# Groundwater Cleanup Update

Presented to: HAB's River and Plateau Committee Oct. 4, 2016

Presented by: Jim Hanson (DOE-RL)

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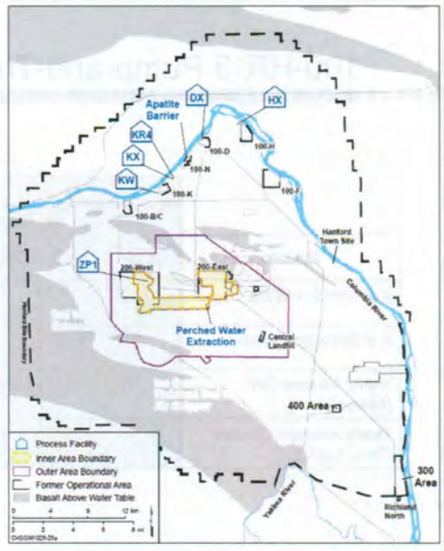
## Pump and Treatment Facilities at Hanford

| Facility | Original Capacity | Current Capacity |
|---|---|---|
| 100-KR-4 | 300 gpm | 330 gpm |
| 100-KW | 200 gpm | 330 gpm |
| 100-KX | 600 gpm | 900 gpm |
| 100-DX | 600 gpm | 775 gpm |
| 100-HX | 800 gpm | 900 gpm |
| 200 West | 2,200 gpm | 2,500 gpm |

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## 100-HR-3 Groundwater Operable Unit (OU) Status

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## 100-HR-3 Pump-and-Treat (P&T) System Status

| | 100-HR-3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100-D | | | | 100-H | | | |
| System | 2010 | 2012 | 2014 | 2015 | 2010 | 2012 | 2014 | 2015 |
| # of Injection Wells | 2 | 14 | 10 | 15 | 3 | 15 | 14 | 17 |
| # of Extraction Wells | 5 | 37 | 44 | 46 | 12 | 31 | 31 | 35 |
| Yearly Treated GW (Million L) | 45 | 1,029 | 1,174 | 1,482 | 268 | 1,335 | 1,178 | 1,123 |
| Yearly Average Chrome Conc. (µg/L) | 1,750 | 483 | 145 | 53 | 122 | 26.4 | 20 | 23 |

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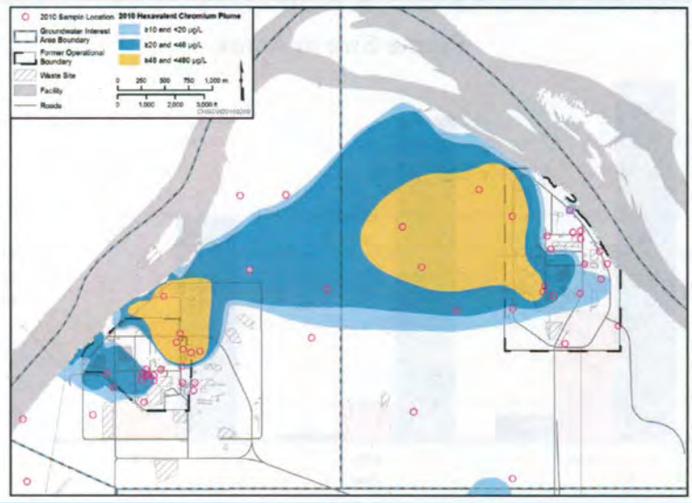
## 100-HR-3, 2010 Hexavalent Chromium Plume

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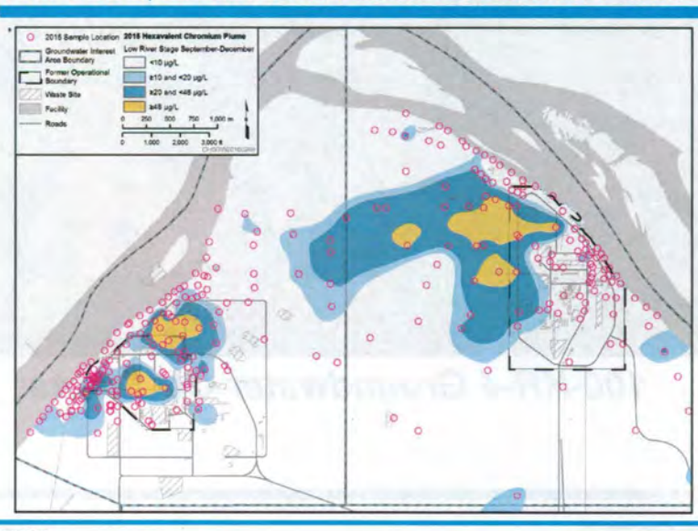
## 100-HR-3, 2015 Hexavalent Chromium Plume

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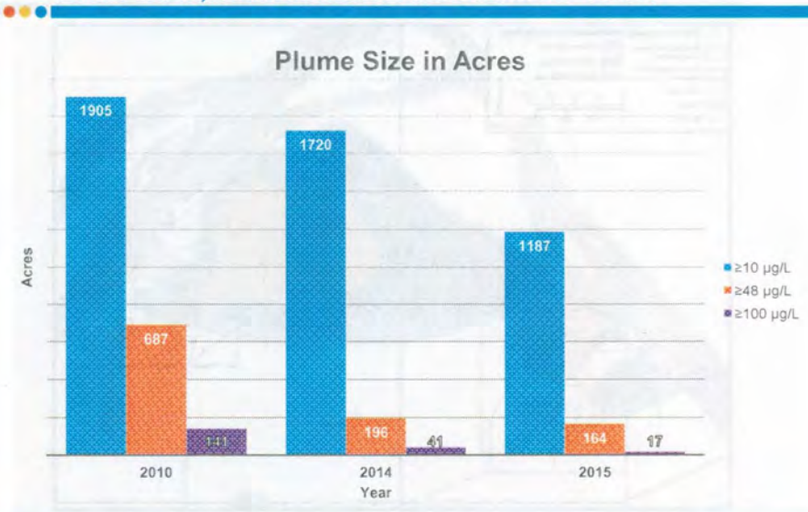
## 100-HR-3, Hexavalent Chromium Plume

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## 100-KR-4 Groundwater OU Status

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## 100-KR-4 P&T System Status

| | 100-KR-4 | | | 100-KX | | | 100-KW | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2014 | 2015 | 2010 | 2014 | 2015 | 2010 | 2014 | 2015 |
| # of Injection Wells | 5 | 5 | 6 | 9 | 9 | 9 | 3 | 4 | 4 |
| # of Extraction Wells | 10 | 12 | 12 | 14 | 18 | 19 | 7 | 11 | 11 |
| Yearly Treated GW (Million L) | 337 | 527 | 655 | 904 | 1,199 | 1586 | 387 | 579 | 651 |
| Yearly Average Chrome Concentration (µg/L) | 23 | 9.5 | 6.4 | 47.6 | 21.5 | 18.7 | 145.5 | 22 | 22 |

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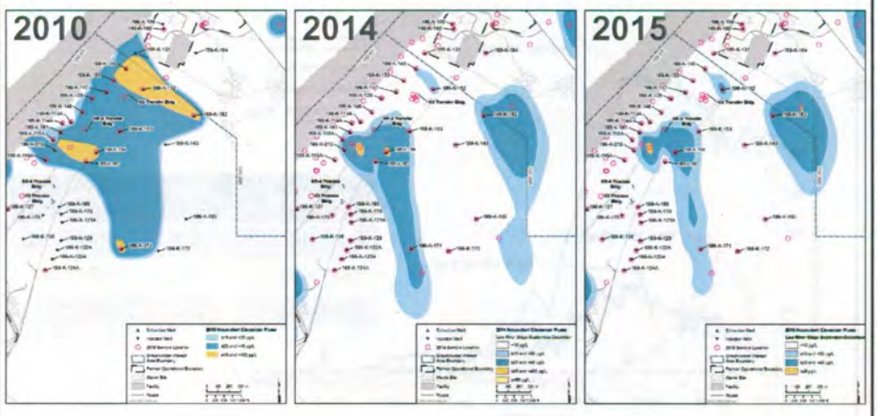
## 116-K-2 Trench Area Hexavalent Chromium (Cr(VI)) Plume

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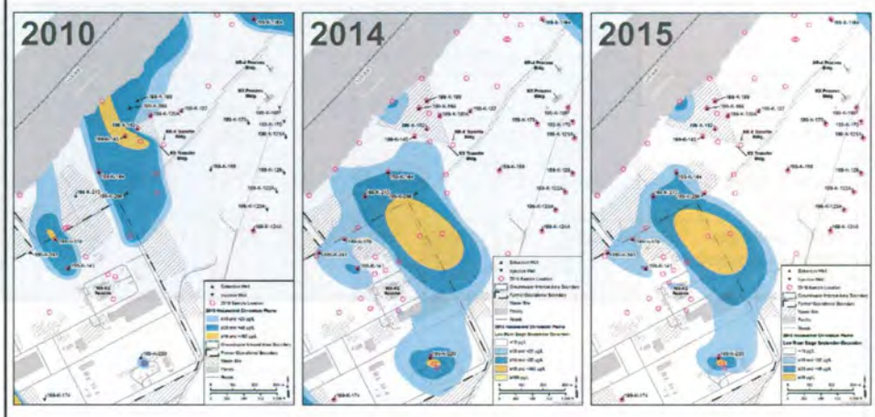
## 100-KE Hexavalent Chromium Plume

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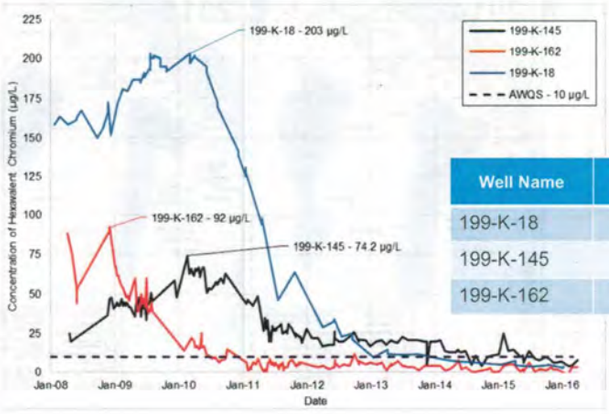
## 100-KE Trend Plots Jan. 2010 through Apr. 2016




| Well Name | Cr(VI) (µg/L) | Date Sampled |
|---|---|---|
| 199-K-18 | 3.7 | 1/15/2016 |
| 199-K-145 | 8 | 4/5/2016 |
| 199-K-162 | 3 | 4/5/2016 |

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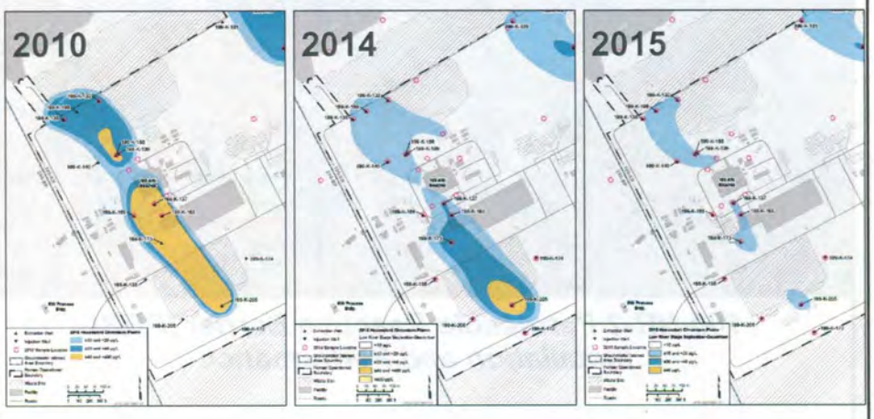
## 100-KW Hexavalent Chromium Plume

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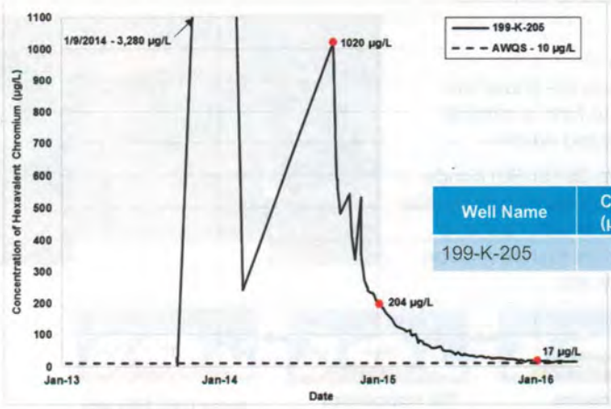
## 100-KW Trend Plot Jan. 2010 through Apr. 2016




| Well Name | Cr(VI) (µg/L) | Date Sampled |
|---|---|---|
| 199-K-205 | 14 | 4/5/2016 |

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## 100-NR-2 Permeable Reactive Barrier (PRB) Installation and Performance

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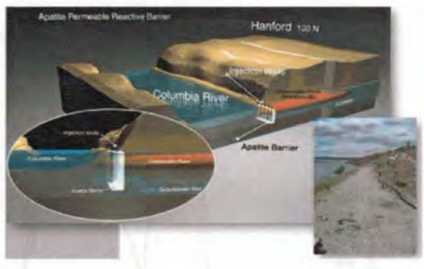
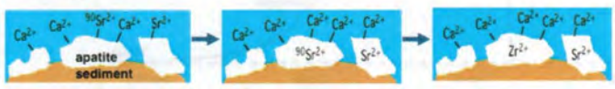
## PRB Installation

- Process used to form the barrier:
  - Injection of calcium-citrate-phosphate solution to form a mineral barrier called apatite
  - Strontium-90 (Sr-90) bonds with apatite making Sr-apatite more stable with heat and temperature in their relation to energy, etc.




$^{90}Sr$ adsorbs (minutes)

$^{90}Sr$ incorporates into apatite (months, yrs)

decay (10s, 100s yrs)

$^{90}Sr \xrightarrow[29.1yr]{t_{1/2}} {}^{90}Y \xrightarrow[60hr]{} {}^{90}Zr$

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## PRB Installation (cont.)

- 162 injection wells have been constructed for injection of apatite forming chemicals to provide a 762-meter-long barrier along the shoreline
- 29 monitoring wells have been constructed for monitoring barrier performance
- Three segments of the installed wells have been treated:
  - Original (central) barrier (91 m treated by injection into 16 wells)
  - Upriver extension (110 m treated by injection into 24 wells)
  - Downriver extension (110 m treated by injection into 24 wells)
- Remaining segments are shown as:
  - Upriver segment (50 m – 11 wells)
  - Downriver segment (400 m – 87 wells)
  - Current remedial investigation will evaluate and recommend how to proceed with remaining segments

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## Lessons Learned

- Timing the shallow injections for when the water table is higher, typically during spring or early summer, improves the placement of apatite in the shallower aquifer zone
- Establishing a pre-injection baseline concentration will help in evaluation of barrier performance monitoring

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## 300-FF-5 Groundwater Operable Unit

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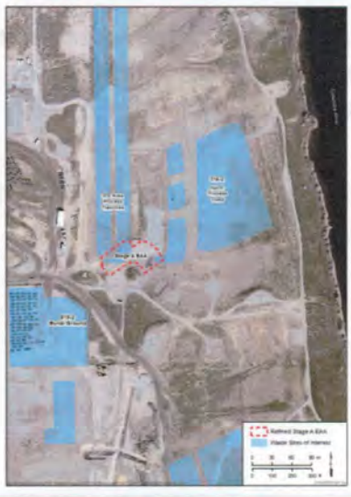
## 300-FF-5 "Stage A" General Location



- Infiltration and injection of phosphate solutions (PO4) into the vadose zone, periodic rewetted zone (PRZ) and groundwater will form insoluble minerals to bind mobile uranium
- Uranium sequestration will occur in two sequential stages, Stage A and Stage B
- Stage A was implemented in a 0.75 acre area of high residual uranium contamination
- Stage B will address the remaining 2.25 acres and is still in the planning phase

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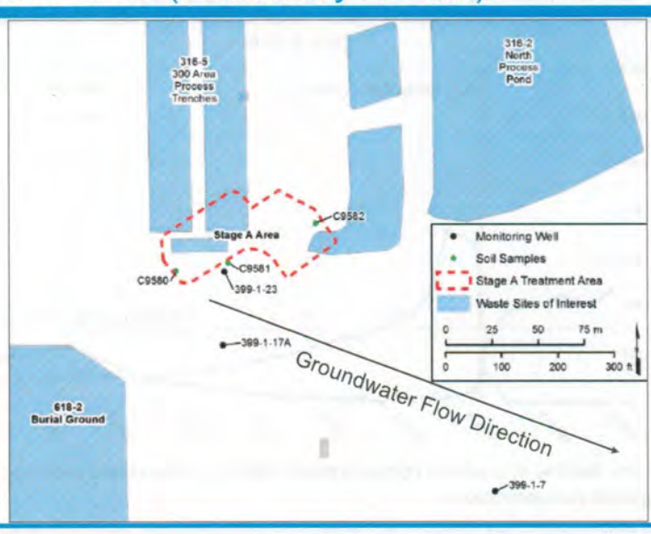
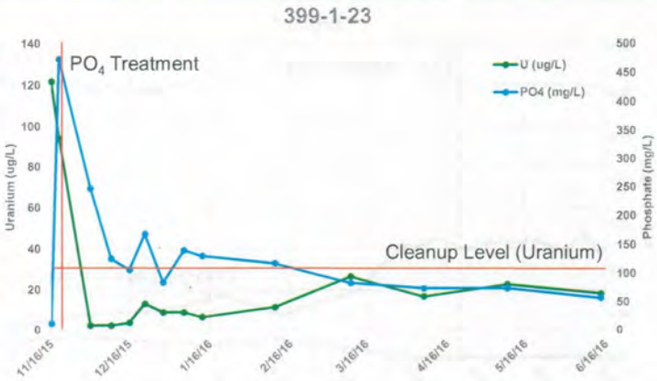
## 300-FF-5 Uranium Sequestration "Stage A" Performance (Preliminary Results)






## 300-FF-5 Uranium Sequestration "Stage A" Performance (Preliminary Results)




Groundwater wells down gradient of "Stage A" with long-term monitoring records show decline in uranium concentrations. The uranium concentrations remain below the cleanup level following the "Stage A" remedy.

## 300-FF-5 Uranium Sequestration "Stage A" Performance (Preliminary Results)

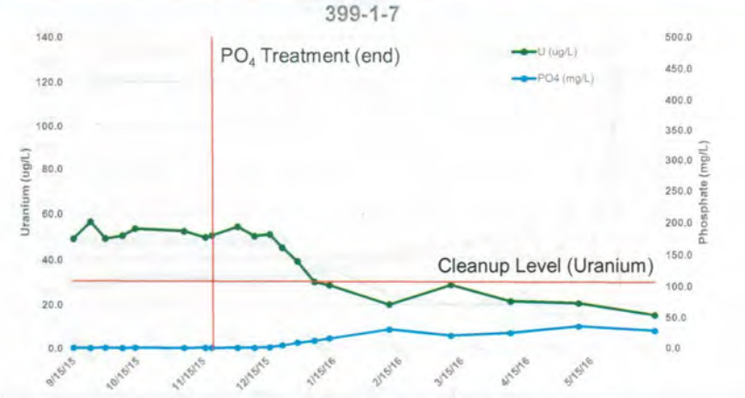
399-1-17A

Note the decline in uranium concentrations with corresponding increase in phosphate concentrations



## 300-FF-5 Uranium Sequestration "Stage A" Performance (Preliminary Results)

399-1-7



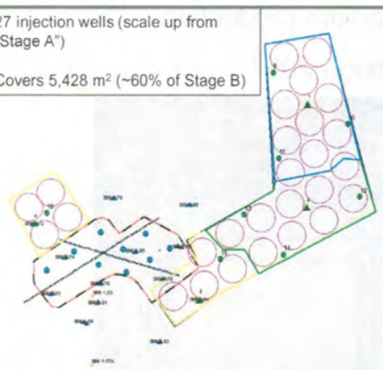

Uranium concentrations remained below cleanup level during the observation time period following the "Stage A" infiltration/injection

## 300-FF-5 "Stage B" Injections

"Stage B" Area: 2.25 acres = 9,085 m²

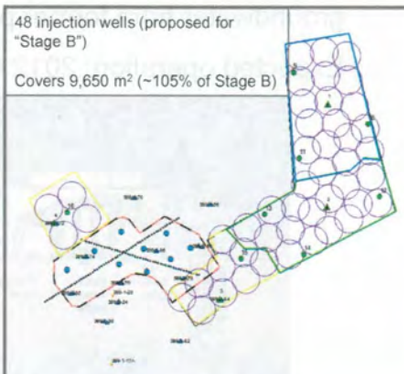
27 injection wells (scale up from "Stage A")

Covers 5,428 m² (~60% of Stage B)



48 injection wells (proposed for "Stage B")

Covers 9,650 m² (~105% of Stage B)



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## 200 West Pump-and-Treat: The First Three Years

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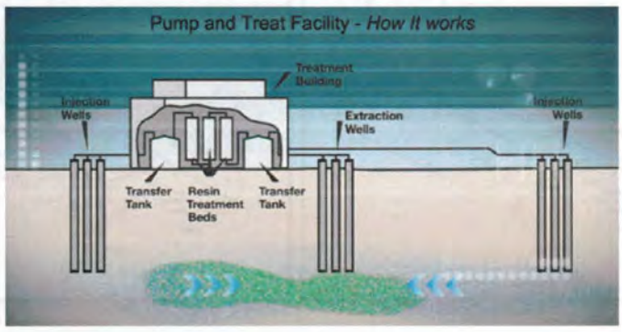
## Pump-and-Treat Concept

- Treats radiological and chemical contaminants in groundwater from former plutonium production
- Expected operation: 2012 through 2037

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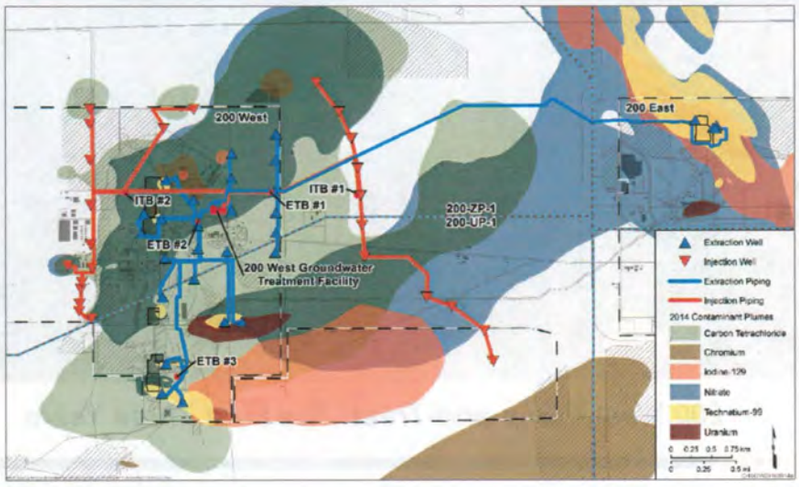
## Well Network with Plumes (2016)

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## Pump-and-Treat Expansion

- Increase capacity of 200 West Pump-and-Treat through system enhancements
  - Membrane Bio Reactor (MBR) cassettes
  - Fluidized Bio Reactor (FBR) upgrades
- Optimize existing remediation well network
- Increase groundwater treatment from the northern portion of the 200 East Area through installation of a second well
- Evaluate expansion to other 200 East Area plumes

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## Questions or Comments?

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