

# Impact of High-Resolution Characterization during Baseline Sampling at Contractors Road Heavy Equipment Area Kennedy Space Center, Florida

Mike Burcham, E.I.T (Geosyntec);  
Anne M. Chrest (NASA); Rebecca  
Daprato, Ph.D., P.E. (Geosyntec); Jill  
Johnson, P.G. (Geosyntec)

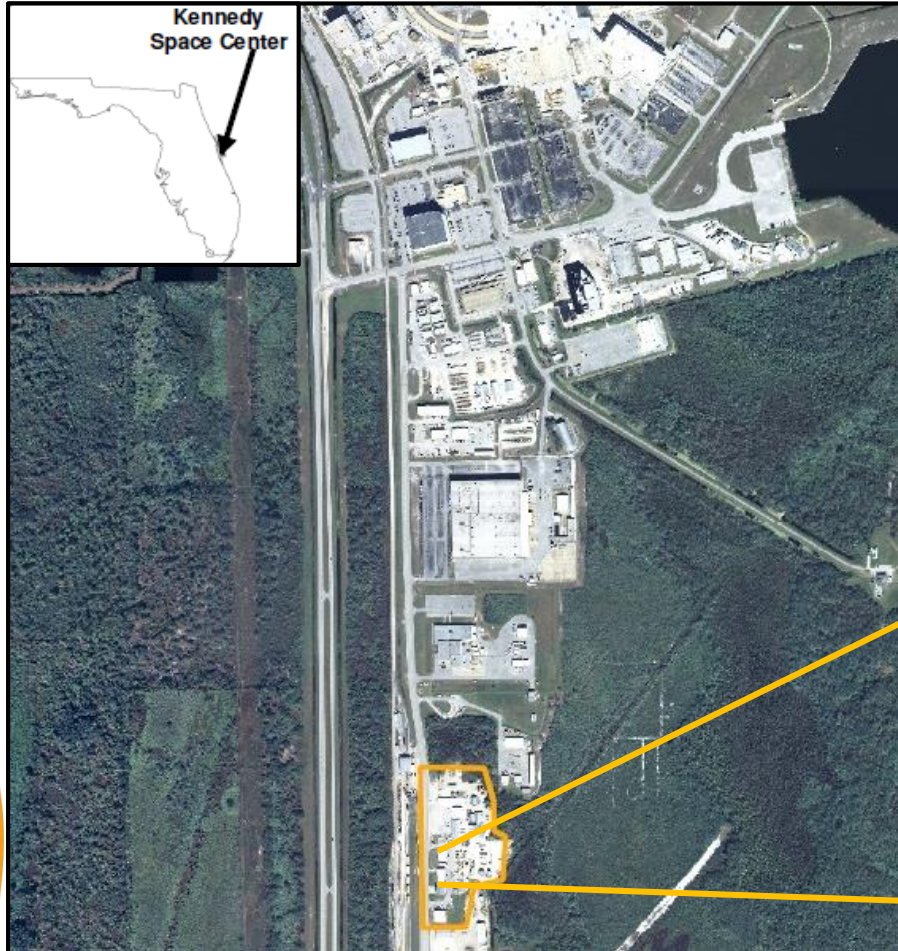


## Outline

- Background
  - Site and methodology
- Pre-baseline high-resolution site characterization (HRSC) results
- Purpose of baseline HRSC
- Results from baseline HRSC
- Impacts of HRSC



## Site Information



- **Location:** Kennedy Space Center (KSC), FL
- **Historically:** hazardous waste storage/staging facility
- **Currently:** heavy equipment storage and maintenance



1993 Aerial Photograph

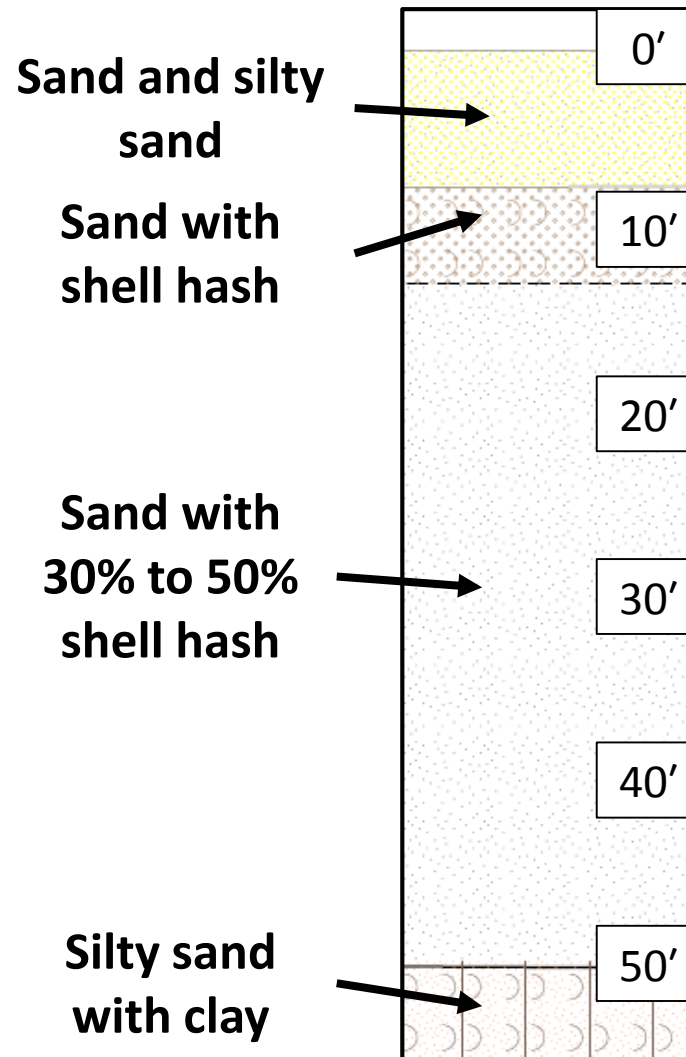




## Site Conditions

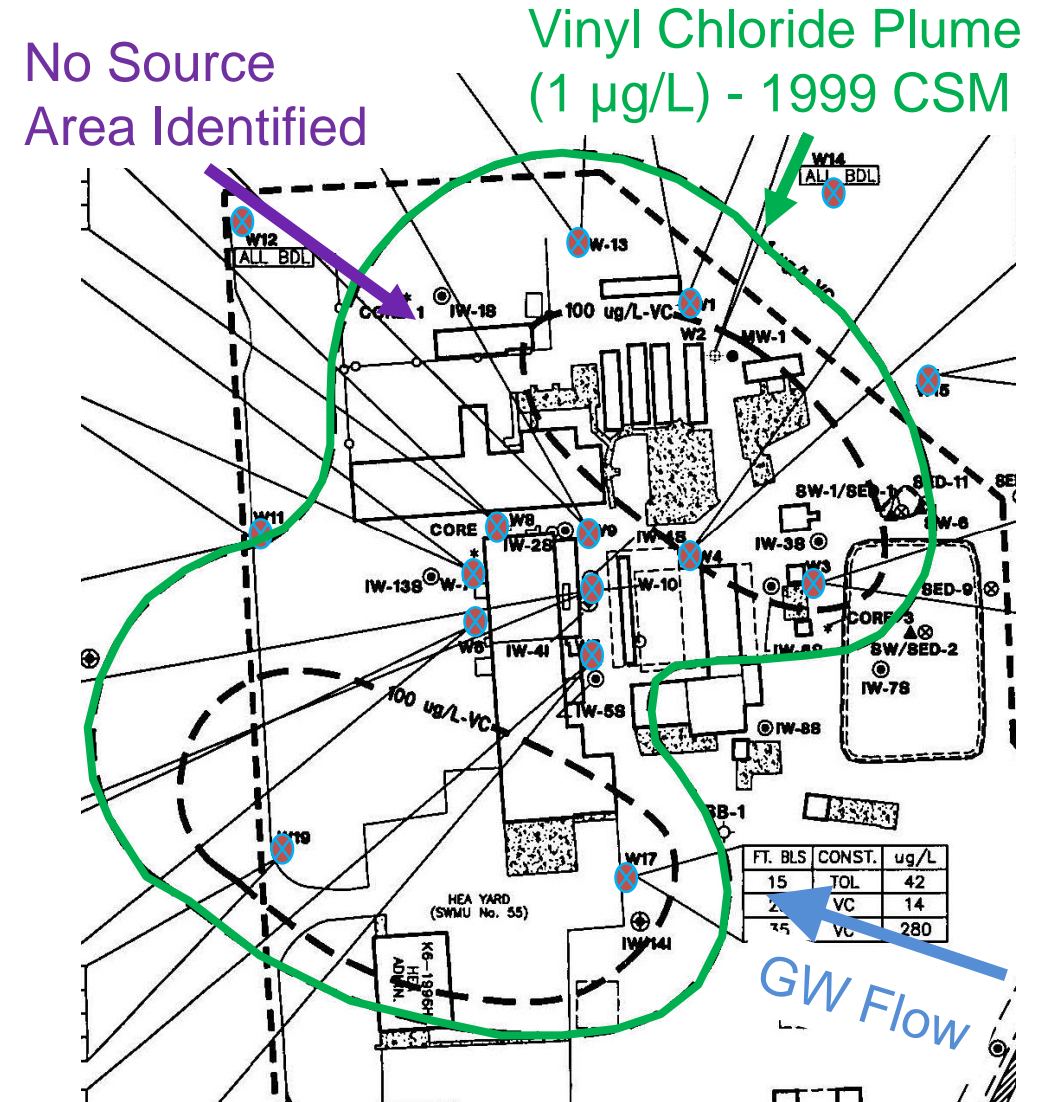
- Site Hydrology
  - Groundwater flow in intermediate zone is generally to west
  - Low permeability layer starts ~50 feet below land surface (ft BLS)
  - Depth to groundwater ranges from 2 to 6 ft BLS

### Lithology with Depth (ft BLS)



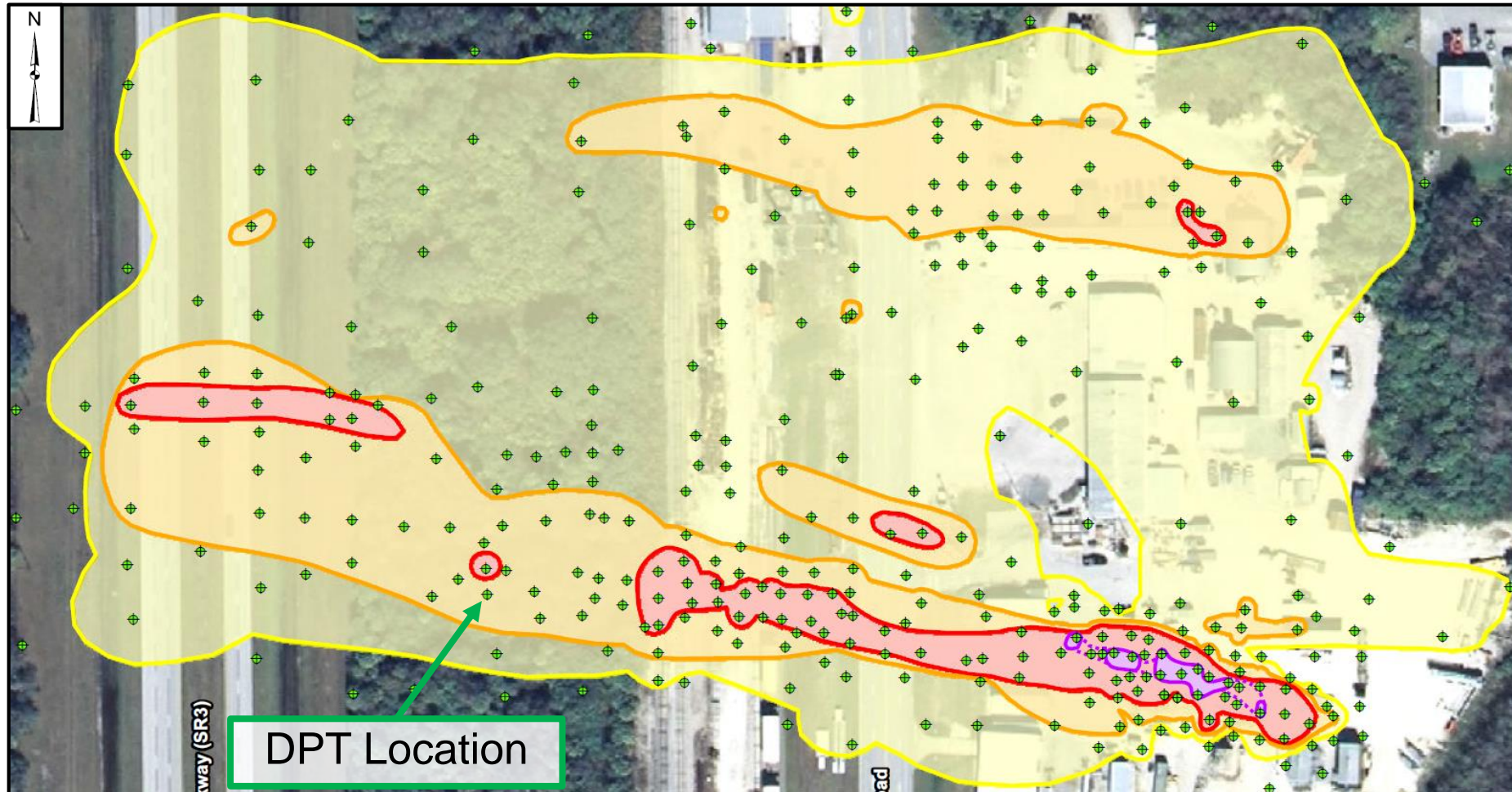
## Site History

- 1990s-2000: RFI and CMS Report (previous consultant)
  - CVOC plume delineation
  - CVOCs were attenuating
- 2000-2009: Long-term monitoring
- 2009-2014: High Resolution Site Characterization (HRSC)
- 2014: Bioremediation of TCE Source Zone proposed
- 2015: Baseline HRSC

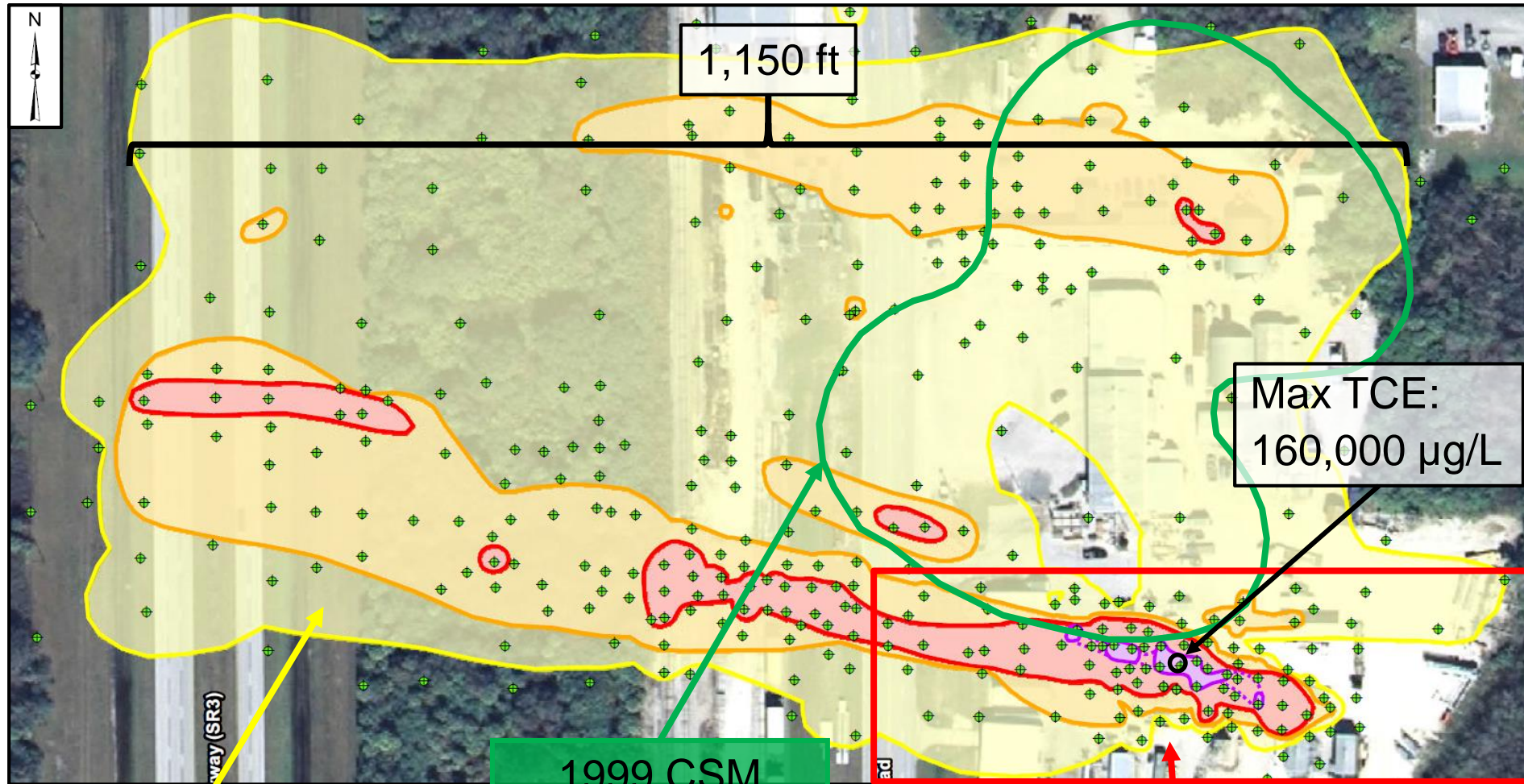


## DPT HRSC Results: 2009 - 2014

- 2009 – 2014:  
~2,340 samples collected from 363 locations
- Collect samples ~8-65 ft BLS using 4-ft sampling intervals
  - 86% of site-wide samples collected from 16-50 ft BLS



# DPT HRSC Results: 2009 - 2014



2014 CSM "MCL"  
CVOC Plume

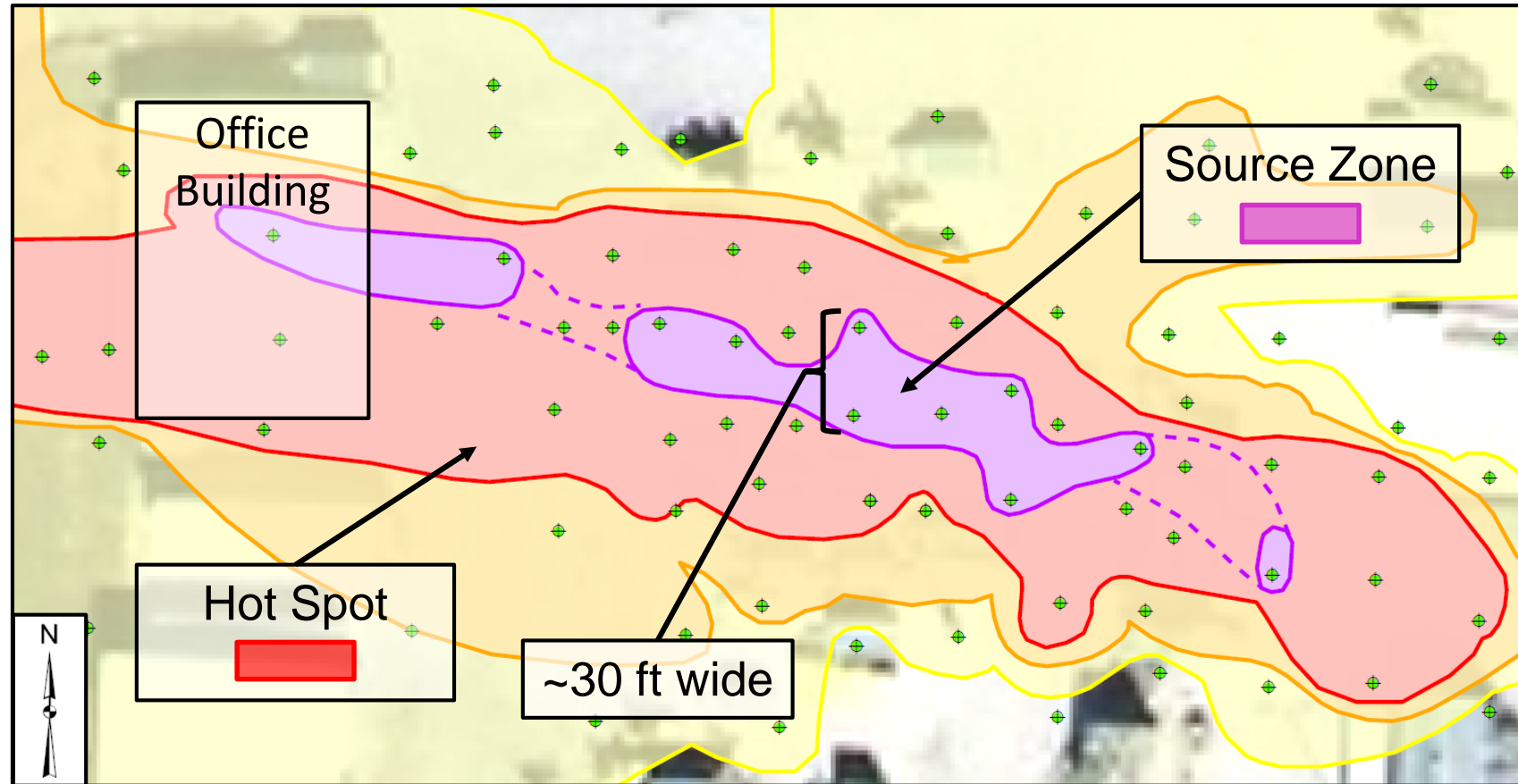
1999 CSM  
Vinyl Chloride  
"MCL" Plume

2014 CSM  
Hot Spot 1 Area



## Hot Spot 1 CVOC Distribution: 2014

- Source zone delineation
  - TCE concentrations > 11,000  $\mu\text{g/L}$  (1% solubility)
  - Source Zone Area: ~1,300  $\text{ft}^2$
- Hot Spot delineation
  - TCE: 3,000  $\mu\text{g/L}$ ;
  - cDCE: 7,000  $\mu\text{g/L}$ ; VC: 1,000  $\mu\text{g/L}$

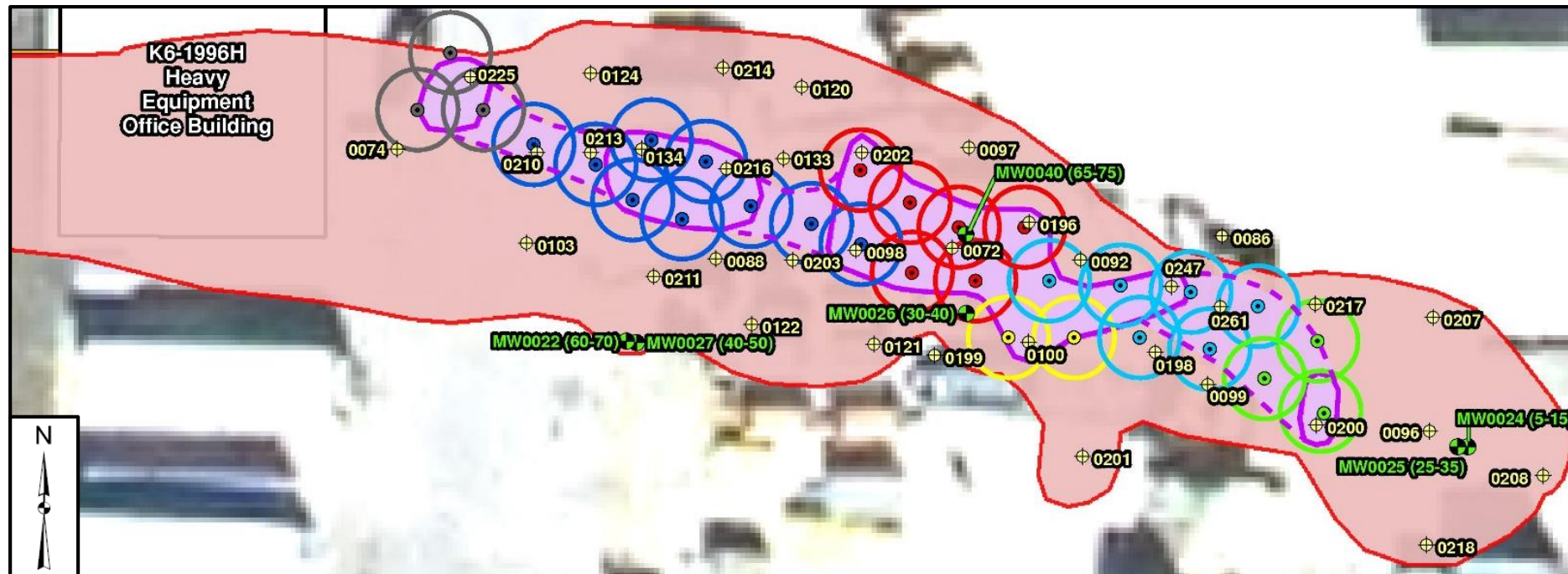






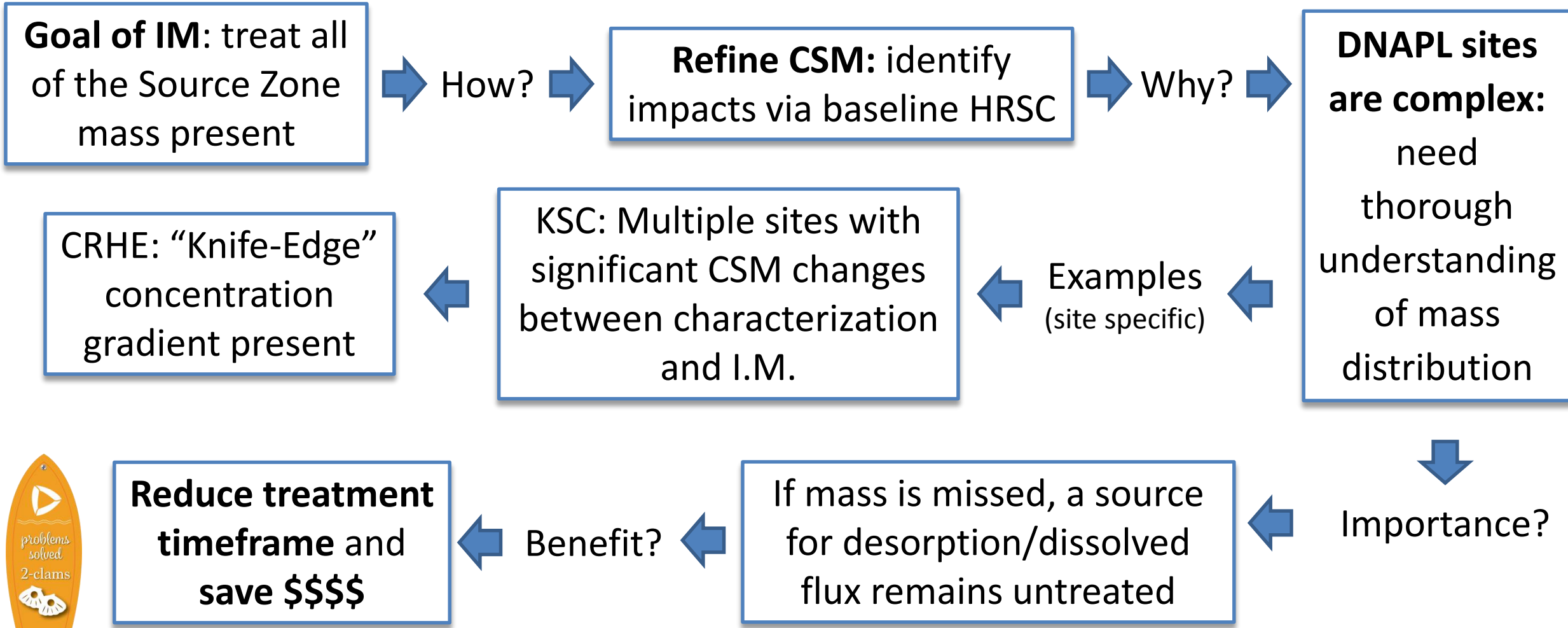
## Bioremediation Design: 2014

- Treatment area ~1,300 ft<sup>2</sup>
- 29 injection locations within Source Zone (SZ)
- Targeted Depth: ~14-50 ft BLS
  - Based on Hot Spot concentrations





## Baseline HRSC Sampling: Why?



## Baseline DPT HRSC

- Baseline HRSC via DPT in Sept and Oct 2015
  - 16 locations
  - 99 samples
  - Additional source area refinement warranted
- Additional HRSC via DPT performed in 2016
  - 44 locations
  - 295 samples

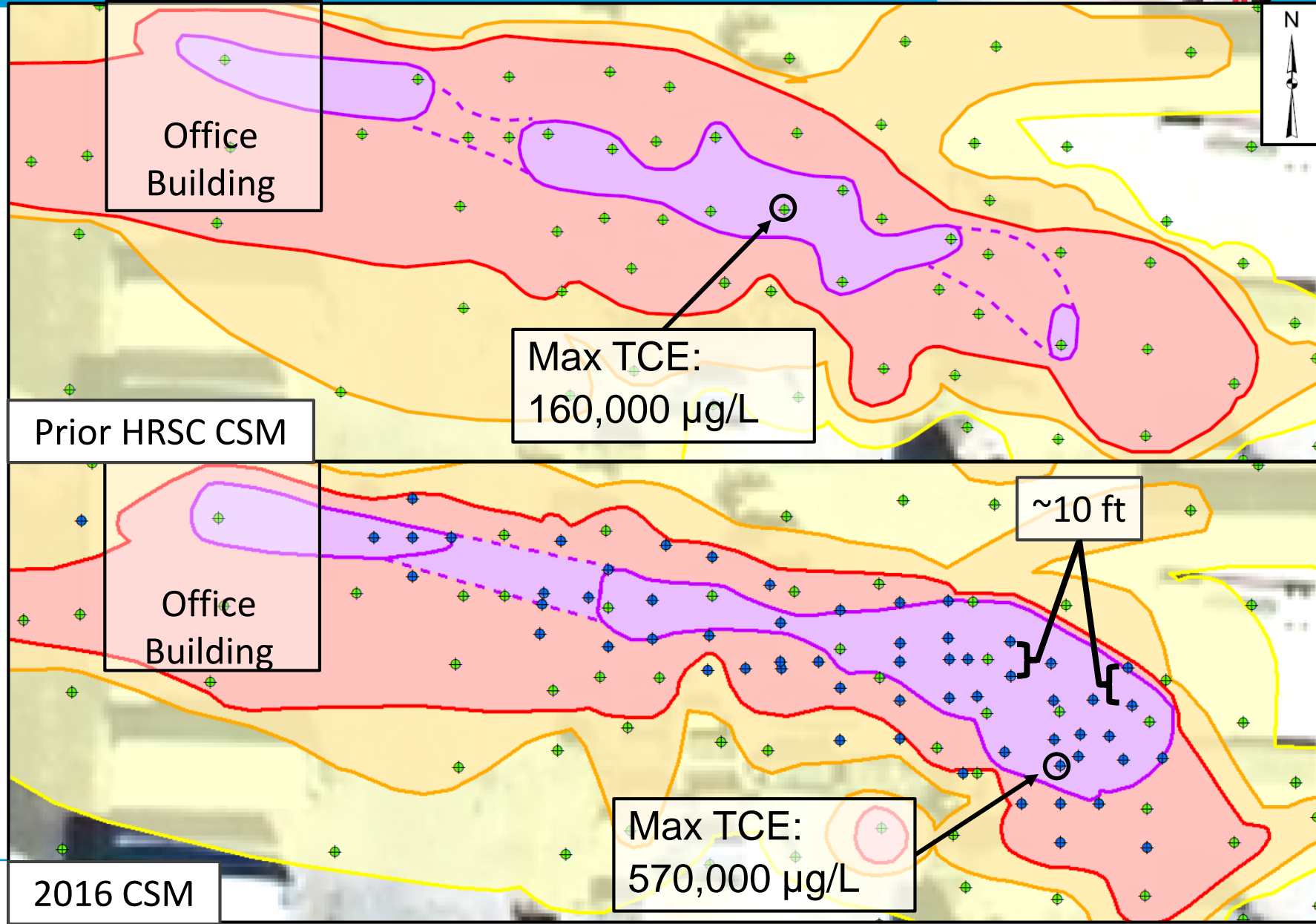


DPT HRSC Locations: Pre-2015 2015-2016



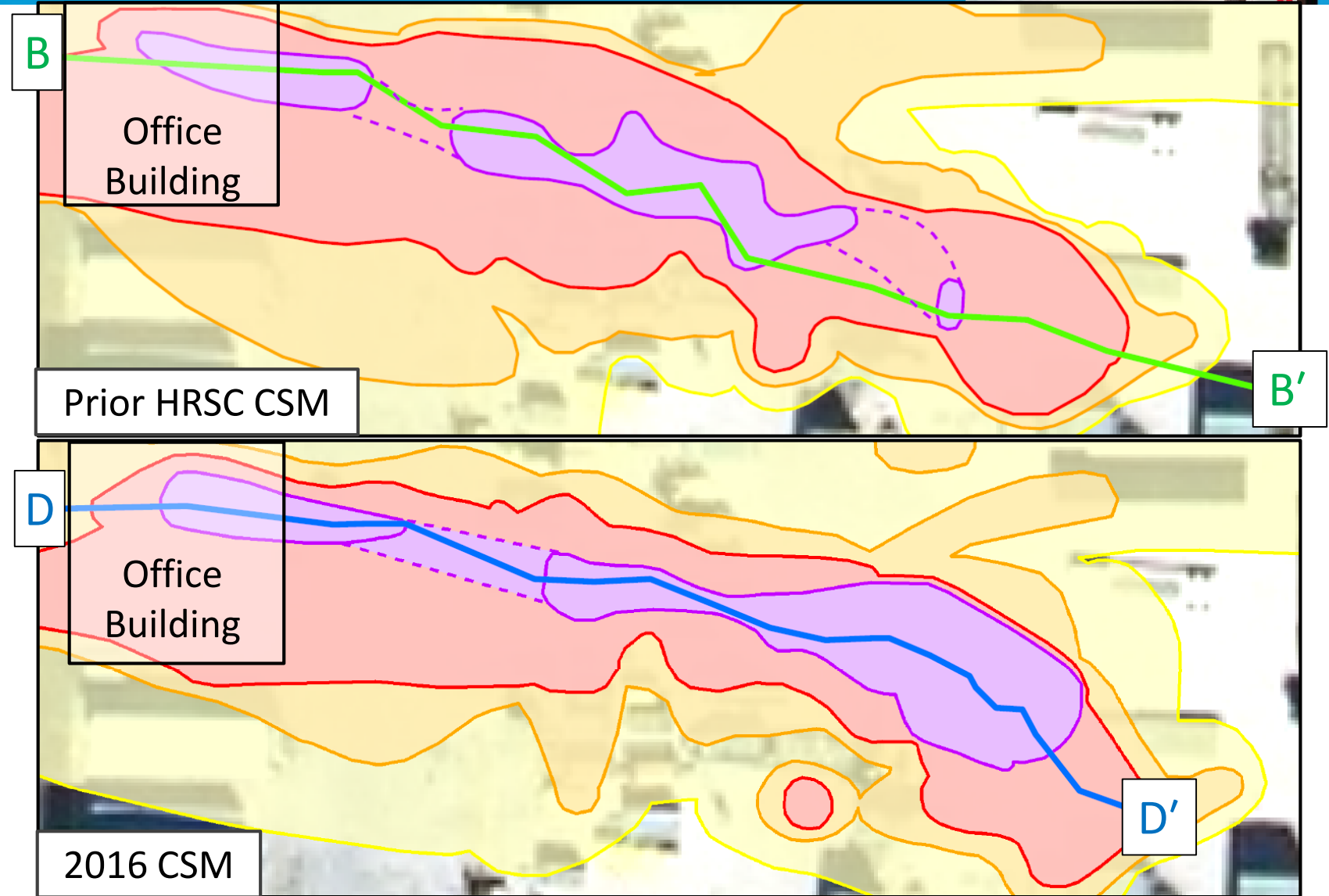
# Hot Spot 1 CSM Comparison: Horizontal

- Max TCE Concentrations
  - Prior HRSC CSM:  
**160,000  $\mu\text{g/L}$**
  - 2016 CSM:  
**570,000  $\mu\text{g/L}$**



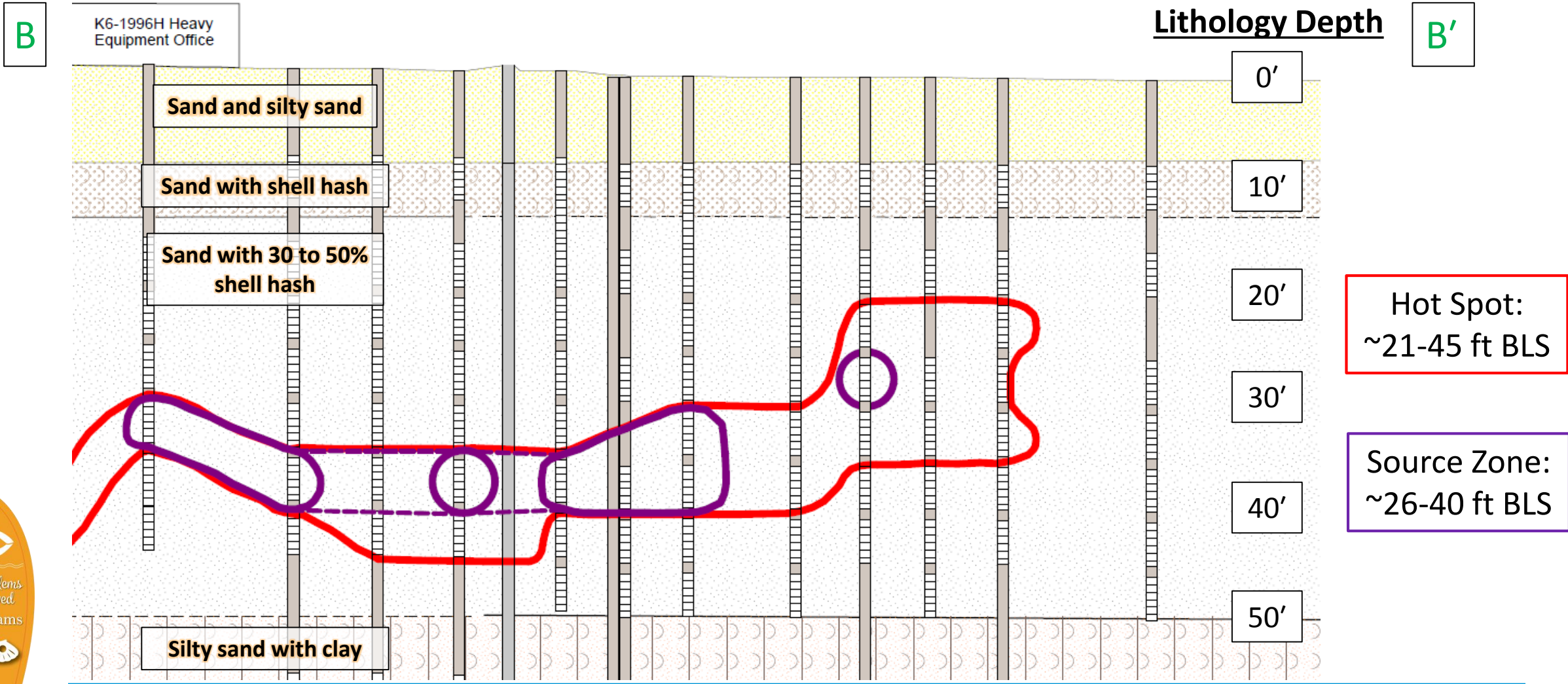
# Hot Spot 1 CSM Comparison: Vertical

- B-B' = Prior HRSC CSM
- D-D' = 2016 CSM



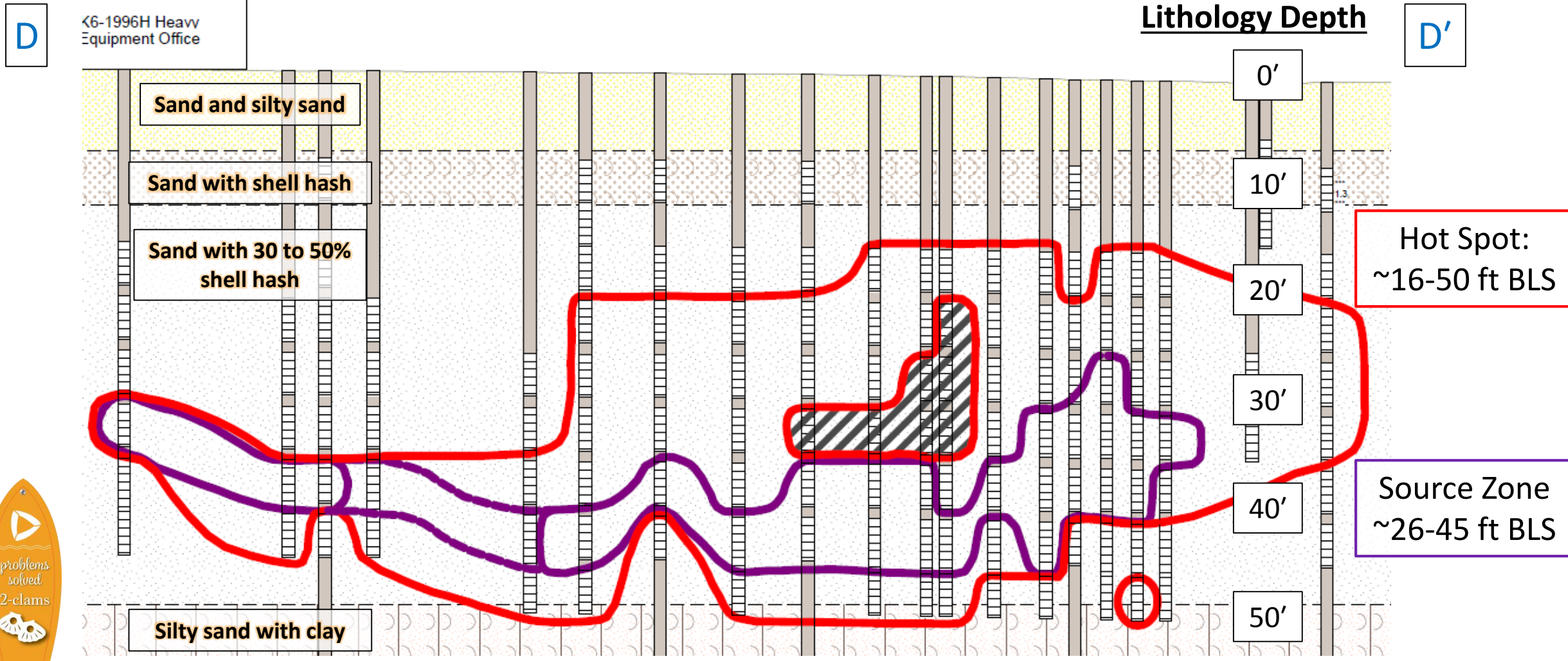


# CSM Comparison: Vertical – Prior HRSC CSM for Hot Spot 1





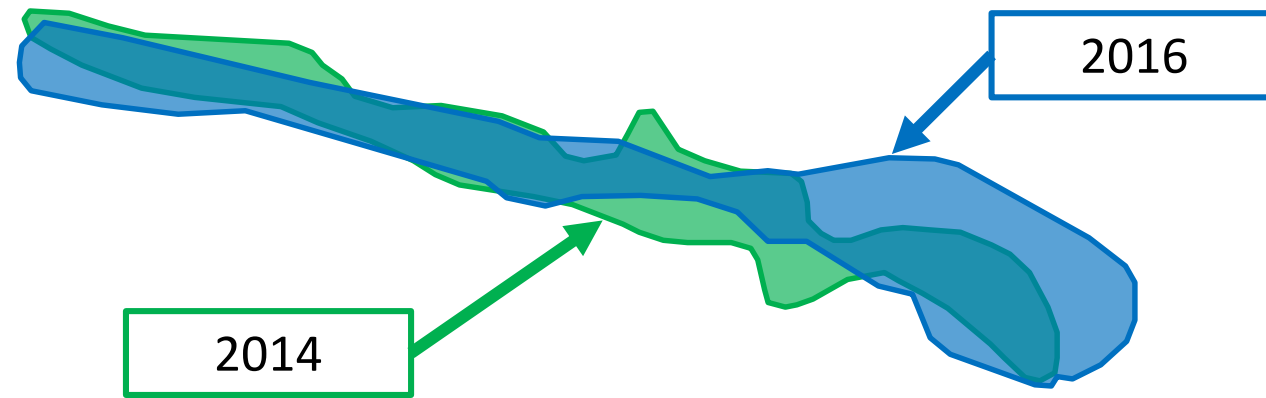
# CSM Comparison: Vertical – 2016 CSM for Hot Spot 1





## What changed?

- Horizontal impacts (Source Zone) expanded
  - Area Change: 3,000 ft<sup>2</sup> → 4,800 ft<sup>2</sup>



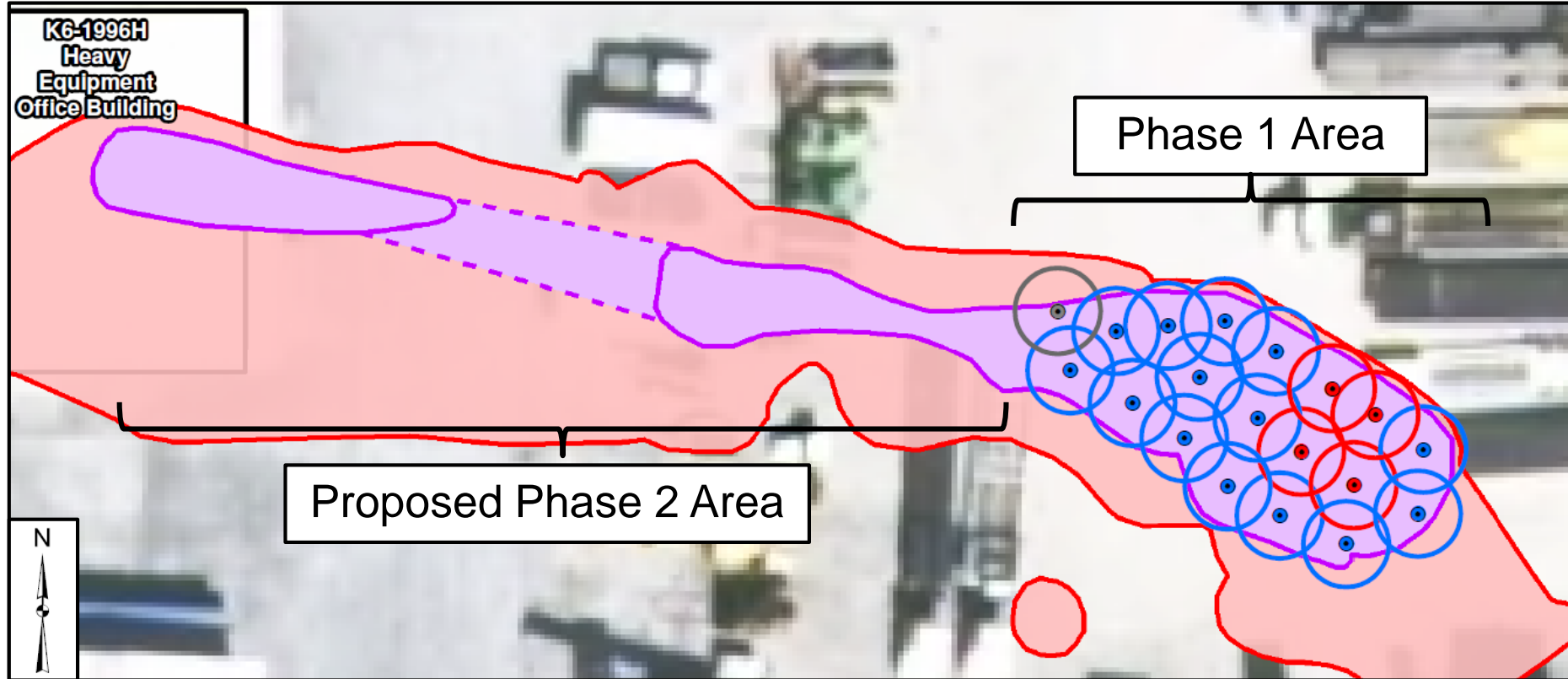
- More impacts on eastern side of Hot Spot 1
- Vertical impacts (Hot Spot) expanded
  - More shallow (Hot Spot) impacts identified





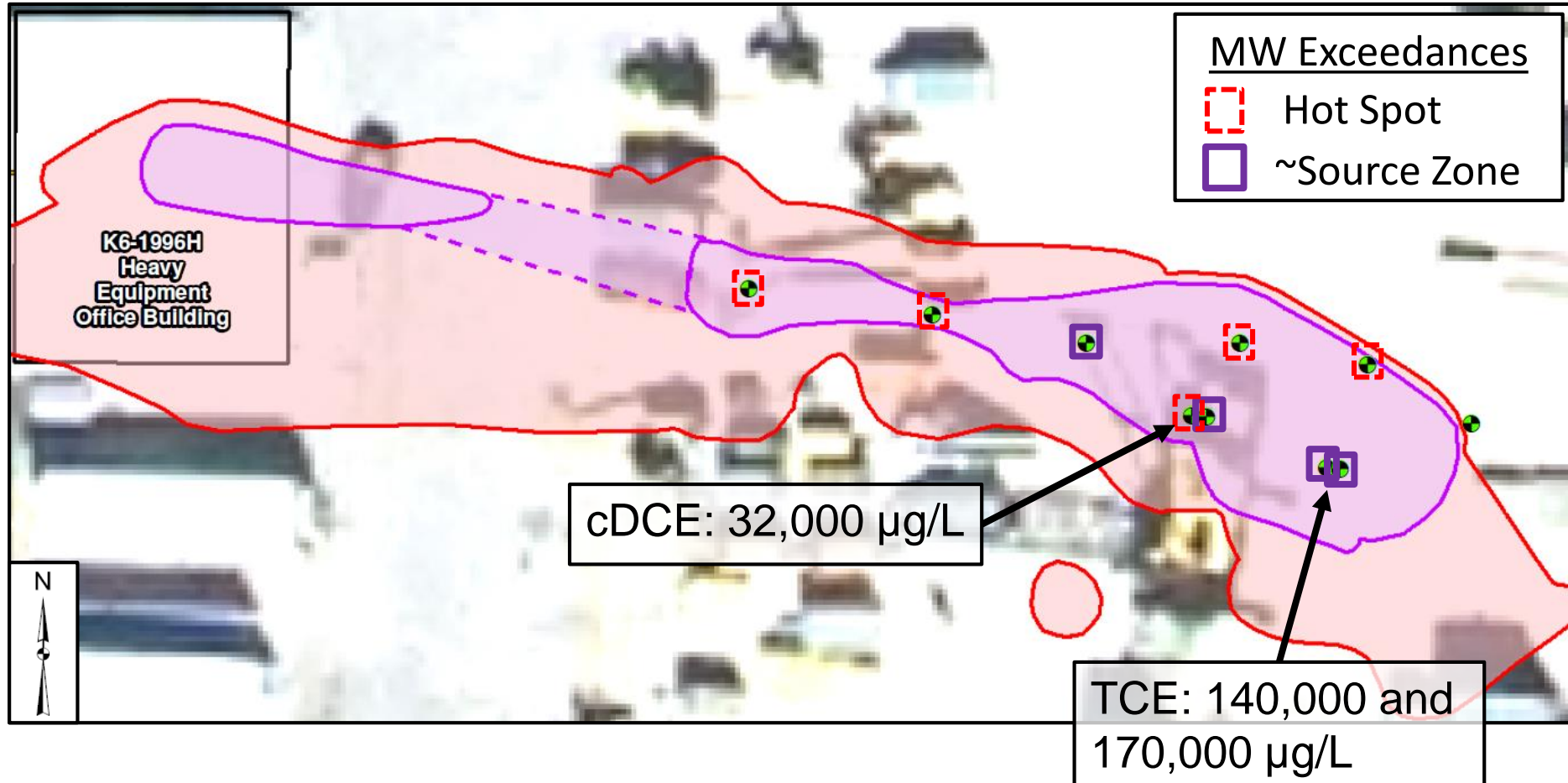
## Impact of Baseline HRSC: Bioremediation

- Implement bioremediation in phases
  - Target “head of the snake” first (as a pilot)
  - Reduced injection locations (29 → 19)



## Impact of Baseline HRSC: Monitoring Plan

- Monitoring well (MW) network adjusted
- Baseline results confirm HRSC CSM refinement



## CRHE Baseline HRSC Summary

- Decrease in CVOOC concentrations in treatment area during 1<sup>st</sup> quarter post-injection sampling
  - Average Percent Decrease: 97% (in TCE equivalents)
- DNAPL sites are complex!
  - Significant mass identified just east of 2014 Source Zone (TCE = 570,000 µg/L)
- Pre-IM baseline HRSC can have **SIGNIFICANT** impact to design
  - Facilitated more effective location of performance monitoring wells within Source Zone
  - Enhanced placement of injection locations with high confidence mass was not being “missed”
  - Implemented design in two phases

