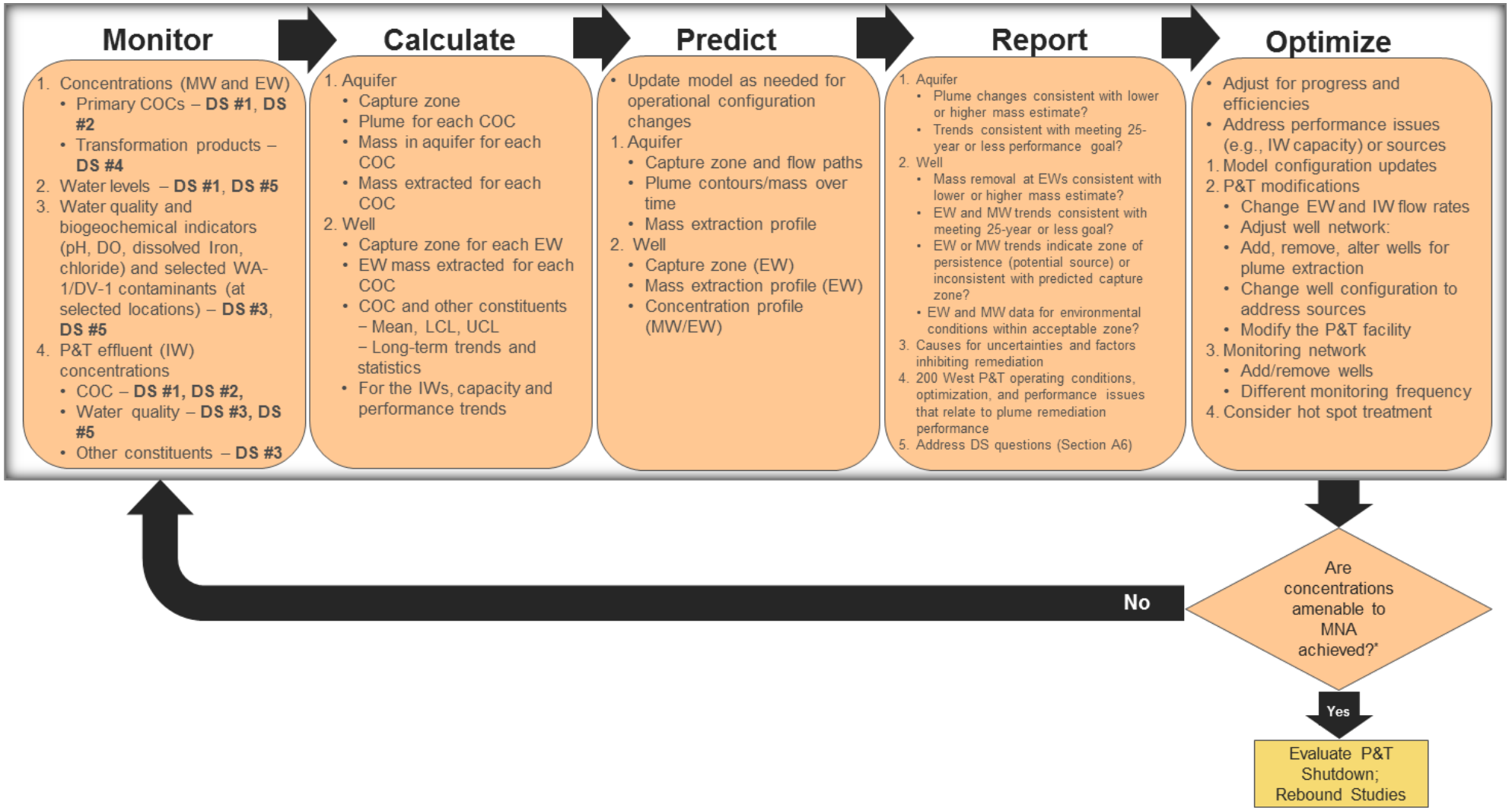
Hydraulic data

- Water levels
- Capture analysis

Concentration Cut-off	3.4	10	25	50	100	500	1000
Percent of Plume area	34%	23%	16%	12%	9%	4%	2%
Capture Frequency	Percent of Plume Area Contained						
0.00	100%	100%	100%	100%	100%	100%	100%
0.10	68%	79%	89%	93%	96%	100%	100%
0.20	67%	78%	89%	93%	96%	100%	100%
0.30	67%	78%	89%	93%	96%	100%	100%
0.40	67%	78%	89%	93%	96%	100%	100%
0.50	67%	78%	89%	93%	96%	100%	100%
0.60	66%	78%	89%	93%	95%	100%	100%
0.70	66%	78%	89%	93%	95%	100%	100%
0.80	66%	78%	89%	93%	95%	100%	100%
0.90	66%	78%	89%	93%	95%	100%	100%
1.00	65%	77%	88%	93%	95%	100%	100%

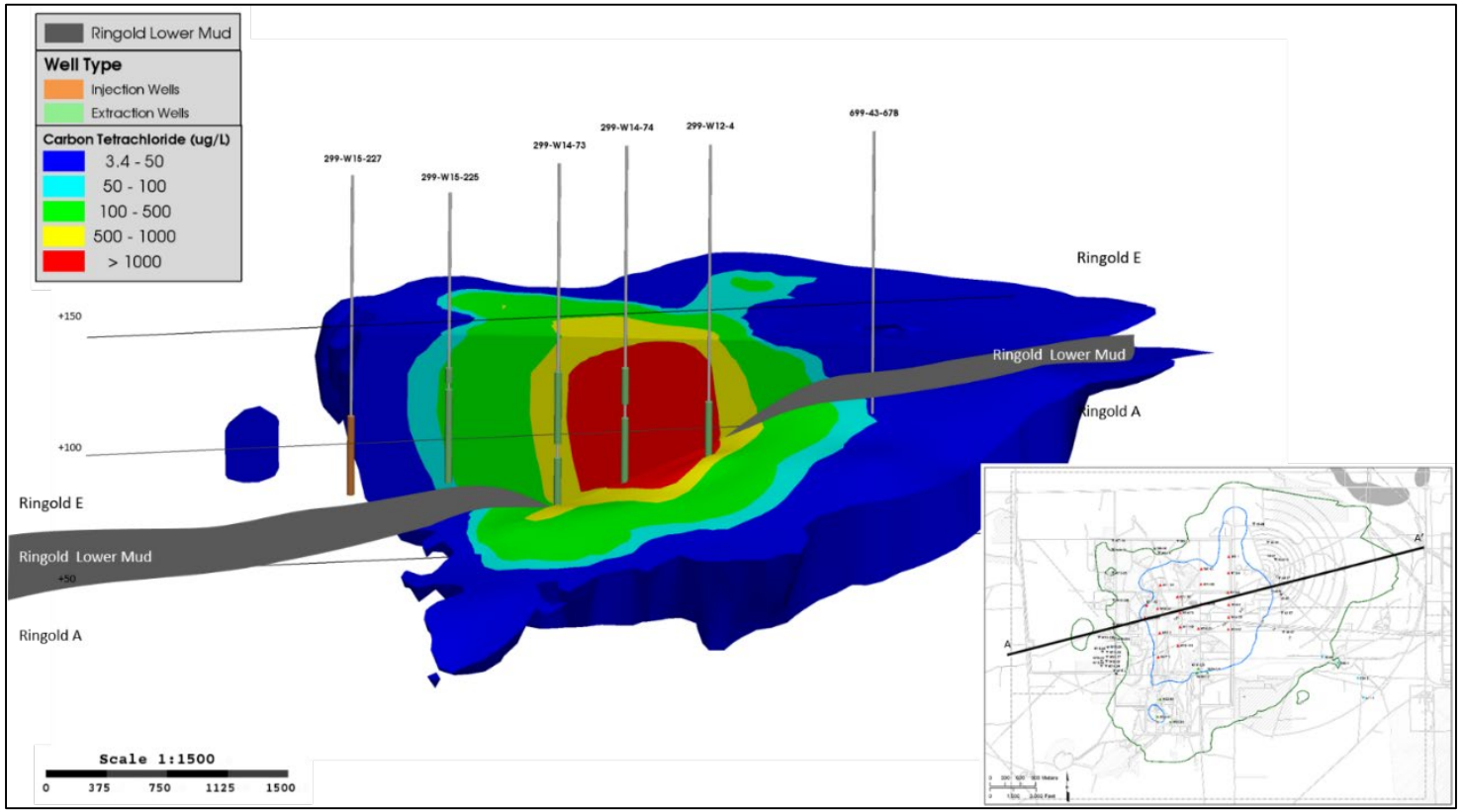


Implementation and Predictive Modeling



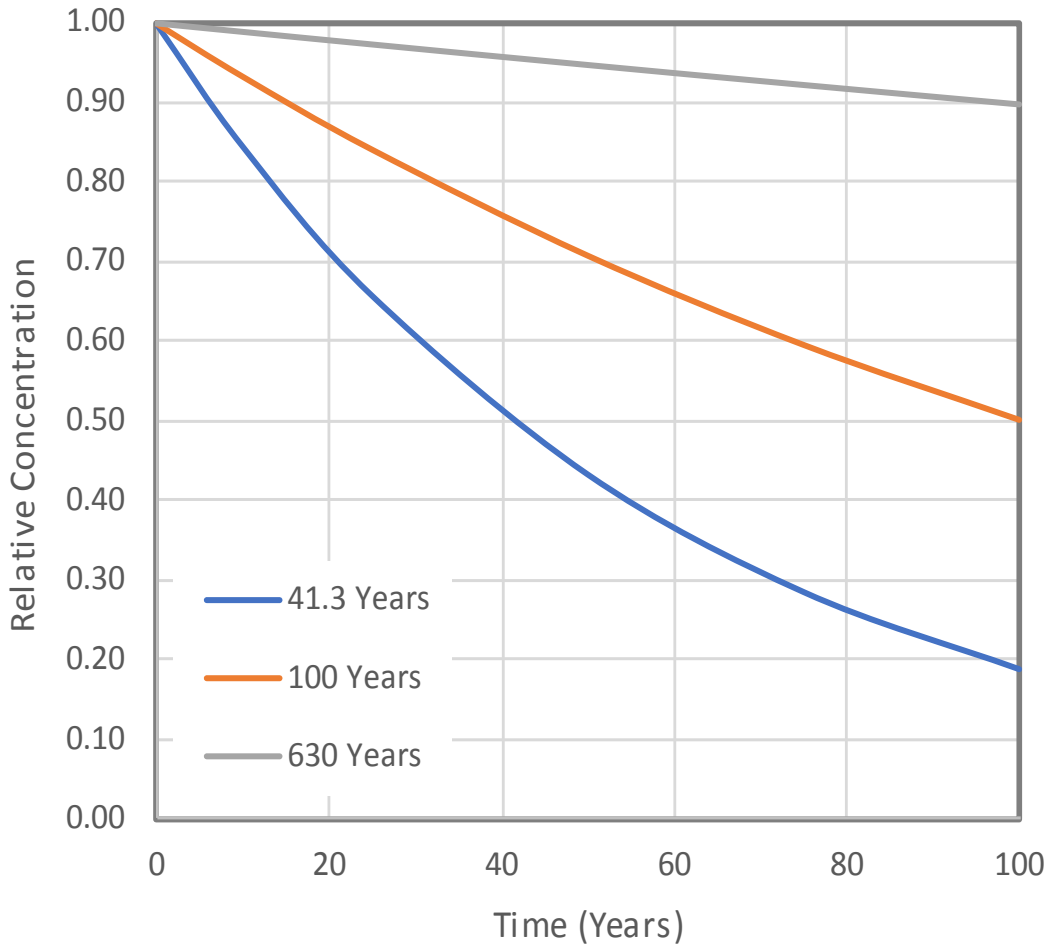
Challenges Identified

- More CCl_4, including more below the Lower Mud Unit (Ringold A) than understood during the feasibility study (FS)
  - Total within FS uncertainty but higher than baseline estimate
  - Ringold A 25% versus 12% of total
- Characterization is planned to define the extent of contaminants of concern in Ringold A and its hydraulic properties



Challenges Identified (cont.)

- Abiotic degradation of CCl_4 (hydrolysis) is slower than FS assumption
  - 630 versus 41–290-year half-life
  - Previous information extrapolated from high temperature
  - Data at site-specific temperature shows lower rate (6-year study)
- Currently studying other degradation mechanisms at the site



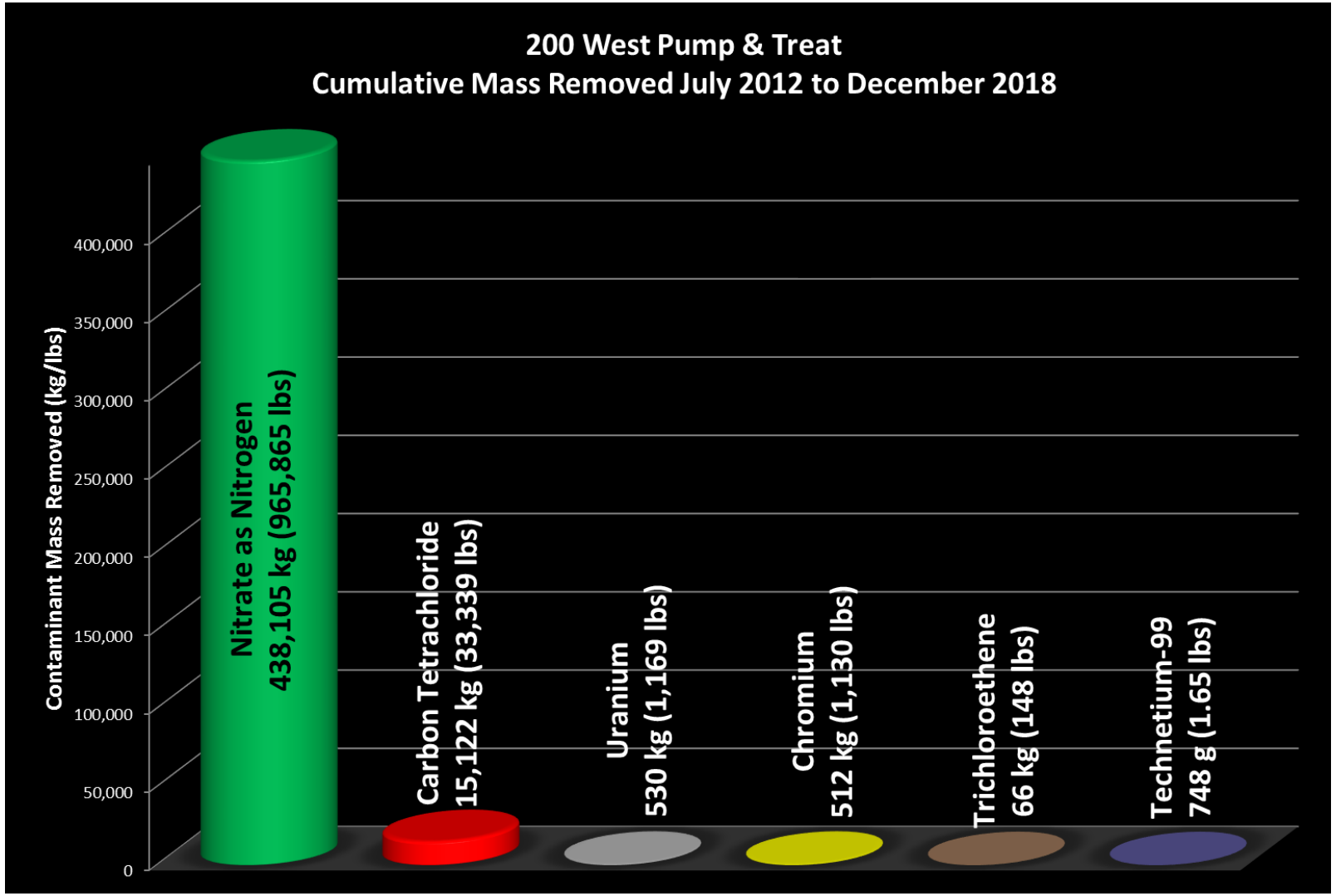
Evaluation of CCl_4 Information

- Need more intensive mass removal during the P&T period to enable transition to MNA
- May need more MNA time
- Need more information in the Ringold A to assess the best approach

Nitrate Considerations

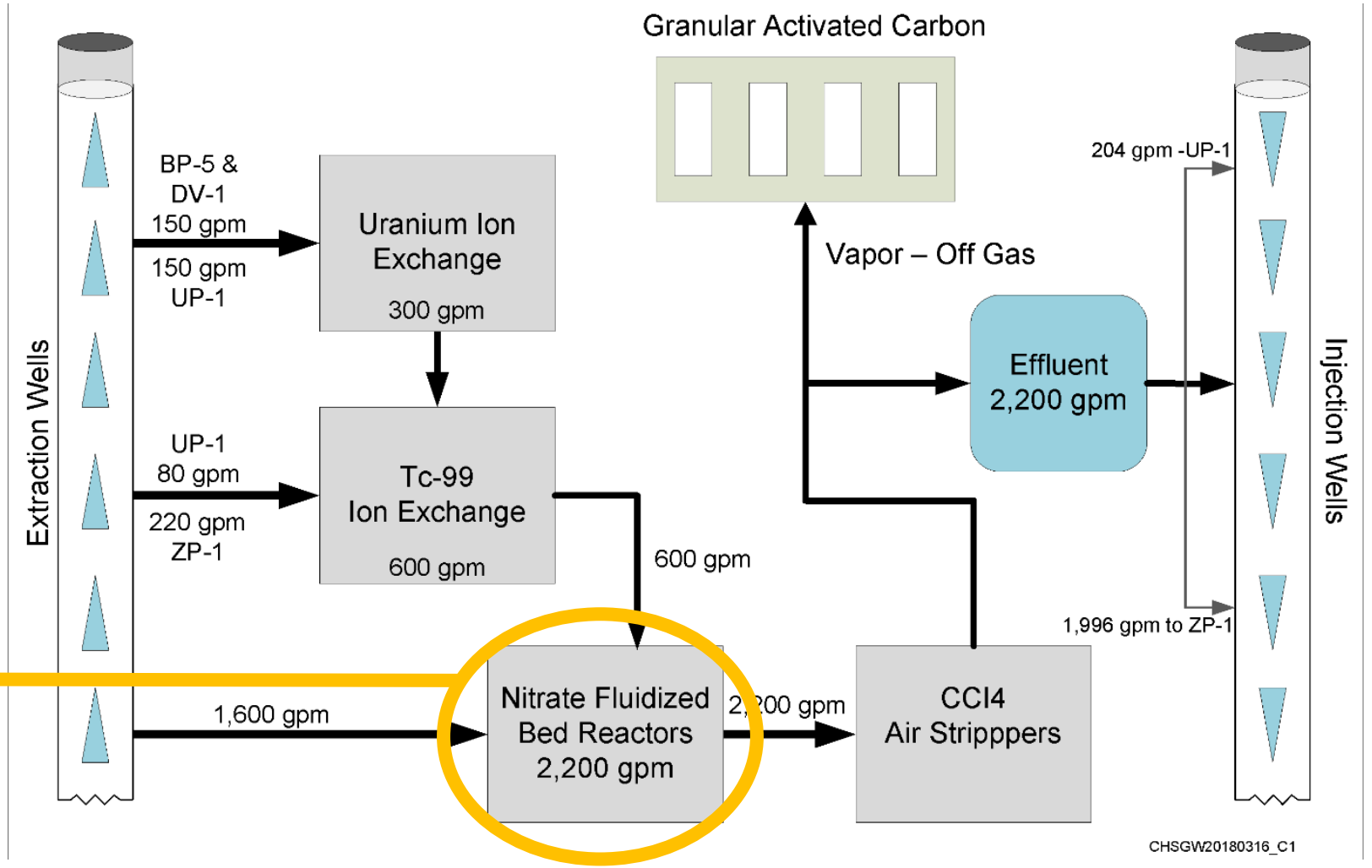
- Sufficient nitrate may have been removed from Ringold E to stop active biological treatment and start transition to MNA as identified in the record of decision (ROD)
  - Blending during P&T
  - Natural attenuation after P&T
- Suspending biological treatment would:
  - Enable more efficient approach for increasing CCl_4 treatment capacity
  - Eliminate operational difficulties associated with biofouling in wells

Contaminants of Concern – Mass Removed, 2012 through 2018



200 West Central Treatment Facility Current Treatment Capacity

- Approximately 40% of Operations and Maintenance cost is due to nitrate treatment
- Biofouling issues with wells would decrease significantly with removal of FBRs/MBRs.



Limits flow through the system

Optimization Study Rationale

- Evaluated six years of 200 West P&T operation data
- Current remedy as designed is projected to be insufficient for meeting remedial action objectives due to
  - Larger mass of CCl_4 in the aquifer
  - Slower degradation rate
- Important to consider remedy optimization for CCl_4 because it is the most significant risk driver; unlike other contaminants, its concentration is up to 1,000 times greater than the RAO

Optimization Study Plan

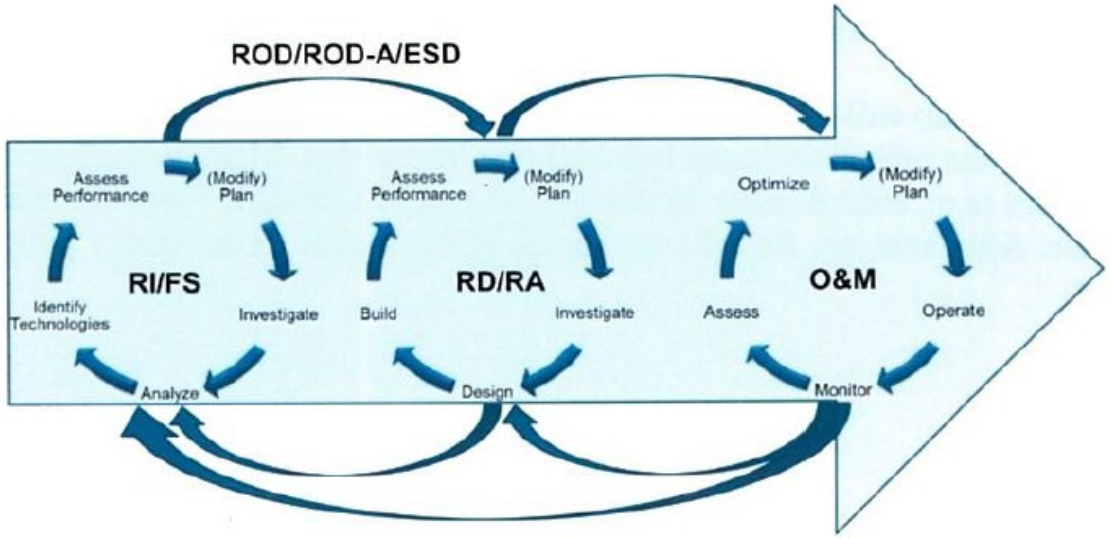
- Suspend biological treatment for specified amount of time and gather data on contaminant behavior in the aquifer
- Treatment capacity for CCl_4 will be increased with an additional air stripper and expanded well network
- Intended to be an iterative process of data evaluation and decision-making
- Once sufficient data is collected and evaluated, the site and regulators will work together to determine if the remedy needs to be changed
  - Will consider if RAOs and timeframes listed in ROD can be achieved
  - No intent to change cleanup levels

EPA Support for Optimization

- September 2012: EPA released a *National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion*.
  - Envisions the application of optimization concepts throughout all phases of the remedial process
- Systematic site review at any phase of the cleanup process to:
  - Identify opportunities to improve remedy protectiveness, effectiveness and cost efficiency
  - Facilitate progress toward completion of site work

EPA Support for Use of Adaptive Management

Figure 1 Adaptive Management's Application in the Superfund Remedial Process



ROD: Record of Decision
ROD-A: Record of Decision Amendment
ESD: Explanation of Significant Differences

RD/RA: Remedial Design/Remedial Action
RI/FS: Remedial Investigation/Feasibility Study
O&M: Operation and Maintenance

Adaptive management is a formal and systematic site or project management approach centered on rigorous site planning and a firm understanding of site conditions and uncertainties. This technique, rooted in the sound use of science and technology, encourages continuous re-evaluation and management prioritization of site activities to account for new information and changing site conditions. A structured and continuous planning, implementation and assessment process allows EPA, states, other federal agencies, or responsible parties to target management and resource decisions with the goal of incrementally reducing site uncertainties while supporting continued site progress.

EPA Memo, Broaden the Use of Adaptive Management, July 2018

Questions