SGW-38573-VA
Revision 0

100-D Chromium Source Investigation Southwestern Cr(VI) Plume

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Date Published
July 2008

To Be Presented at
EM22 Peer Review

DOE HQ
Richland, WA

July 29 - 30, 2008

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J. D. Aardal 08/20/2008
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100-D Chromium Source Investigation, Southwestern Cr(VI) Plume

Scott Petersen, Fluor Hanford

July 29, 2008

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Soil & Groundwater Remediation Project

Refine Location of the Chromium Source(s)

Problem

Groundwater data show that there is a continuing source of chromium feeding the ISRM plume. The source needs to be identified and treated before a final ROD can be enacted.

Solution

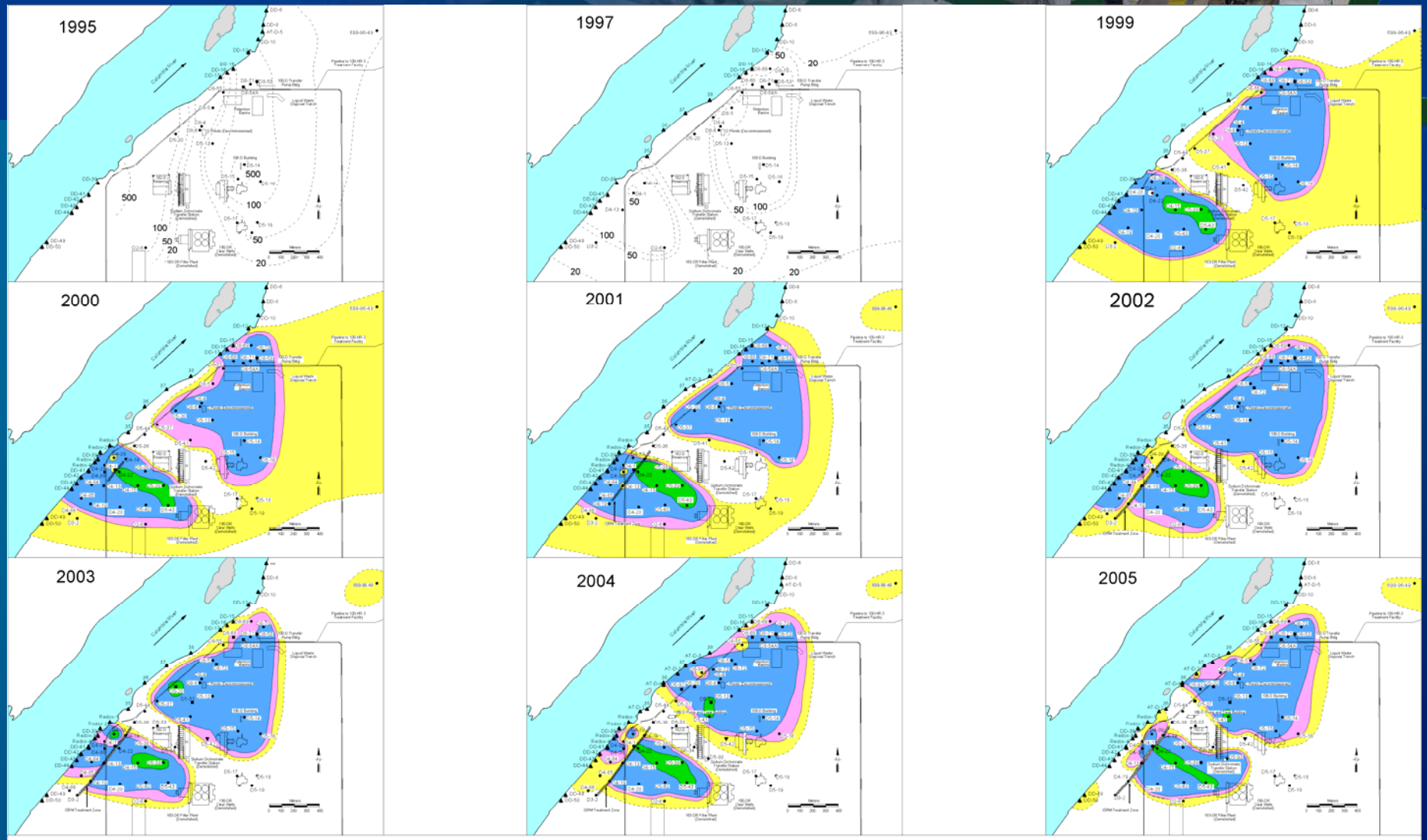
Geochemical and hydrogeologic investigation of the aquifer has been used to "backtrack" Cr(VI) to the source

Phase 1

- **Drill 7 boreholes near the origin of the groundwater plume**
- **Collect and analyze vadose zone samples for chromate**
- **Monitor chromium concentrations and groundwater levels in the wells for 6 months**
- **Monitor water levels (new wells, existing monitoring network, river stage)**

Phase 2

- **Drill four new monitoring wells near the southwest plume source to further refine source**



- ■ Extraction Well
- ▼ Injection Well
- ● Monitoring Well
- ▲ Aquifer Tube

- Chromium > 1000 µg/L
- Chromium > 100 µg/L and < 1000 µg/L
- Chromium > 50 µg/L and < 100 µg/L
- Chromium > 20 µg/L and < 50 µg/L
- Chromium < 20 µg/L

100-HR-3 (100-D Area)
Chromium Plume
Fall 1995 to 2005

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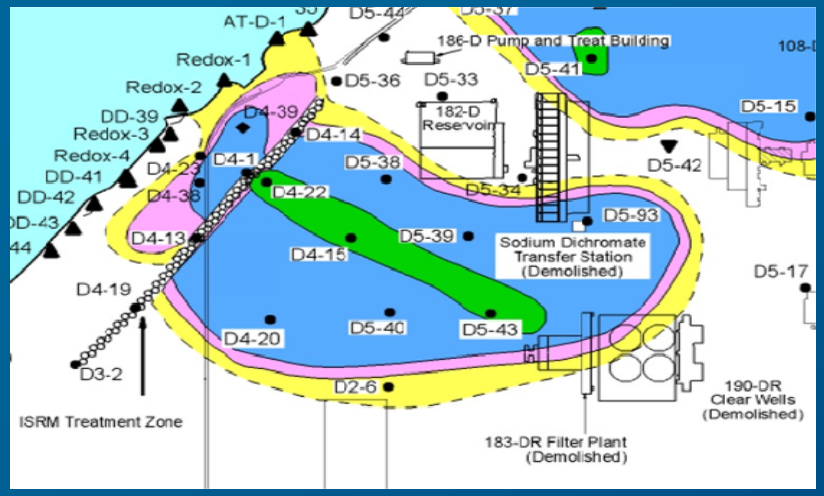
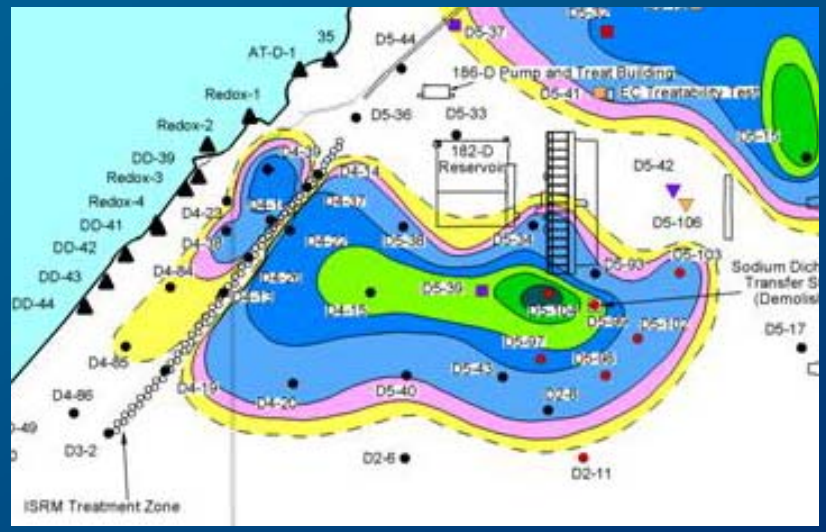
100-D Plume Maps Before and After Phase I Source Investigation





- Before spring of 2007, the groundwater plume map indicated the source was near the 183-DR Filter Plant
- New wells drilled in FY07 showed the source is located farther north, perhaps associated with the chromate transfer facility where rail tankers were unloaded
- Concentrations of Cr(VI) in certain new wells is much higher than previously encountered

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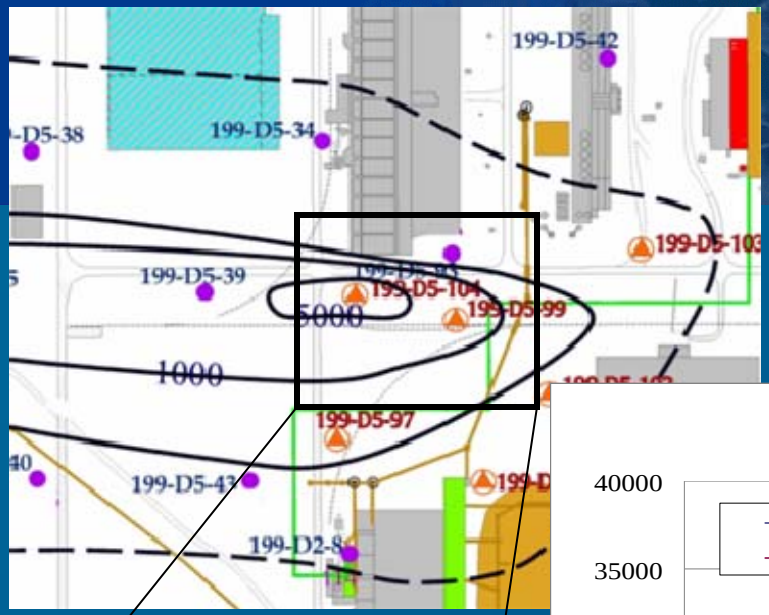
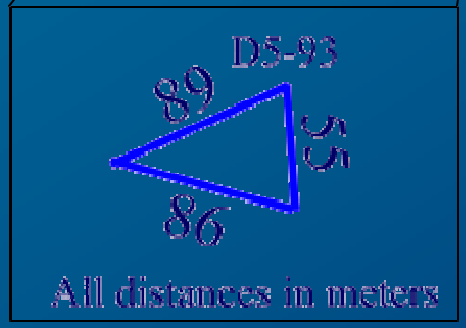
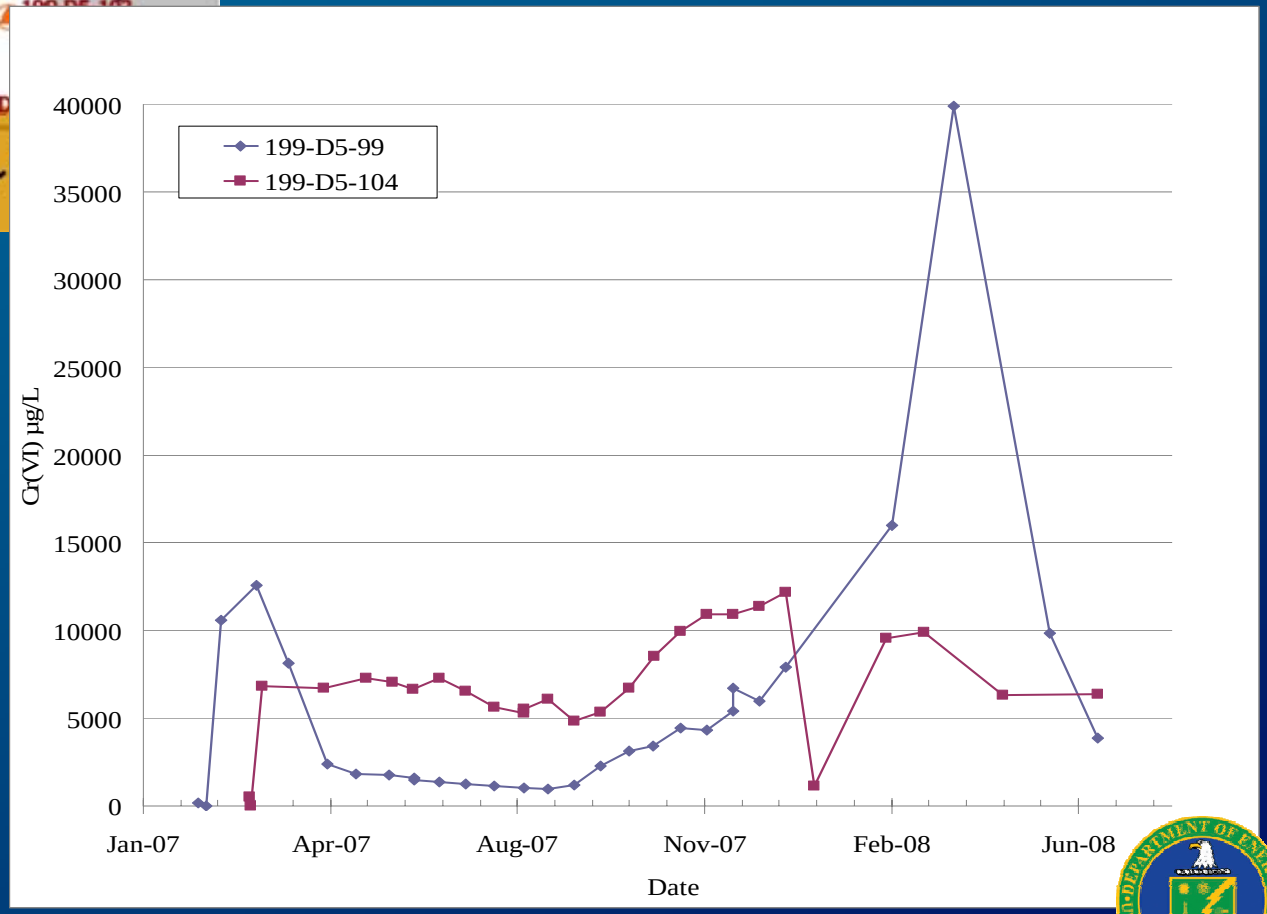
Hexavalent Chromium in the Two "Hot" Wells







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Cr(VI) Contamination Around the "Hot Spot"

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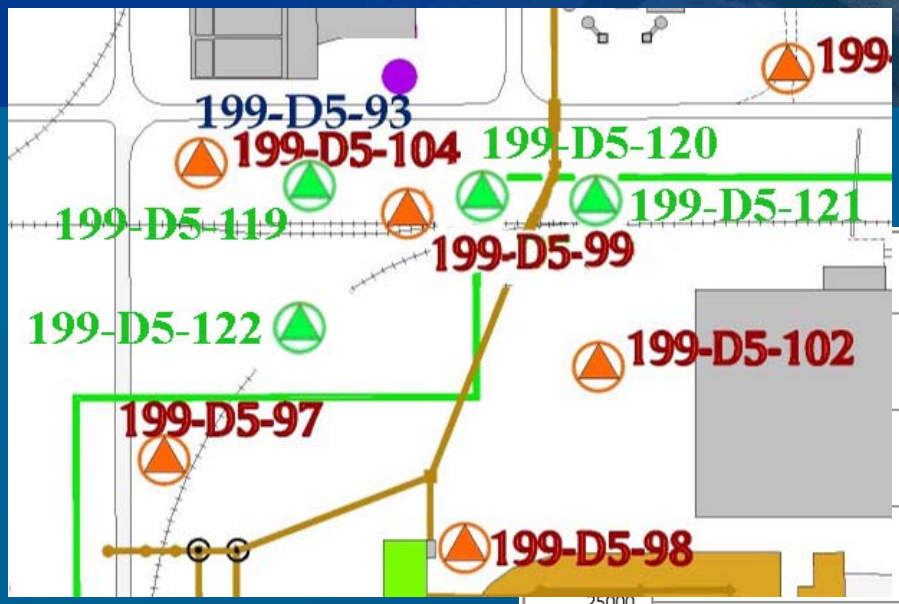
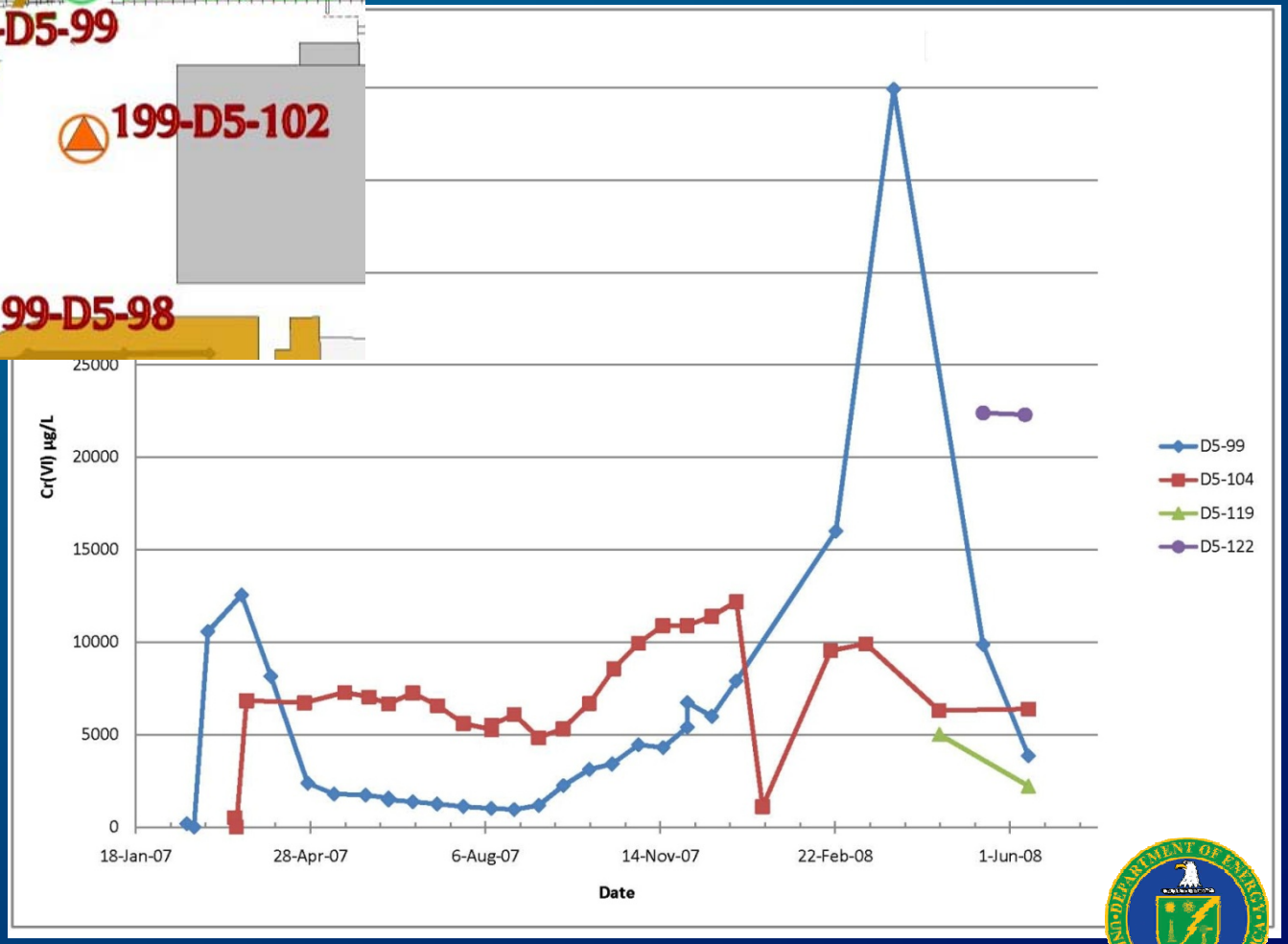
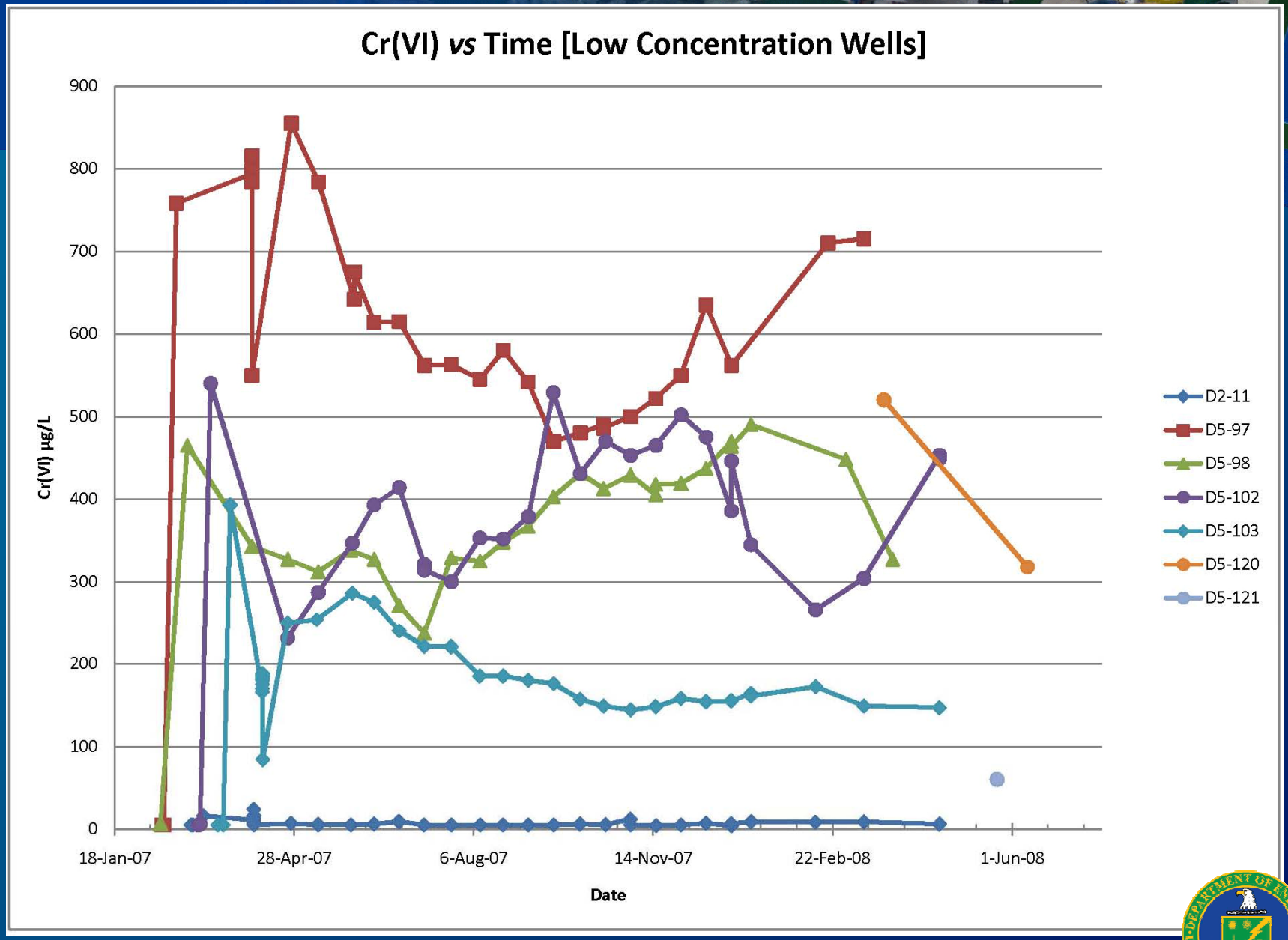
New Wells in 2008

- Drilled 4 more groundwater monitoring wells to further refine the source location
- Collected and analyzed vadose zone samples for chromate
  - Three of approximately 50 samples were above detection of 0.22 mg/kg hexavalent chromium
  - Highest value was 1.5 mg/kg hexavalent chromium
- Collected aquifer samples every two feet while drilling, and after completion/development
  - Highest value was 22,000 ug/L
- "Hot spot" has moved from 199-D5-104 to 199-D5-99 to FY08 well 199-D5-122

New FY08 Wells and Data






Cr(VI) vs Time [Low Concentration Wells]
900
800
700
600
500
400
300
200
100
0
Cr(VI) µg/L
18-Jan-07
28-Apr-07
6-Aug-07
14-Nov-07
22-Feb-08
1-Jun-08
Date
D2-11
D5-97
D5-98
D5-102
D5-103
D5-120
D5-121

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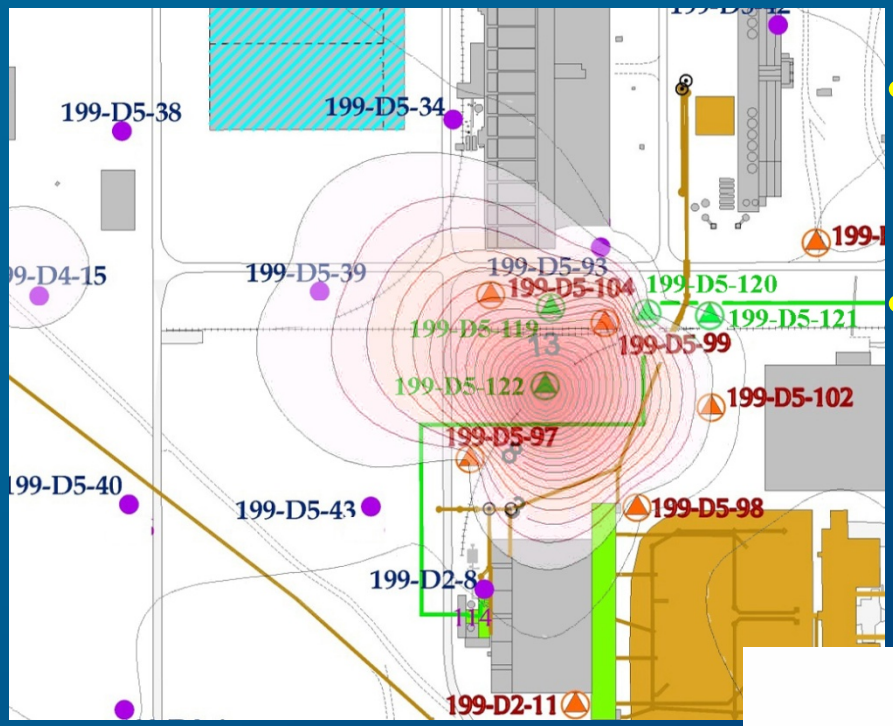
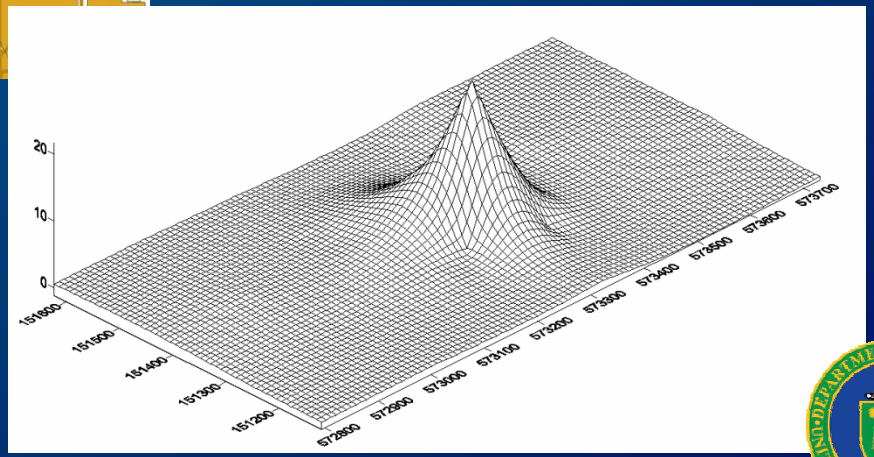
Current Plume Configuration



- **Distinct bimodal Cr(VI) distribution**
- **High concentration zone ~20 times more concentrated than extended plume**



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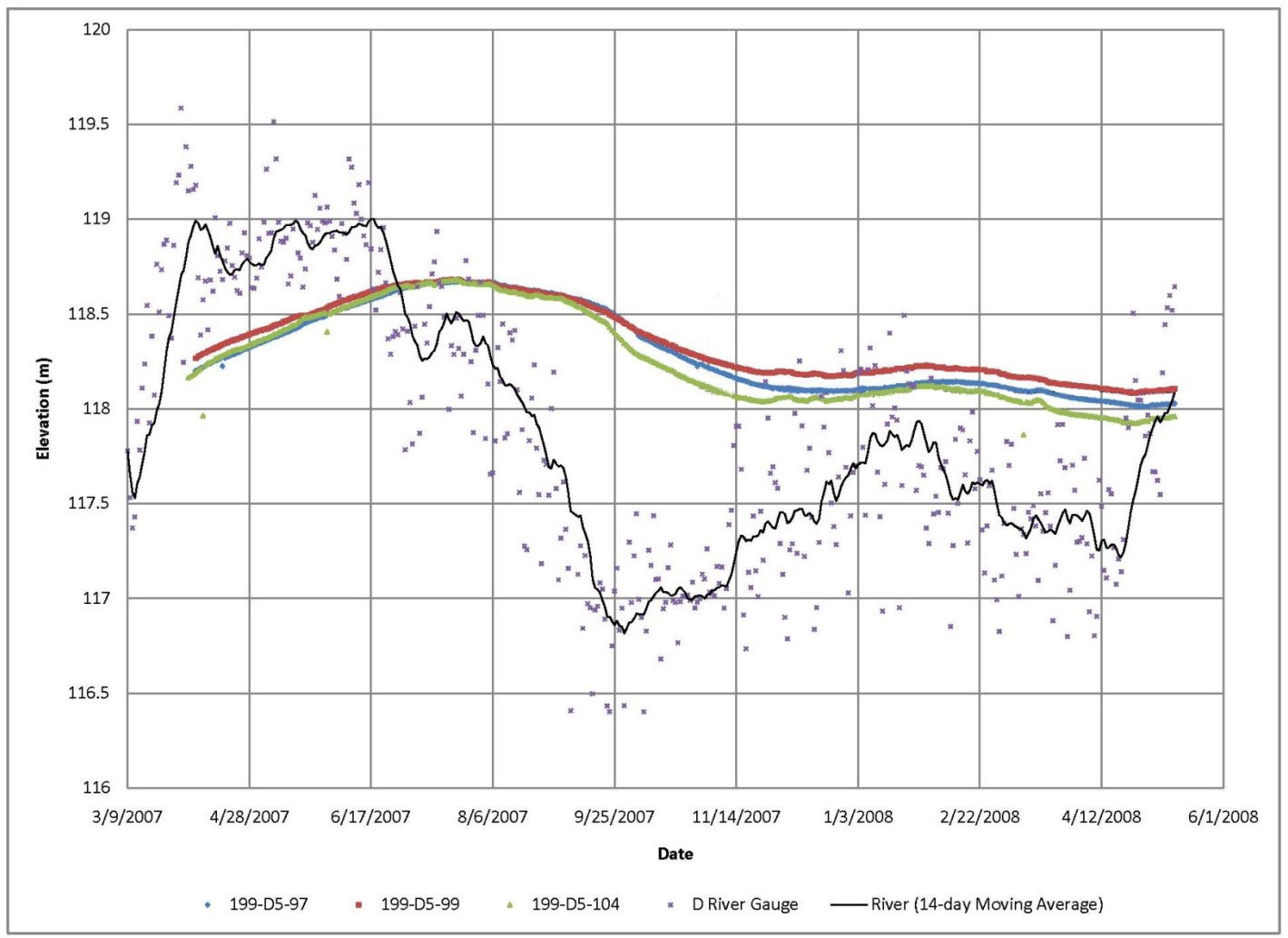
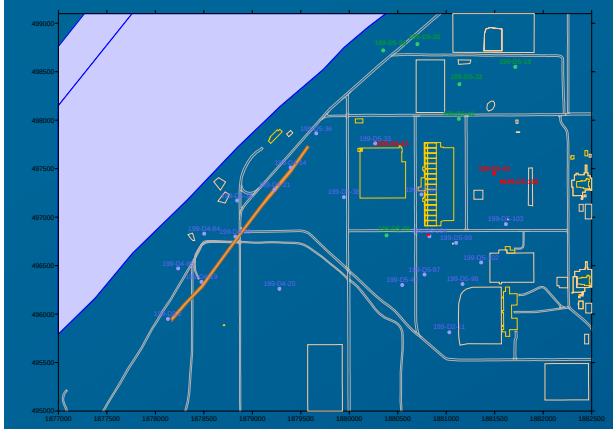
Effect of River Stage

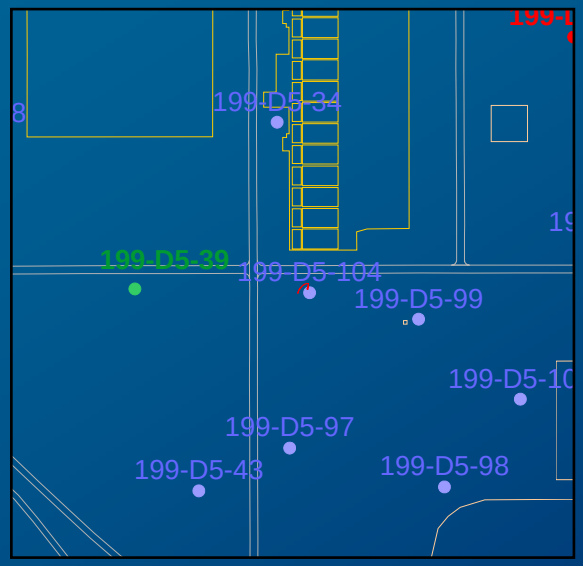


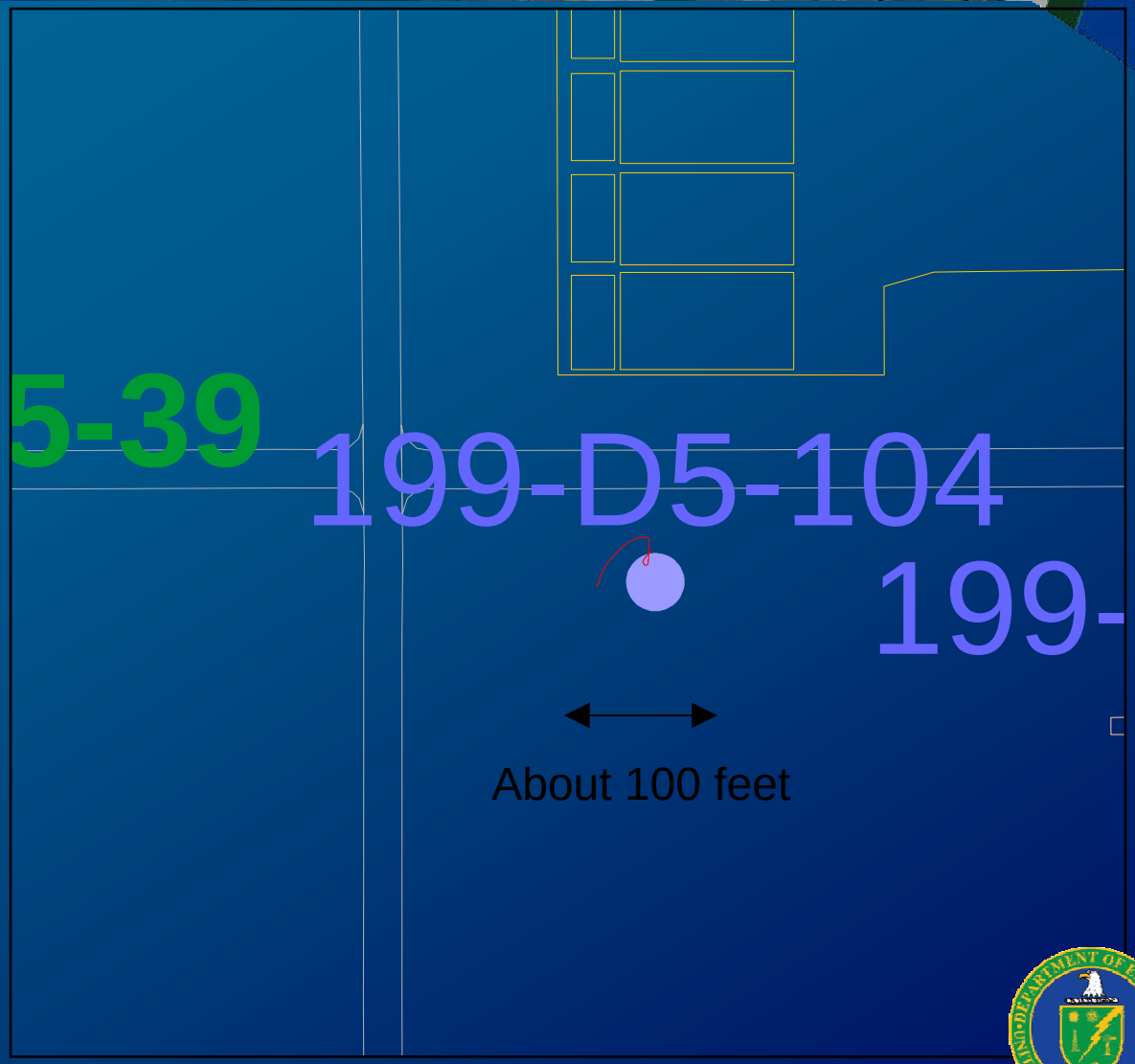
Groundwater Flow Modeling

- **Net regional flow towards Columbia River, but with reversal at high river stage**
- **Hydraulic gradients generally small in high concentration zone**
- **Particle tracking simulation indicates near stagnation in high concentration zone**

Analysis of Groundwater Flow







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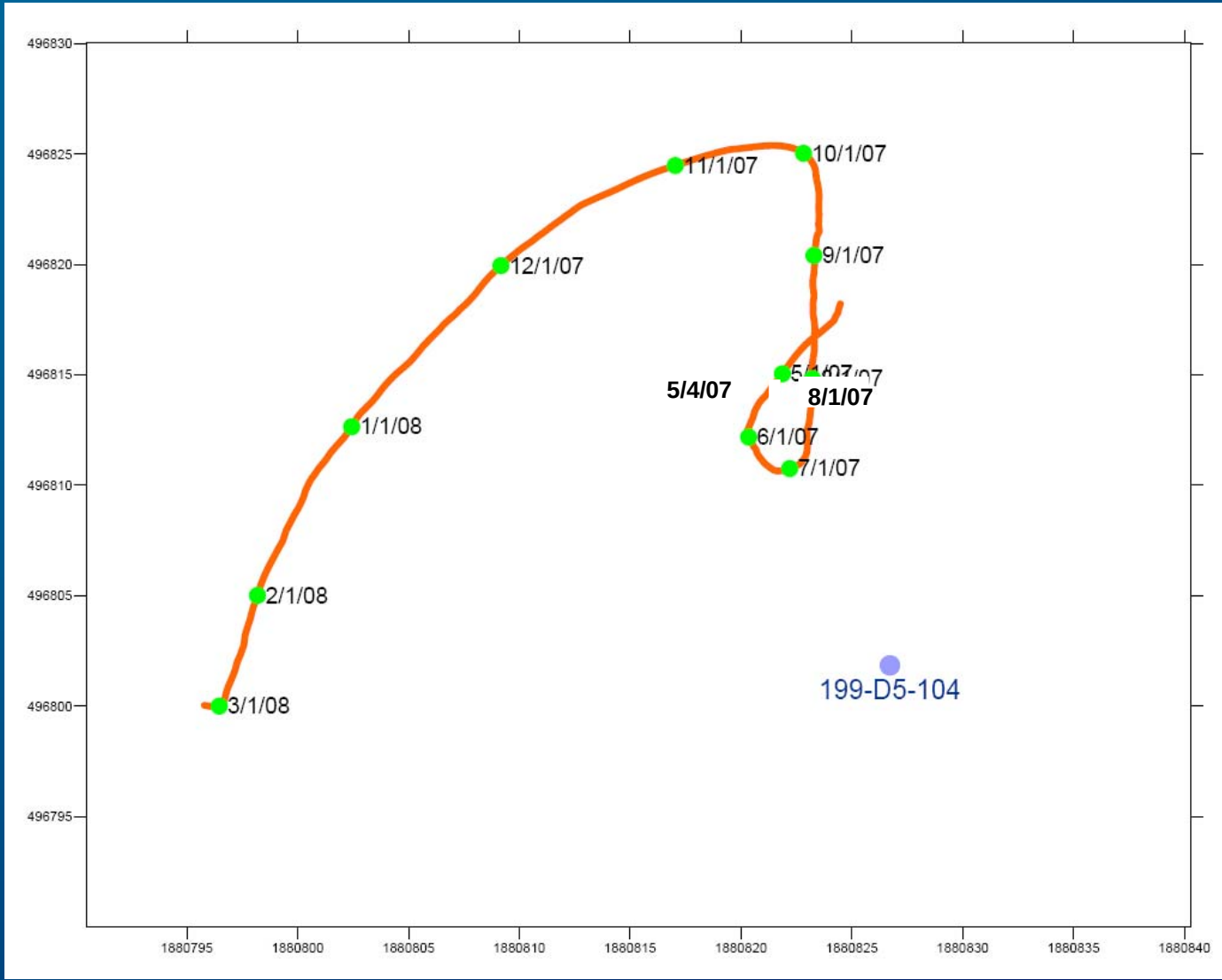
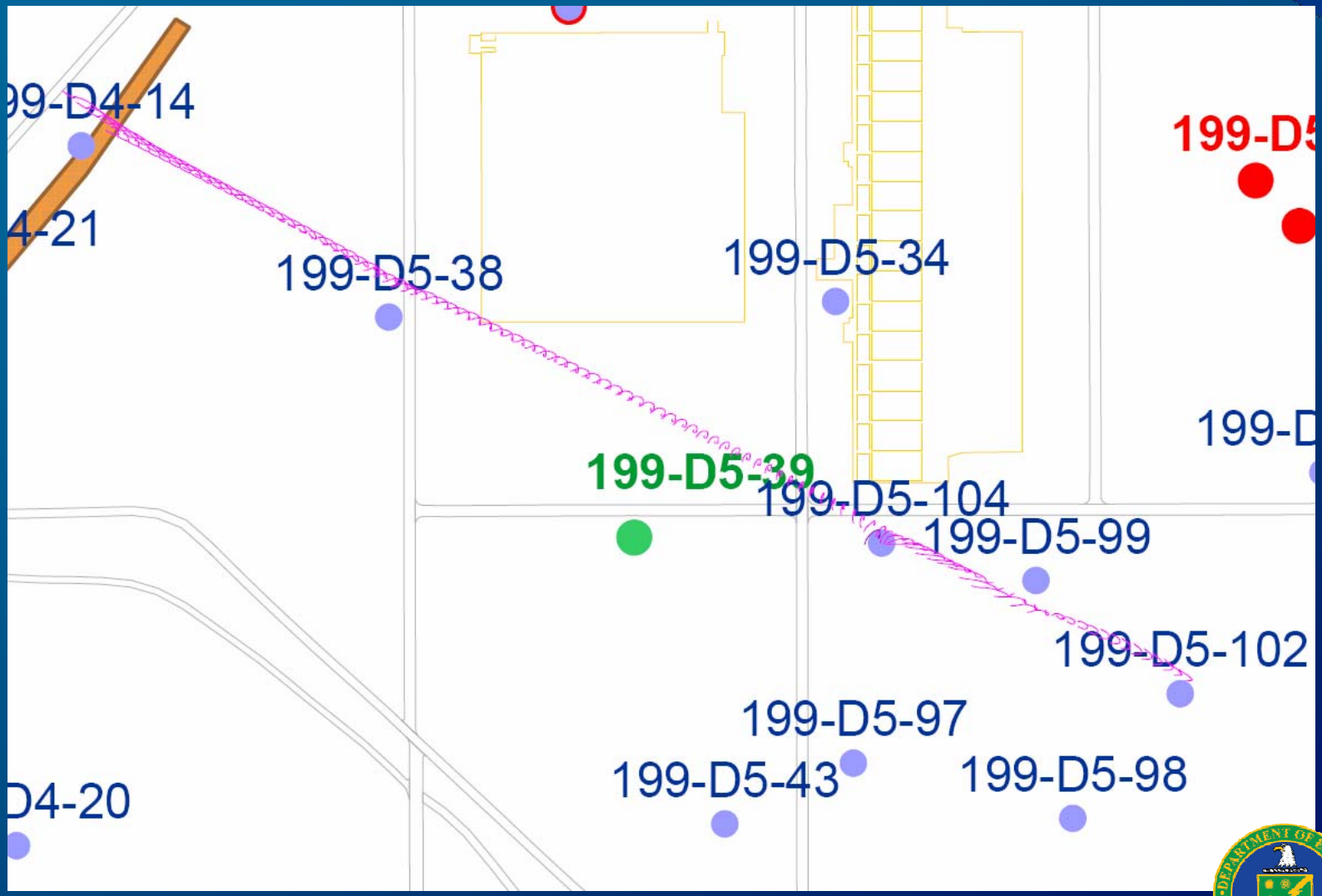
Flow Path Near Hot Spot



Particle Tracking Parallel to Plume



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Conclusions

- Flow modeling and particle tracking simulations suggest near stagnation of high concentration zone
- Simulated particle track is consistent with observed “wandering hot spot”
- Possible preferential flow around high concentration zone; dispersion at zone margin supplies Cr(VI) to the extended plume

Conclusions (continued)

- **High concentration zone fits within one-hectare circle**
  - **Could target this area for vadose zone remediation**
- **Model based on current data neither requires nor eliminates an active vadose zone source**
- **Estimated mass in high concentration zone: 170 kg as Cr(VI) in 4×10^6 L**