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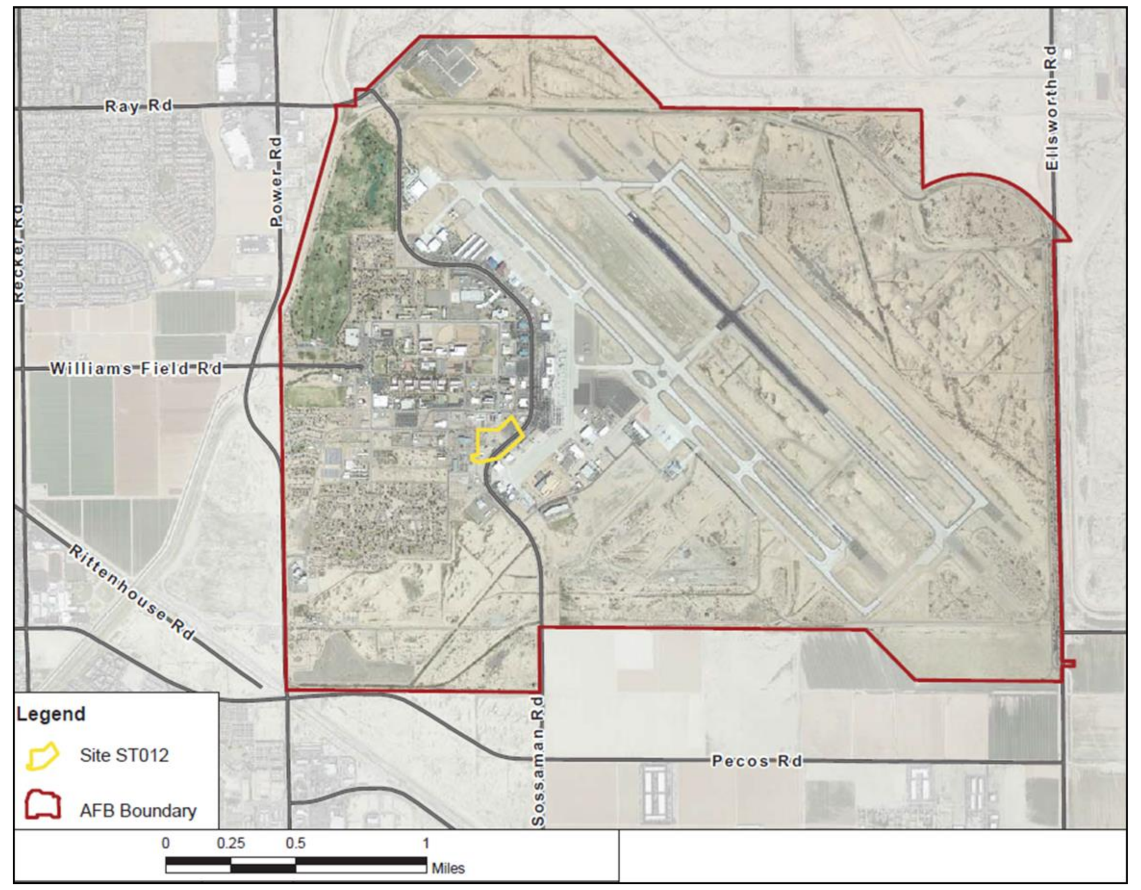
Lessons Learned: The Importance of Proper Project Planning When Integrating In Situ Mechanical and Biological Hydrocarbon Remediation Technologies

Overview

Summary

- Former U.S. Air Force Base (AFB) was decommissioned in the early 1990's, after over 50 years of military service
- Impacts by JP-4 jet fuel persisted in the subsurface
- Mechanical remediation was conducted to remove contaminants but was discontinued prematurely
- **Problem:** Enhanced bioremediation (EBR) was planned to follow, but regulator concerns developed from improper planning for the transition between mechanical and biological remediation, as well as for monitoring progress
- Substantial project delays, increased lifecycle costs, and heightened regulator scrutiny resulted



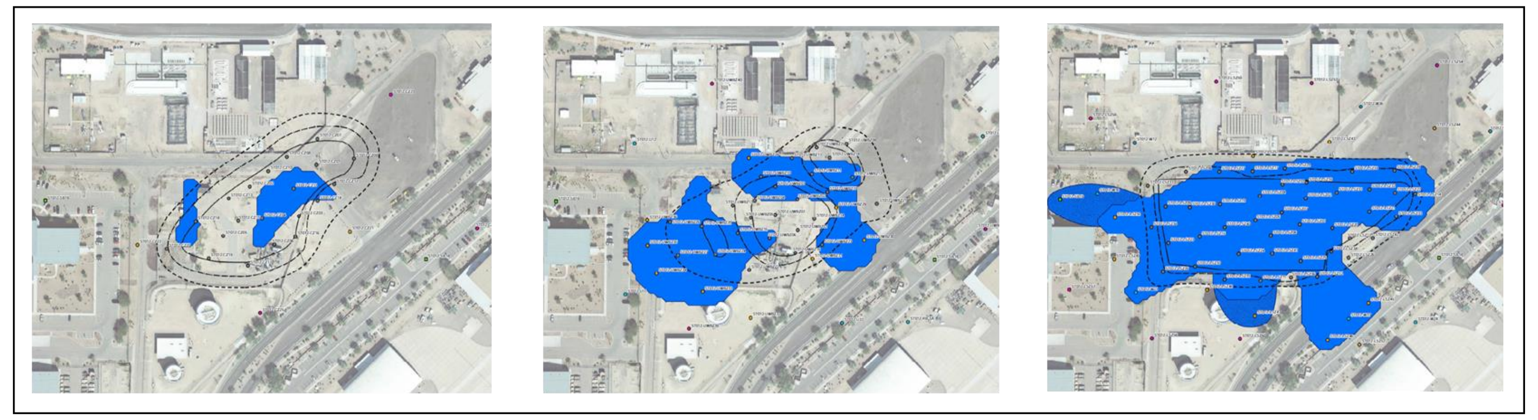
Source: Amended RODA, 2017

- Parsons (with UXO Pro) brought in by state and federal regulators as part of a Technical Expert Remediation Panel
- **Goal:** Address these issues and develop a successful plan forward that included proper monitoring and documentation of site progress
- Project underscores the need to correctly plan for the transition between mechanical and biological remediation strategies

Site/Area Description

General Base History

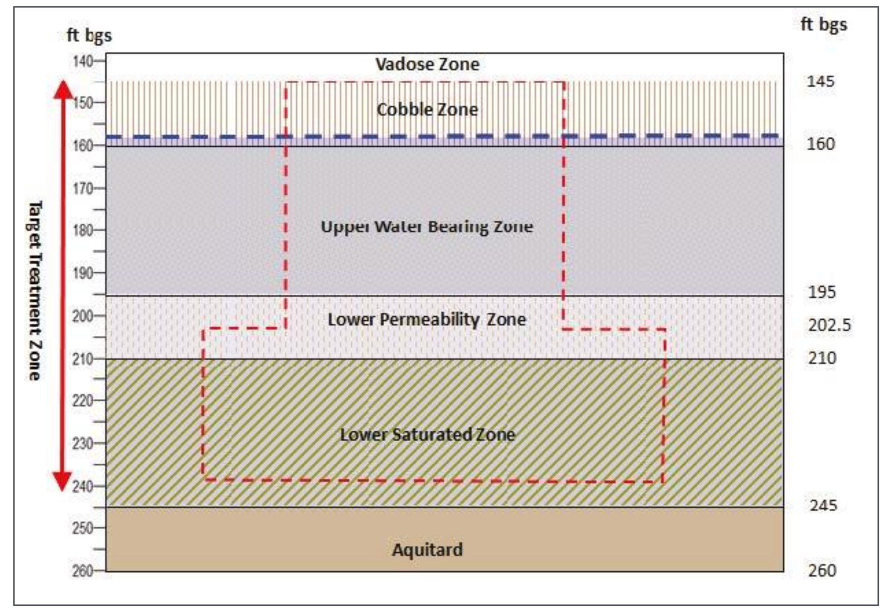
- AFB was first operational in the early 1940's
- Established as a pilot training facility, but also used for bombardier, bomber pilot, and fighter gunnery training
- Wide range of military aircraft used at the site, and thus high amounts of aviation fuels were stored and used during Base history
- Multiple known jet fuel (JP-4) and aviation gasoline releases occurred, impacting soil and groundwater (GW) as free product and dissolved-phase contamination



LNAPL presence above the shallow aquifer, in the shallow aquifer, and in lower aquifer (L to R)
Source: Amended RODA, 2017

Geology and Hydrogeology of Area Within the Site

- Stratified aquifer system: a shallow aquifer overlies a fine-grained aquitard, which maintains separation from the deep (confined) aquifer
- Shallow aquifer GW elevations have steadily increased since the 1990's
- Current depth to GW is approximately 150 ft bgs
- GW flows generally to the east at a gradient of approx. 0.0061 ft/ft



Shallow aquifer cross section, and SEE treatment zone
Source: EPA, 2014

Remedial Activities

Groundwater Remediation Efforts

- Investigations and treatability studies initiated in late 1980's to discern extent of soil contamination in vadose zone as well as GW
- GW extraction and treatment not effective due to poor extraction efficiency and rising GW levels
- Remaining free product acted as continuing source of GW contamination
- Steam enhanced extraction (SEE) performed 2014-2016; temperatures regularly exceeded 100ºC
- Approximately 216,000 gal of LNAPL reportedly removed by SEE
- LNAPL remained (volume unknown), residual dissolved benzene as high as 13,000 ppb
- Sulfate-based EBR proposed to remove remaining LNAPL and dissolved phase; based on incomplete data taken before any mechanical remediation initiated
- Informal dispute between USAF and regulators was initiated, resulting in over 18 months of costly site delays

Installed SEE treatment system

Corrective Actions Taken

- EBR postponed, GW activities ceased in order to prevent any environmental harm
- Critical post-SEE baseline geochemical, modeling, mapping data identified and obtained to discern current (post-SEE) site conditions
- Post-SEE microbial information obtained to see if EBR is possible, and if so, how to most effectively perform microbial enhancements
- Post-SEE metrics were established to provide realistic EBR expectations, to monitor if EBR is progressing as planned, and to determine if EBR modifications need to be made
- Proper site monitoring schedule established; will assist as EBR eventually transitions into MNA
- Regulators now satisfied of EBR success chances, informal dispute ended, site-customized EBR now initiated

Lessons Learned/Path Forward

- Project dramatically underscores need to correctly plan for transition between mechanical and biological remediation strategies
- Cannot assume that site conditions will support microbial attenuation of remaining site contaminants
- Critical biogeochemical baseline information required after mechanical remediation is completed, to finalize subsequent EBR and/or MNA plans
- Well thought-out workplan for all stages of project will allow for greater chance of success as well as proper monitoring and documentation
- Incorporation of these lessons will result in a better regulator relationship, a prevention of costly project delays, and a minimizing of the risk of failure to meet remedial objectives

Developed Project Workplan

General	Metrics	Frequency	Purpose
Hydrogeology	Groundwater gauge data: indicators of biofouling	• Once as baseline • Quarterly during EBR • Minimum of semi-annual after EBR	Subsurface plume location and movement
Mapping	LNAPL and dissolved-phase presence, quantity, and composition	• Once as baseline • Quarterly during EBR • Frequency amended per modeling and EPA guidance on MNA	Locate and map LNAPL, dissolved-phase presence; calculate total LNAPL mass present
Modeling	Site geochemistry, contaminant, geology, hydrogeology, parameters	• Once as baseline • At least annually during EBR • As needed post-EBR	Provide a remediation time estimate; provide proof of concept and optimize injection strategy
Geochemistry	Natural attenuation parameters, TPH (GRP< DRO) VOCs	• Once as baseline • Quarterly during EBR • Frequency amended per modeling and EPA guidance on MNA	To monitor environment for EBR potential and activity, as well as to monitor COC concentrations
Microbiology	Detailed analysis of entire population with focus on COC degraders; variety of molecular and isotopic techniques	• Once as baseline • At least once during EBR • Once after initial EBR injection • May need to be repeated	Quantify and monitor size, makeup, and health of EBR community; preparation for MNA
TEA Injection Fluid	Location and concentration of each injection/ amendment; anticipated zone of influence for each injection/ amendment	• During EBR • Per batch mixed and injected	

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