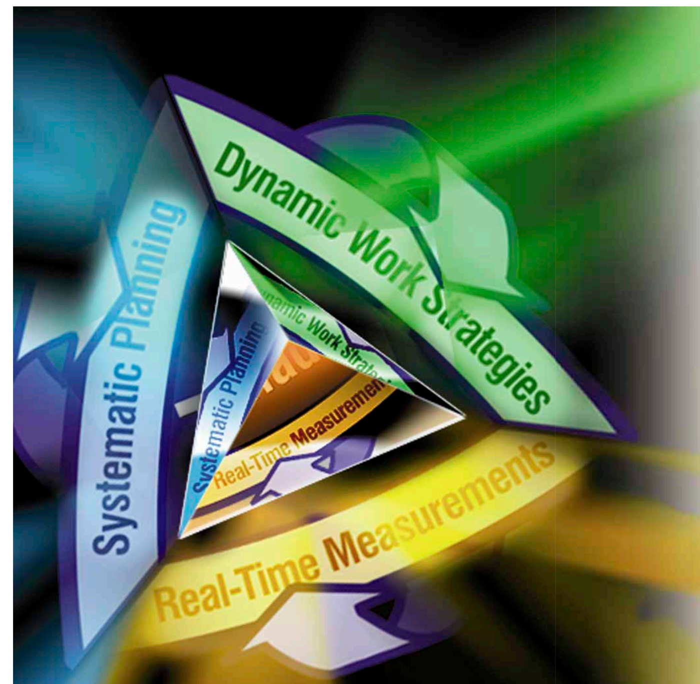


A Triad Case Study: Define data uncertainty quickly and cost effectively

CH2MHILL

Triad: The Fast Track to Reducing Conceptual Site Model Uncertainty

Kim-Lee Yarberry, Chris Hood, P.E., and Tom Palaia, P.E. (CH2M HILL)
Artur Kolodziejski (AFSOC, Hurlburt Field)

Triad Process

Triad Methods

Triad is a second-generation approach, which has evolved from advances in field data collection and data quality, data management, and communication tools, to reduce the cost and time required to conduct a hazardous waste site investigation. Field activities can be modified quickly while the investigation proceeds, and the primary objective is to eliminate decision uncertainty. The three principal components of Triad (Systematic Planning, Dynamic Work Strategies, and Real-Time Measurements) were used to reduce CSM uncertainty.

Systematic Planning:

- Define investigation objectives and develop a preliminary conceptual site model (CSM)
- Establish data quality objectives and acceptable uncertainty levels

Dynamic Work Strategies:

- Develop decision logic to run a dynamic field investigation
- Use a phased approach for the field investigation to address high-priority data needs first

Real-Time Measurements:

- Use real-time and fast turn-around-time technologies to facilitate quick field decisions
- Use 3D data visualization methods to continually update the CSM to select future sampling locations and reduce decision uncertainty

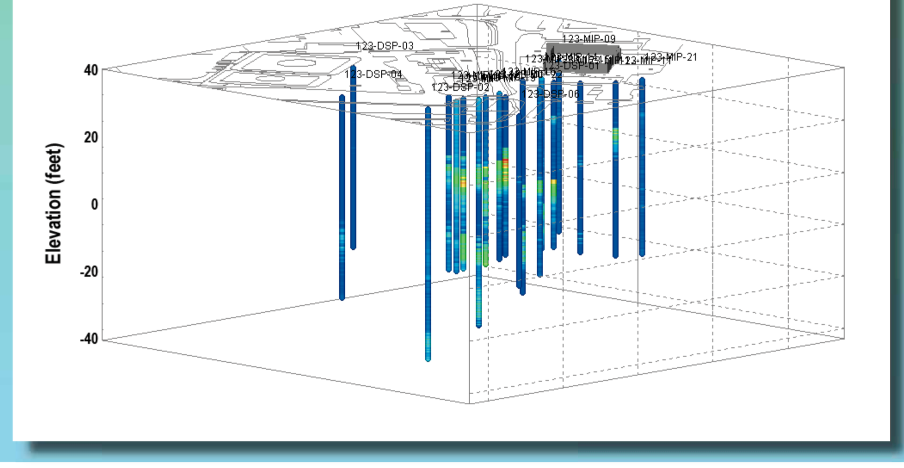
Dynamic Work Strategies Used to Collect Real-Time Data

- Project team members reached consensus on project objectives, sampling decision logic, and site contingencies during Systematic Planning, allowing the field team to make quick decisions in the field.
- Field implementation flexibility kept the project on schedule. Field activities were adjusted to accommodate equipment availability, site access restrictions, and weather.

Real-Time Data Used to Guide Investigation Toward Site Direction Statement

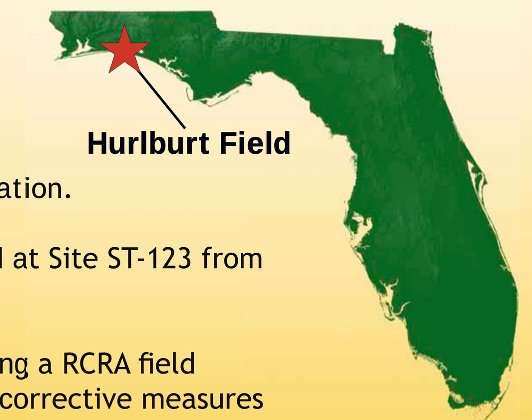
- Mining Visualization System (MVS), Surfer®, and ArcView GIS used to update CSM daily to weekly.
- CSM changes were communicated daily and for each 10-day interval to project team members through e-mail and a project FTP site.

ECD Response
Site ST-123, Hurlbert Field



Site Summary

Storage Tank Site ST-123 is a POL Fuel Yard constructed in the 1940s at Hurlburt Field, Florida, with petroleum and chlorinated volatile organic compound (CVOC) contamination.



A 5-month Triad Investigation was conducted at Site ST-123 from October 2004 through February 2005.

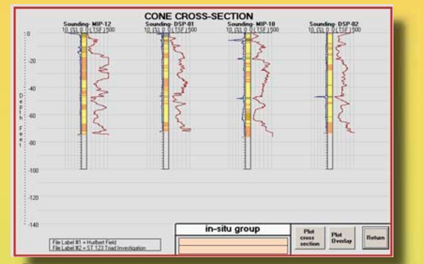
Since 1994, numerous investigations, including a RCRA field investigation, baseline risk assessment, and corrective measures study, were conducted at the site before Triad implementation.

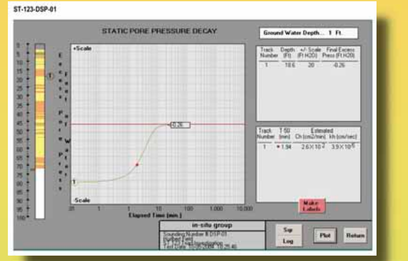
Triad Project Objectives

- Define source areas
- Delineate vertical and horizontal extent of groundwater contamination
- Obtain conceptual design data for potential remediation system
- Assess monitored natural attenuation (MNA) effectiveness
- Perform additional risk evaluation
- Develop remediation strategy


A


B


C


D

Field Implementation

Level I Data

- Surveying
- Groundwater field monitoring parameters
- Organic vapor analyzer (OVA) screening of sonic soil cores (F)
- Dense non-aqueous phase liquid (DNAPL) presence test kits

Level II Data

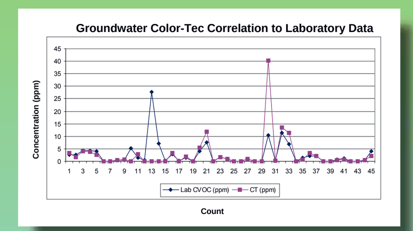
- Water level assessment
- 6 geotechnical soil samples
- 51 membrane interface probe (MIP) points between 20-96 feet bls (B)
- 9 cone penetrometer testing (CPT) points between 18-75 feet bls (C)
- 15 pore pressure dissipation tests (D)
- 54 soil samples for Color-Tec field test kit analysis
- 87 groundwater samples for Color-Tec field test kit analysis (E)

Level III Data

- 37 soil samples for laboratory analysis (G)
- 80 groundwater samples for laboratory analysis (H)

Other

- 6 multichamber wells to 150 feet bls (I)
- 7 conventional monitoring wells
- 3 continuous sonic soil cores to 150 feet bls (A)

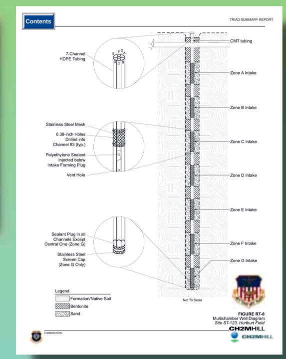


E


F


G


H


I

Key Field Decisions

- Shift investigation focus from intermediate groundwater zone to shallow groundwater zone and previously unidentified source area (former Building 90129/Building 90141)
- Install multichamber and conventional monitoring wells because of direct push technology refusal
- Accept Color-Tec field test kit data as estimate of total CVOC concentrations in groundwater
- Accept MIP screening data to identify source areas

CSM Evolution

Source Area

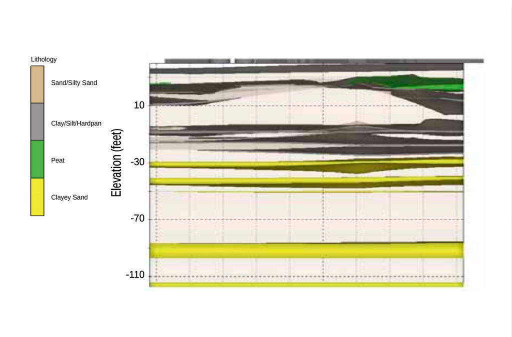
- Identification of previously unknown source (Former Building 90129-Radio and Radar Shop/Building 90141-Aircraft and Maintenance Building) for chlorinated contamination
- Resolution of source area within 10 feet of existing Building 90141
- No DNAPL was usually observed, but contaminant concentrations were indicative of its presence
- Previous suspected sources were eliminated

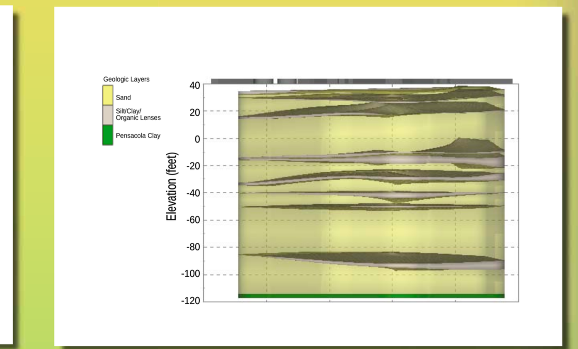
PRE-INVESTIGATION

POST-INVESTIGATION

Lithology

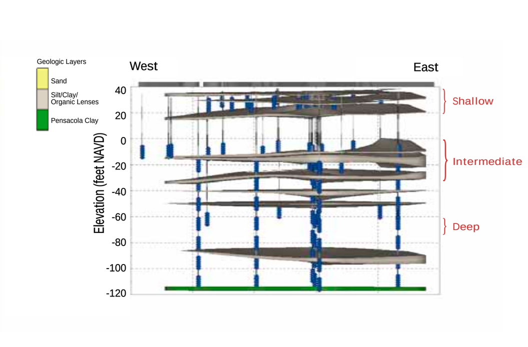
- Additional data collected to Pensacola Clay:
- New CPT data allowed detailed refinement and understanding of silt layer integrity, clip/tilt direction, and continuity
- Lithology revision aided understanding of plume migration
  - Semiconfining layers between sample locations were better identified, appearing more competent in shallow and intermediate zones
- New model extends further horizontally into the downgradient portion of the site


PRE-INVESTIGATION

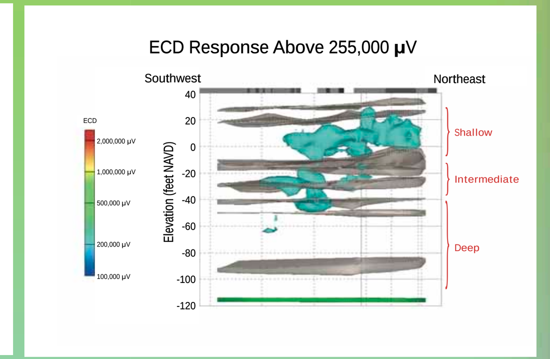

POST-INVESTIGATION

Hydrogeologic Zones

- Groundwater contaminant zones were redefined based on electron capture detector (ECD) results and lithologic refinement
- Revised zones are more consistent with regional hydrogeologic definitions
- Several existing intermediate zone wells are actually screened at bottom of shallow groundwater zone
- Remaining intermediate wells are screened with cemented semiconfining lenses, not visible in soil borings



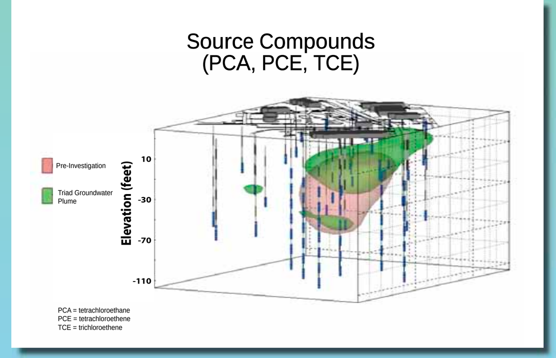
PRE-INVESTIGATION

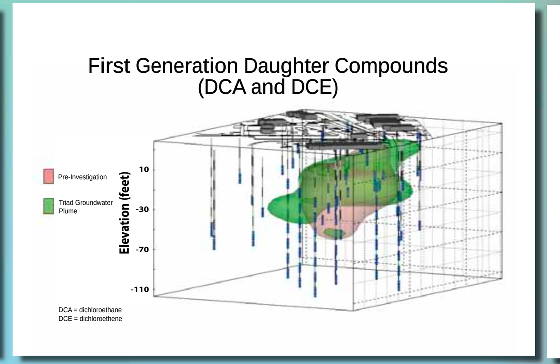


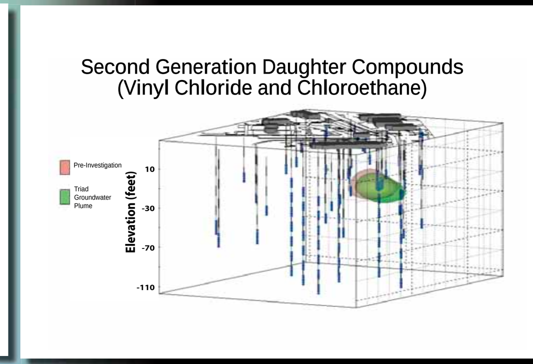
POST-INVESTIGATION

Groundwater Plume Definition

- Primary dissolved phase plume was identified in previously undefined zone
- Center of contaminant mass is shallower than original model
- Groundwater plume in intermediate zone extends further downgradient than originally expected
- Vertical extent of contamination was delineated







Conclusions

Benefits of Triad Project

- Reduced uncertainty for exit strategy development
- Identified primary source of CVOCs cost effectively after years of investigation
- Used screening technologies to refine lithology and plume geometry for more focused remedial strategy
- Adjusted field implementation schedule to address site priorities, additional risk evaluation, groundwater modeling, and natural attenuation evaluation not complete

Follow-up Action Items

- Define extent of source area for target treatment
- Install additional permanent wells to monitor revised groundwater plumes
- Calculate contaminant mass
- Revisit risk exposure pathways based on revised CSM
- Evaluate MNA effectiveness

Recommendations

- Revisit old assumptions
- Allow decision logic to guide dynamic sampling locations
- Update CSM continually during process and distribute to project team members to maintain stakeholder interest and facilitate project decisions
- Remain focused on ultimate project goals

Acknowledgements

Major Ida Widmann, U.S. Air Force (USAF) Air Staff, Pentagon

John McCown, P.E. and Joann Socash, Air Force Center for Environmental Excellence (AFCEE)

Artur Kolodziejski and John Steele, Air Force Special Operations Command (AFSOC), Hurlburt Field, Florida

Jeff Lockwood, P.E., Florida Department of Environmental Protection (FDEP)

Craig Benedict, U.S. Environmental Protection Agency (EPA)

David Miller, Argonne National Laboratory

Kim-Lee Yarberry, Chris Hood, P.E., Tom Palaia, P.E., Ryan Bitely, and Mark Hoover, CH2M HILL

E052006006GNV