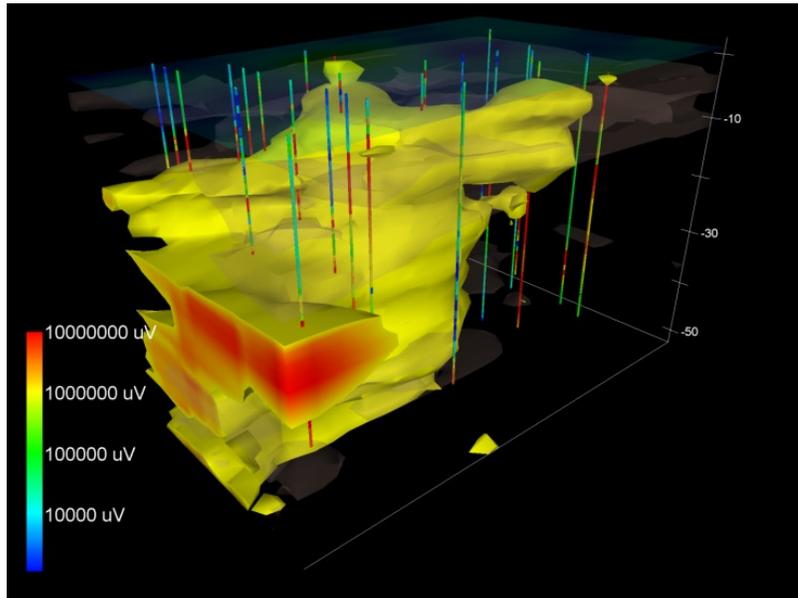


HRSC Approach to Assist with In-Situ Remediation Design: Looking for “Trouble”

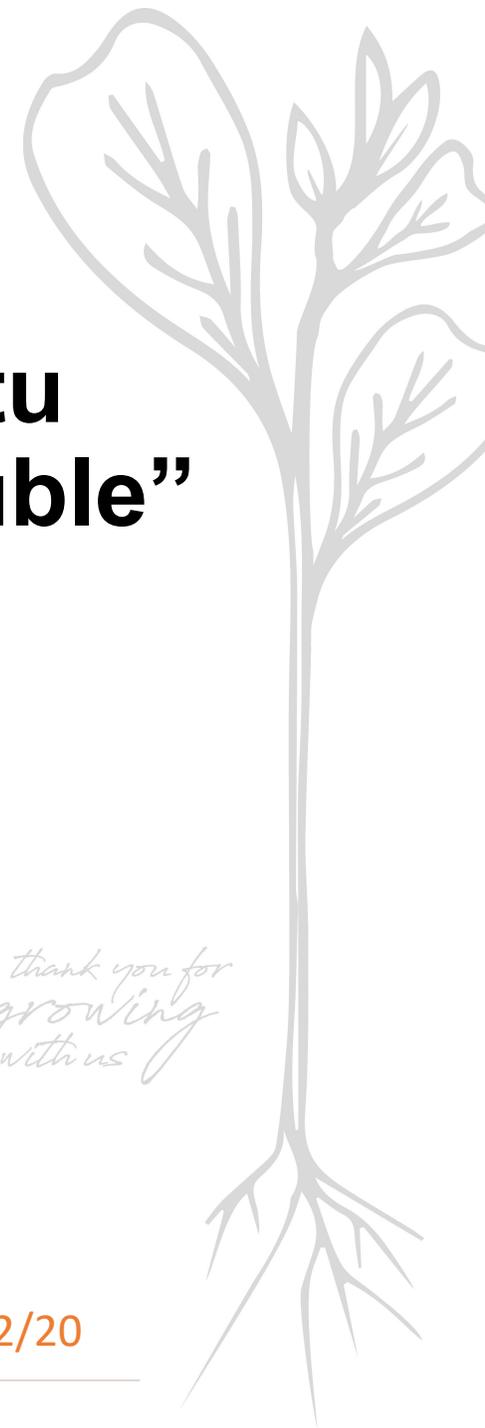
2nd March 2020



Denton Mauldin, PE
HRSC Workshop - Sydney

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03/02/20



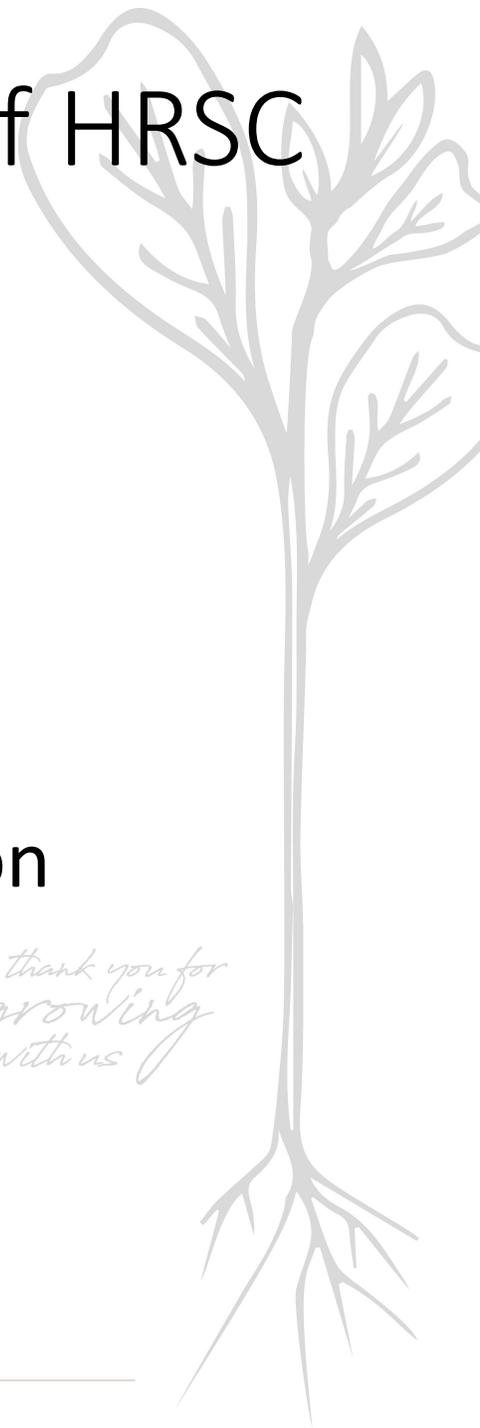
- Benefits of HRSC
- Conditions for using HRSC
- HRSC Mindset
- Driving Remedial Design
- Post-remediation Considerations
- Case Study



Benefits of HRSC

- Refines CSM specific to remediation
- Can refine excavation plan and disposal costs
- Improves in-situ remedial design (well screens and placement)
- Improves understanding of sorbed mass
- Improves long-term management (post-remediation hotspots)

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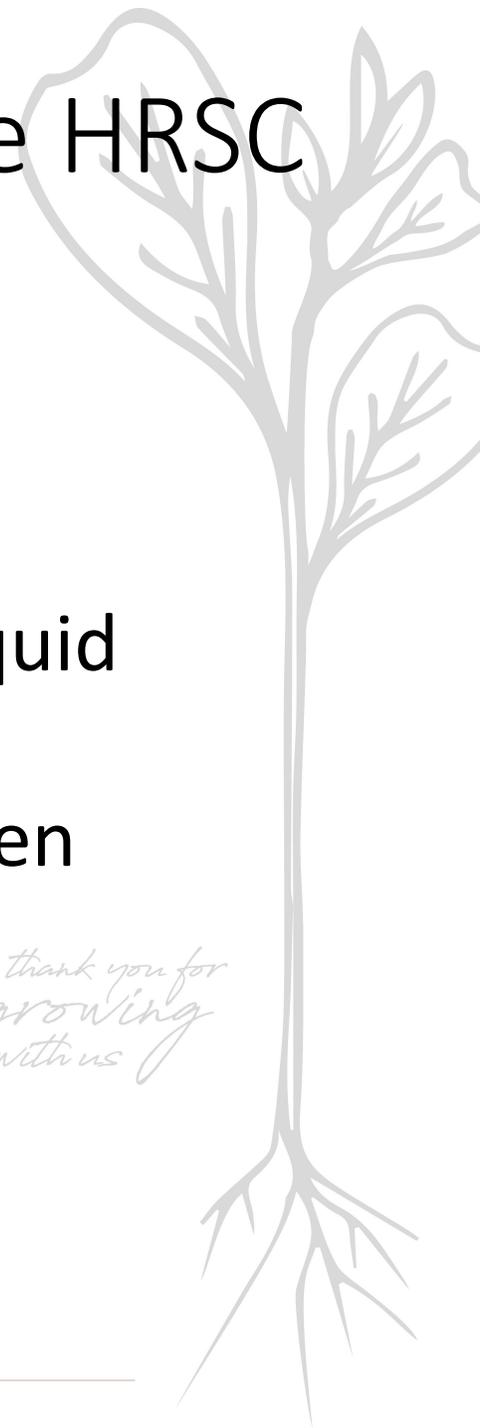


When to Use HRSC

HRSC is worth considering when:

- The need to remediate is relatively certain
- Evidence suggests “non-standard” migration
- Indicative concentrations of non-aqueous phase liquid (NAPL) exists
- Vertical delineation of dense NAPL (DNAPL) has been completed
- A thick vadose and/or saturated zone is present
- Need to identify dual-porosity issues

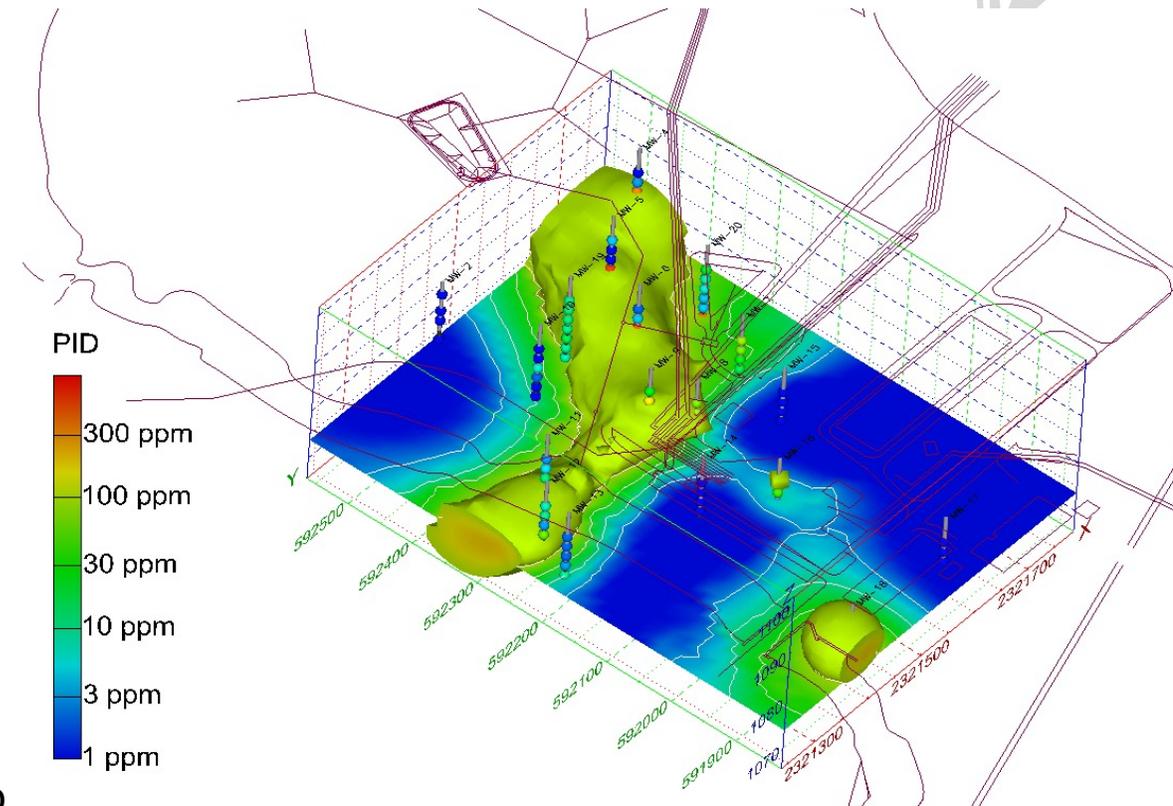
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A Screening Tool for HRSC

To further evaluate the merits of HRSC one can:

- Data mine for photo-ionisation detector (PID) data or other semi-quantitative data
- Create a preliminary 3D model
- Assess for data gaps (LRSC) and decide whether to not use* HRSC



*Note: A key component of creating a usable 3D model is to correlate analytical data with HRSC data

HRSC Mindset - Looking for Trouble

Investigation Component	Attributes of HRSC	Conventional Investigation	Remedial Investigation
Impacts on Receptors	Minimal	Primary Objective	Threatened Receptors Already Established
Plume Dynamics	Depends on tools	Drives Risk Model	Risk Model Already Complete
Migration Pathways	Key Attribute	Overall plume dynamics are more important	Drives Remedial Design
CSM	Can Help Refine CSM	Identifies Data Gaps and Documents Understanding	Supports development of remedial design and is focussed on attainment of cleanup objectives
Plume Size	Can assist but may not be cost effective	Potential magnitude of plume used to ID receptors	Can effect scaling of remediation effort
Source Zone Knowledge	Key Attribute	Yet to be defined risks drive efforts and source size, shape and mass are not key drivers.	Influences technology choices and potential performance

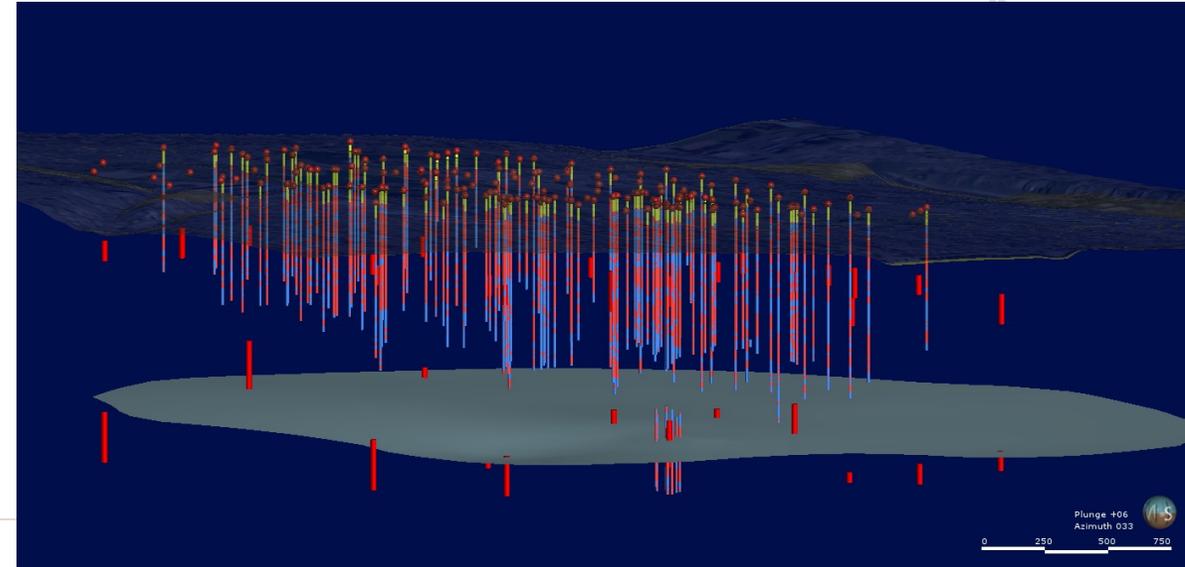
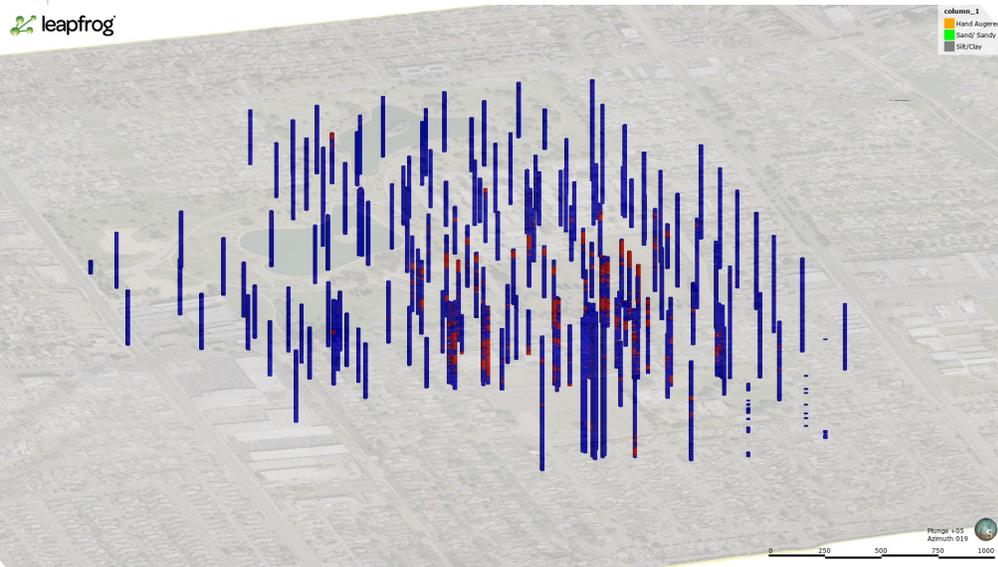


Useful but not important
Useful and important
Essential

Geared for In-situ Remediation

HRSC is geared for in-situ remedial investigations:

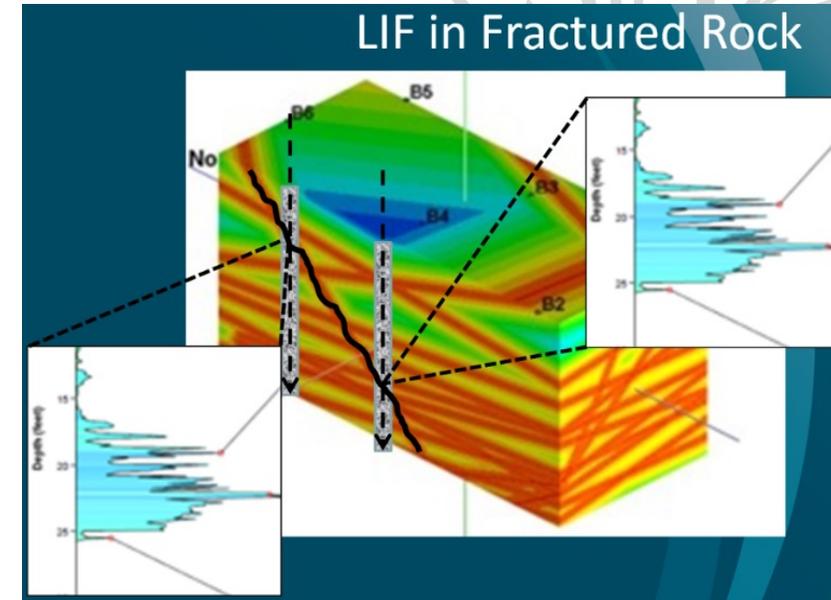
- Can refine understanding of migration pathways which is key for attacking the source
- Can provide key information about source zone
 - Influences technology choices
 - Drives potential remedial performance



HRSC and In-Situ Remedial Design

HRSC can drive the remedial design in the following ways:

- Remediation wells can be strategically placed
- Well screen lengths can be shortened to target a migration pathway
- Additional technologies may be added to the treatment train to account for sorbed mass in the source zone (cosolvent flushing)
- Alternative technologies may be used to address findings (SVE in vadose zone)



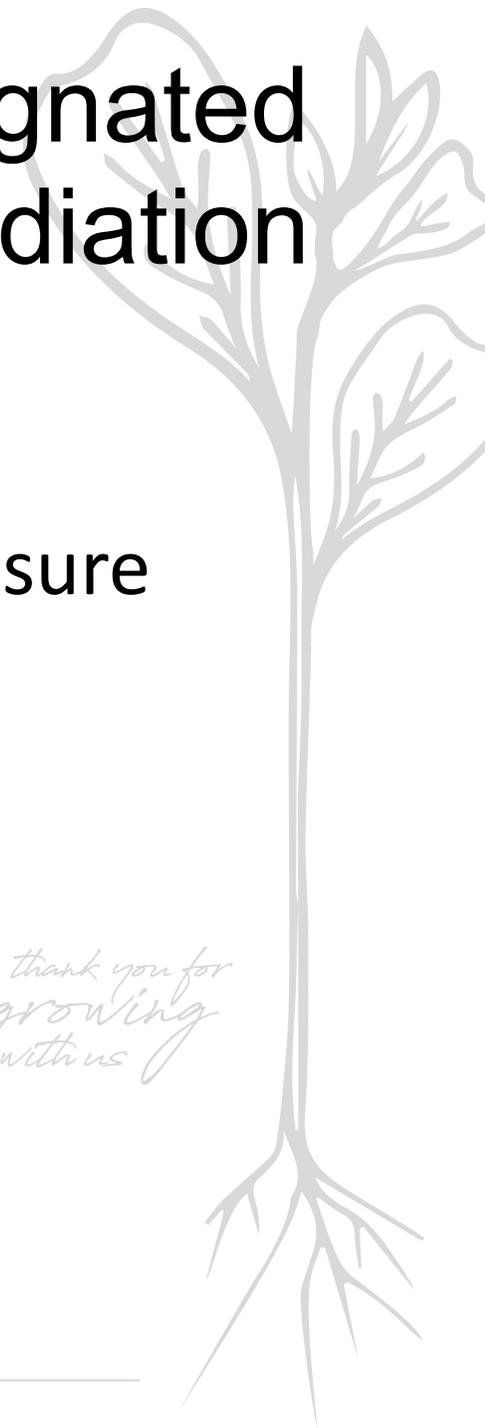
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Post-Remediation or Stagnated Remediation

HRSC can be used after remediation for:

- Identifying residual hotspots
- Providing percent removal estimates to support closure

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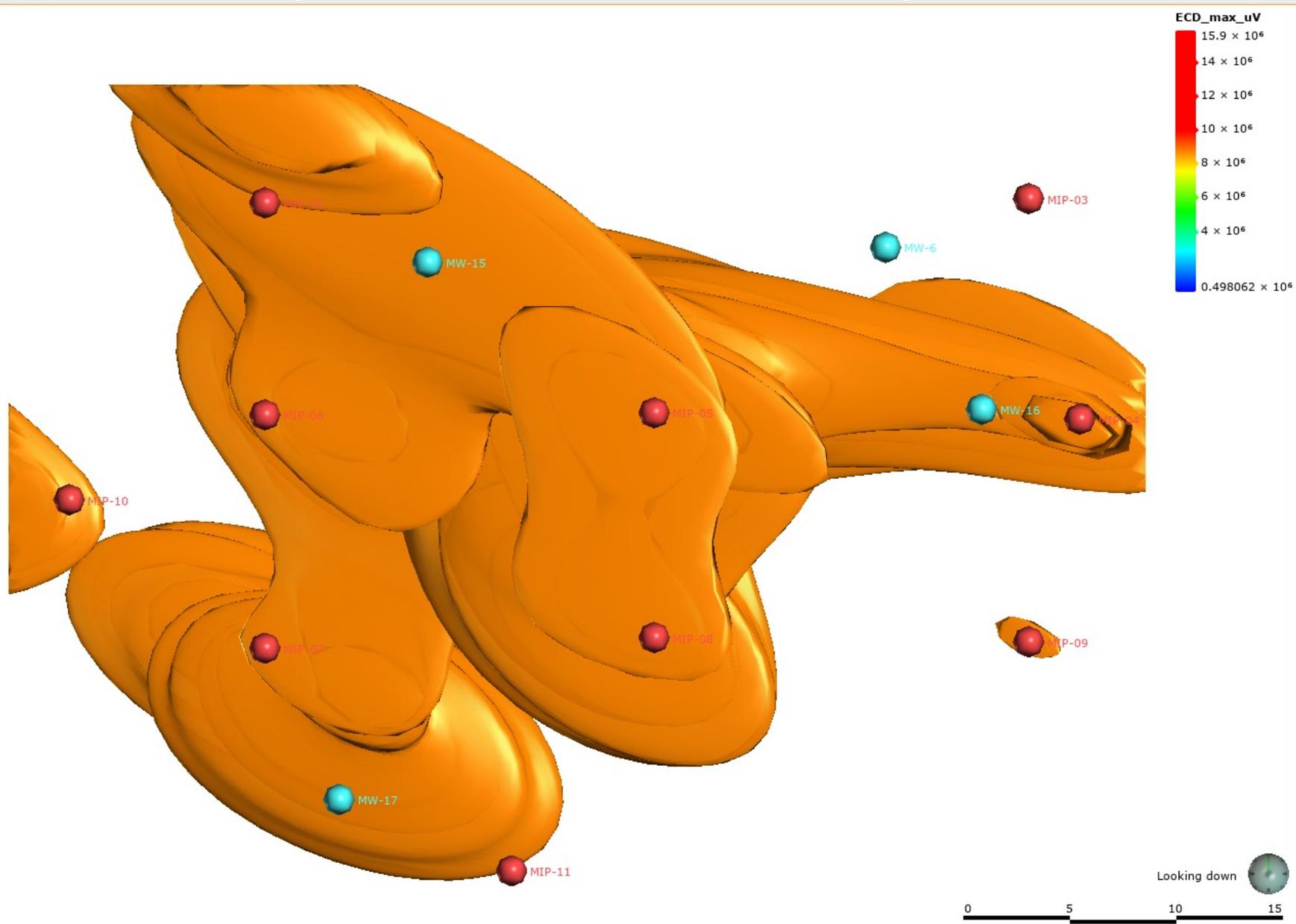


Case Study: DNAPL INVESTIGATION

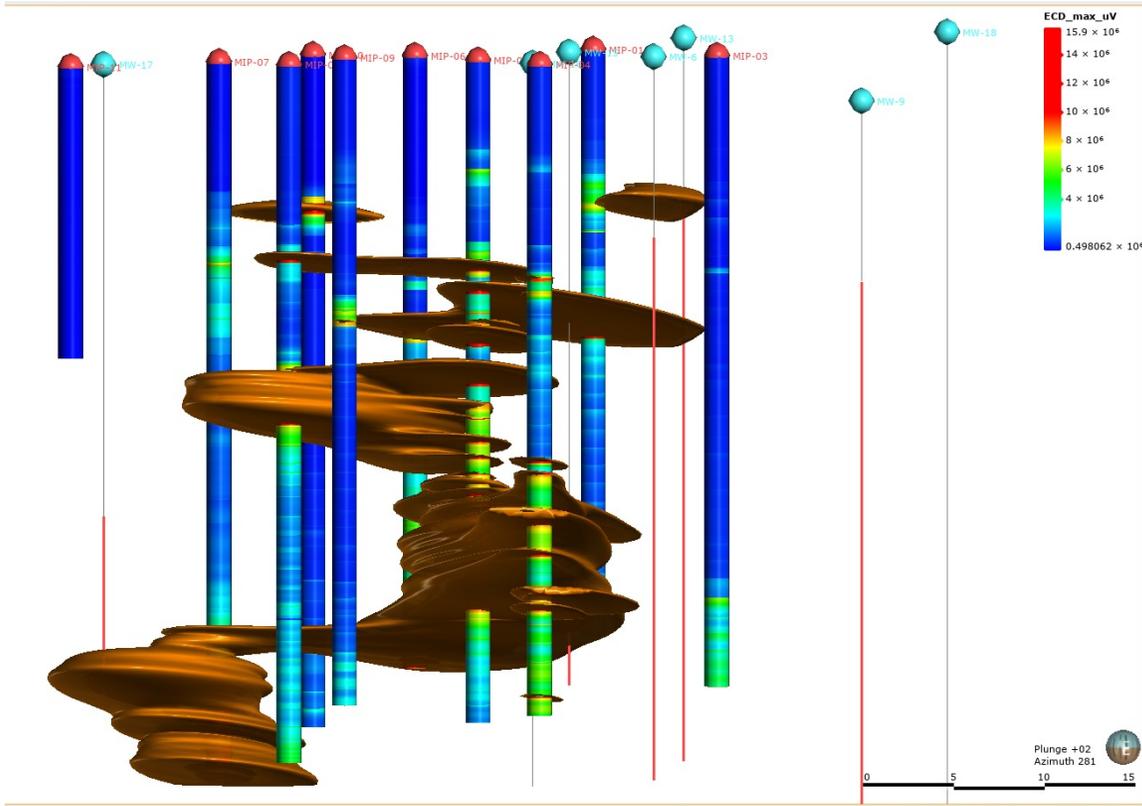
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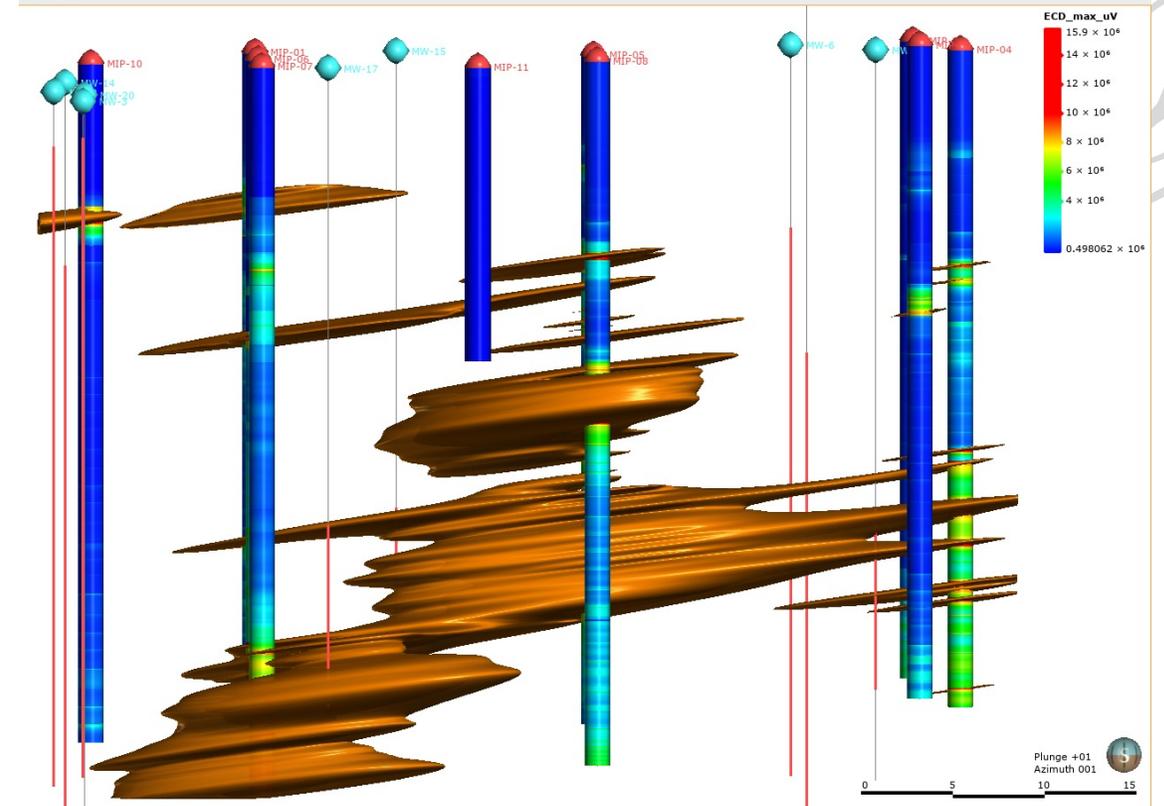
Top View of Electron Capture Detector (ECD)



3D Model of Chlorinated Hydrocarbons and DNAPL-Indication



View Along Flow Path



Cross-Gradient View