Remedial Characterization: Filling the Gaps and Refining the CSM and Case Studies

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WHAT THE HELL JUST HAPPENED????

Have you ever started a day and know that it is going to be a bad day?:

My “Day” was August 12, 1997

CASE STUDY # 1 – BUDGET LOUISVILLE, KY

- (1) 4,000-gallon Diesel and (2) 8,000-gallon Gas USTs
- Common pit with shallow groundwater/free product
- Tanks are “Swiss cheese” and leaking product
- 6,500 gallons of free product removed from pit
- Environmental Response Team called
- Free product continues to pour in from walls
- Spend the night at site with Fire Marshal
- No cigarettes please……


Budget
SEARS

Prelude to a Conceptual Site Model (CSM)

- Initial Abatement/Product Recovery Reports - 1997
- UST Closure Report: 1997
- (4) Phases of Assessment: 1998 - 2001
- Corrective Action Plan dated November 20, 2001
- KDEP Approved/Rescinded
- (4) Additional Phase of Assessment 2002-2011
- In-Situ Injections Summary Report
- No Further Action Letter issued December 20, 2012

Lessons Learned

- 16 years of time and tax payer's money to correct this problem
- Conventional methods can be enhanced by in-situ methods
- An Up-Front CSM can save time/money on the back end
- A CSM allows for less money to be spent on years of assessment
- This leaves more money for actually remediating the site
- Thus, receiving that all important NFA letter for your client

So How Did We Do It On This Site?:

- The KDEP, UST Branch got smarter in the Fall of 2011 and instituted utilizing CSMs for sites; along with,

- Established soil/groundwater "screening levels" to expedite closure of sites

- Three groundwater "screening" tables that reflect more reasonable goals. They are primarily based on the distance from the excavation zone relative to domestic-use wells, cisterns or springs summarized as follows:

*A variance provision for benzene in groundwater to allow for use of the, less stringent, if a site is serviced by a public water supply. This allows a slightly higher value at or beyond the point of compliance.

The Problems Facing LFI in Remediating Sites:

- ❑ Tried a lot of different remedial technologies with little success
- ❑ Remediation technologies worked in the laboratory but not in the field
- ❑ Getting the remediation product in “contact” with the contaminant
- ❑ Biggest hurdle relative to “contact” in Kentucky is cohesive soil
- ❑ Limited success with soil mixing in open pit but none by in-situ means
- ❑ Site-specific to the Budget site **Free Product** in 3 monitoring wells (benzene)

Development of the CSM along with new technologies has helped with expediting site closure:

- ❑ Emphasis on P.G./P.E.'s to develop the CSMs taking into consideration the concentration mass in the evaluation of site specific plumes

- ❑ Allowing for a more in-depth evaluation of the site-specific conditions so that facilities enter into the corrective action phase much sooner

- ❑ Combining the use of successful remediation products and a high pressure/high velocity delivery technology that gets the product in direct contact with the contaminant

Let's Fix This:

- More effective remedial efforts have now been developed
- Conceptual Site Models (CSMs) take into account:
  - Local geology
  - Determines whether a useable groundwater resource based on quantity/quality has been impacted
  - Plume stability
  - Fate/transport of contamination in relation to exposure pathways and usable groundwater.

Prologue to Budget Site:

- ❑ Final goals of soil/groundwater cleanup (less stringent)
- ❑ New directive (January 27, 2011) allows for “new” approach
- ❑ **Evaluation of site involved CSM components -** Utilize BOS 200® product combined with high pressure/high velocity injections
- ❑ Submit Pre-Approval Request Letter to KDEP (February 4, 2011)
- ❑ Directive issued (June 7, 2011) to inject 20,425 pounds of product into 150 injection points across the site
- ❑ Injected over a two week period (one event) in September 2011
- ❑ Submitted Summary Report dated September 16, 2011
- ❑ Directed to complete 2 quarterly monitoring events to gauge for rebound
- ❑ **No Further Action Letter** issued for the site on December 2012

Case Study # 2 – Miller Oil Co. Sacramento, KY:

- LFI acquired site by providing Expert Witness in 2003 testimony (on my 40th Birthday!) to get the site back into the KY Petroleum Storage Tank Environmental Assurance Fund (PSTEAF), no activity between 2000 - 2003

- Leaking USTs previously removed from the site and above ground storage tanks (ASTs) currently operate at the site

- Dissolved benzene was the driver constituent for remediation when LFI acquired the site; water table 1 to 2 feet below grade across site

- Previous consultant had spent approx. $400,000 since initial release in 1987. Including UST closure, assessments, monitoring events and CAP between (1994-2000); no remediation completed (maximum allowed for release via PSTEAF $1,000,000

LFI's Steps To Closure

- Directive was issued to LFI by the KDEP to perform a round of sampling in March 2004
- Per the KDEP, no activity directed for the site between 2004-2009
- Directive issued December 2009 for Site Summary (initial part of CSM); report submitted April 19, 2010; In 2010, KDEP directs to incorporate Site Summary into a CSM for the site
- All wells subsequently sampled in 2011, Monitoring Report in 2011
- LFI submit a CSM to KDEP dated October 28, 2011

Critical Components of the CSM

- ❑ Complete understanding of hydrogeologic regime
- ❑ Spatial distribution (vertical/horizontal) of the mass release
- ❑ Estimates of the current contaminant mass in the free, sorbed and dissolved phases
- ❑ Estimates of the contaminant mass to be removed/treated in order to achieve site remedial goals
- ❑ The CSM included Total Contaminant Mass Calculations in both the unsaturated and saturated (i.e. free/dissolved phase) regimes
- ❑ Completed a Point Attenuation Analysis including natural attenuation rate constants and plume lifetime estimates along with bulk attenuation analysis

- Preliminary remedial technologies considered via a Technology Evaluation Matrix and preliminary site-specific geologic/hydrogeologic factors (i.e. permeability, grain size, heterogeneity, consolidation and hydraulic pressure)

Technology Evaluation Matrix (FRTR)

Technology Description	Development Status	Treatment Train	O&M	Capital	System Reliability/ Maintainability	Relative Cost	Time
Groundwater Extraction & Exsitu Treatment	●	⊞	○	○	⊞	○	○
Air Sparging	●	⊞	⊞	⊞	⊞	⊞	⊞
In well air stripping	⊞	⊞	○	○	⊞	⊞	○
Insitu - Chemical Oxidation	●	●	⊞	⊞	⊞	⊞	●
Insitu – Enhanced Bioremediation	●	●	⊞	●	⊞	⊞	○
Insitu - Rapid Remediation Compounds (BOS 200®)	●	●	●	●	●	⊞	●
Dual phase extraction	●	○	○	○	⊞	⊞	⊞

● Above average – See Table 5 for definition for each category
⊞ Average – See Table 5 for the definition of each category
○ Below Average – See Table 5 for the definition of each category

- CAP to implement CSM was submitted in Oct. 2012; approved November 2012

CSM Conclusions and Recommendations

Based on the development of this CSM, LFI has concluded that little or no natural attention has taken place in the immediate area around the former tank pit and thus additional remedial measures are warranted to ensure that petroleum impacts are addressed in both the unsaturated and saturated zones at the site. The preliminary technology evaluation concludes in-situ injection as the most viable option to address saturated zone impacts combined with excavation of contaminated soils to address the unsaturated zone petroleum impacts.

Status of Miller Oil Site:

- ❑ Directive issued (December 4, 2012) to inject 38,250 pounds of product into 256 injection points across the site
- ❑ Discovered 3 to 4-inches of free product in one well (modified injection plan in field; (i.e. adapt and overcome)
- ❑ Injected over a 3 to 4 week period (one event) in February 2013
- ❑ Summary Report submitted to KDEP on March 26, 2013
- ❑ Directed to complete 4 quarterly monitoring events to gauge for rebound
- ❑ 1st of 4 quarters completed (BOS200® is starting to do its thing!)
- ❑ **No Further Action Letter** expected after 4 quarters of monitoring

NEXT SITE PLEASE……

To date, LFI using the “Right Approach” has closed:

- (6) petroleum-based contaminated sites

AND

- (2) chlorinated-based contaminated sites

WRAP-UP

Success Comes From a Combination of:

- ❑ A "Great" Team
- ❑ A "Collection" of Proper Data During The Assessment Phases
- ❑ **An "Accurate" CSM**
- ❑ A "Proven" Remediation Product; and a,
- ❑ A "Successful" Delivery System

Questions and Comments

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