Streamlining Lifecycles with High Resolution Site Characterization (HRSC) and 3-Dimensional Conceptual Site Models

Session: I7

Group 2

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INTRODUCTION

Typical Challenges:

1.Traditional investigation and data collection methodologies = inadequate data density, data quality and data interpolation.

2.Low data density and data quality deficiencies lead to repeated investigations during initial stages of a site's lifecycle often result in inaccurate Conceptual Site Model (CSM) and flawed remediation strategies.

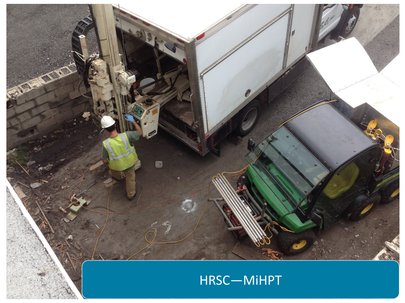
Case Study:

Former specialty chemical manufacturing facility located in Edison, New Jersey was actively undergoing investigations and remediation since the late 1990's.

- An Interim Remedial Measure (IRM), groundwater recovery and treatment system was operational from 2001 to 2006 designed for hydraulic control.
- A unique strain of *dehalococcoides* were identified during bench scale testing that were naturally degrading CVOCs at a low pH range of 5.8-6.0

Primary Contaminants of Concern:

Chlorinated volatile organic compounds (CVOCs); 1,1,1–trichloroethane (TCA), trichloroethylene (TCE) and their respective degradation products.



HRSC—MiHPT

Geology:

. 0-1 ft bgs. Fill-Overburden

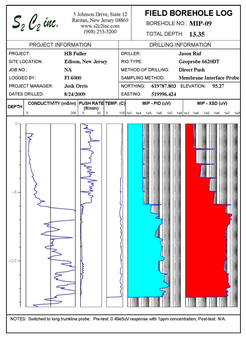
. 1-6 ft bgs. Weathered Brunswick Shale

. >6 ft bgs. Brunswick Shale

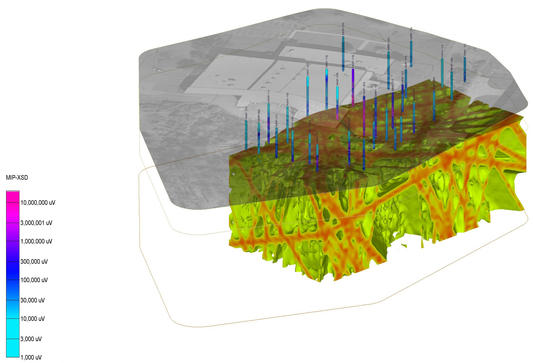
Hydrogeology:

. Perched Groundwater above Bedrock

. Fractured Bedrock Flow



Membrane Interface Probe Log



MIP-XSD Detector Data and Interpreted Bedrock Fracture Model from Geophysics

APPROACH

HRSC Investigation and 3-Dimensional Data Visualization CSM:

- Historical site data were migrated into an EQuIS database and exported for visualization using C Tech's Mining Visualization Software (MVS).
- A geologic model of overburden and fractured rock was developed from historic geophysics data; including an interpreted 3D bedrock fracture model utilized for targeted remedial design and future monitoring well locations.
- 3D kriging was completed with results from MIP and historical soil and groundwater data sets for TCA and degradation daughter compounds.
- The updated 3D CSM with HRSC data identified and fully delineated a shallow source of TCA at a former loading area and along a railroad spur.
- Contaminant transport pathways and hydro-geologic systems were confirmed, which eliminated an original hypothesized second source area.
- MIP was advanced in overburden to top of bedrock to delineate remaining residual source areas and confirm performance of Pilot Test Injections

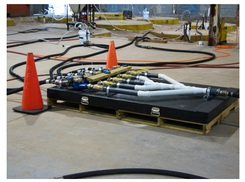
Enhanced Pilot Tests & Full Scale Design:

- Borehole geophysics completed in bedrock open borehole injection wells
- Emulsified Vegetable Oil (EVO) and zero-valent iron (ZVI) delivery application for enhanced In-Situ dechlorination
- Enhanced targeted Injection well design
- Reduced total number of injection wells within shallow overburden and intermediate bedrock zones
- Enhanced Radius of Influence with Pneumatic Fracturing delivery and Contaminant Mass Treatment

Remediation and Closure Strategy Implemented:

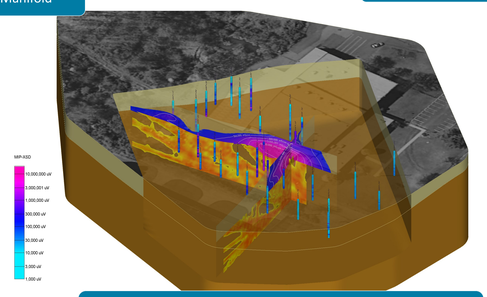
⇒ Excavation of remaining source along loading dock, rail spur to top of bedrock and placement of **EVO/ZVI** at base of excavation to accelerate treatment of impacted groundwater.

⇒ Residual Soil Source Area beneath facility closed with complete delineation utilizing both **HRSC** and traditional analytical data sets with 3DCSM by Engineered and Institutional controls.



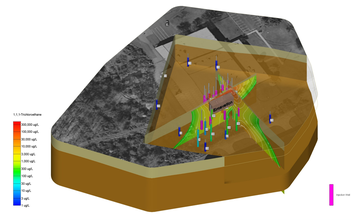
Injection Array and Manifold

Excavation of Source Material



Fence of MIP XSD Results and Interpreted Bedrock Fracture Model

RESULTS AND CONCLUSIONS



1,1,1-Trichloroethene in Groundwater, Injection Wells and Soil Excavation

Leveraging Technology— **HRSC**, **G**eophysics, **M**embrane **I**nterface **P**robe and historical groundwater data as inputs to develop a comprehensive **3D CSM** created significant economic savings:

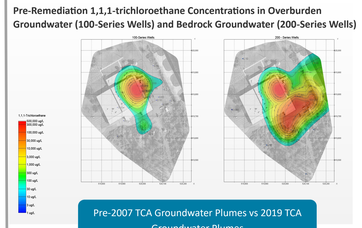
- more targeted investigations
- reduced number of injection wells
- refined pilot studies.
- precise full scale design and successful implementation of pneumatic injection.
- enhanced remediation performance
- P&T System shut-down ($180k / year savings in O&M)

HRSC with a 3D CSM enabled a ***"Best-In-Class"*** solution for enhancing insights into the fractured bedrock environment for a refined remediation strategy implementation and performance monitoring that facilitated a **reduced lifecycle**: and cost savings.

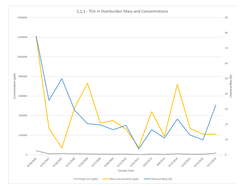
- **Enabled streamlined regulatory process approvals and transition to MNA strategy**
- **Reduced Annual Monitoring Well Network ($100,000)**
- **Enabled shutdown (2006) of pump and treat system $180,000/year at a savings to date of (~$2.88M)**
- **Estimated $300,000 full scale remediation cost savings**
- **ROI: $3,200,000 savings**
- **Lifecycle reduction estimated at 15+ years.**

Evaluation of Mass and Chemical Concentration Trends

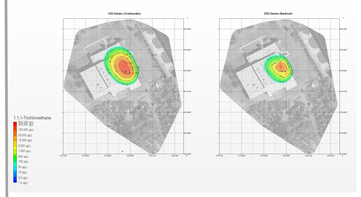
Pre-Remediation 1,1,1-trichloroethane Concentrations in Overburden Groundwater (100-Series Wells) and Bedrock Groundwater (200-Series Wells)

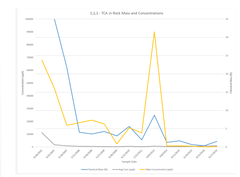


Pre-2007 TCA Groundwater Plumes vs 2019 TCA Groundwater Plumes



Compound (TCA)	Overburden Percent Reduction (%)
Chemical Mass	58%
Maximum Concentration	83%





Compound (TCA)	Bedrock Percent Reduction (%)
Chemical Mass	99%
Maximum Concentration	99%

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