Refinery Remediation: Fuel Recovery and Recycling

EPA Superfund

Introduction

The site is a former refinery that occupied approximately 64 acres of land in West Texas. Refinery operations produced all grades of gasoline, tractor fuels, diesel, distillate products, and fuel oils and operated between 1939 and 1954. As a result of past waste management practices, releases to soils and ultimately ground water occurred, resulting in the formation of a dissolved-phase benzene and 1,2-dichloroethane plume more than a mile in length. Beneath the facility itself contamination in the form of a light non-aqueous phase liquid (LNAPL) also occured. Analysis of this LNAPL suggested that this partially refined product was a petroleum condensate. The refinery equipment was removed by 1958.

The remedy implemented at the site consists of a site-wide groundwater recovery and treatment system combined with a source area soil vapor extraction system. The soil vapor extraction system consists of 62 wells that were installed in 2009. The remedy construction was completed in August 2009 and is currently operating at the site.

Site Geology

The vadose zone in the vicinity of the plume ranges in thickness from about 140-150 feet, and contains fine-grained units of caliche, silt, and very fine-grained sand there were deposited by eolian and pedogenic processes. The vadose zone is fairly uniform across the site: however, the degree of cementation varies vertically. In particular, the vadose zone contains a unit of well cemented, fine-to medium-grained sandstone that was consistently encountered at approximately 95 ft below ground surface (bgs) and varies in thickness from about 5 to 15 feet. This sandstone separates the upper and lower zones that are being addressed by SVE.

The saturated zone varies in thickness from approximately 40-90 feet, and consists of unconsolidated sands and gravels. The yellow clay unit is believed to be the base of the impacted portion of the Ogallala Aquifer because its fine-grained composition should minimize the potential for downward or upward leakage to or from the coarser-grained sediments that lie above. The top of the saturated zone (i.e. the water table), which occurs at depths ranging from approximately 140 to 150 ft bgs, exists within loose, fine- to medium-grained sand. In general, grain sizes within the saturated zone increase with depth, and gravel-sized chert clasts were commonly encountered near its basal contact with a yellow clayey unit.

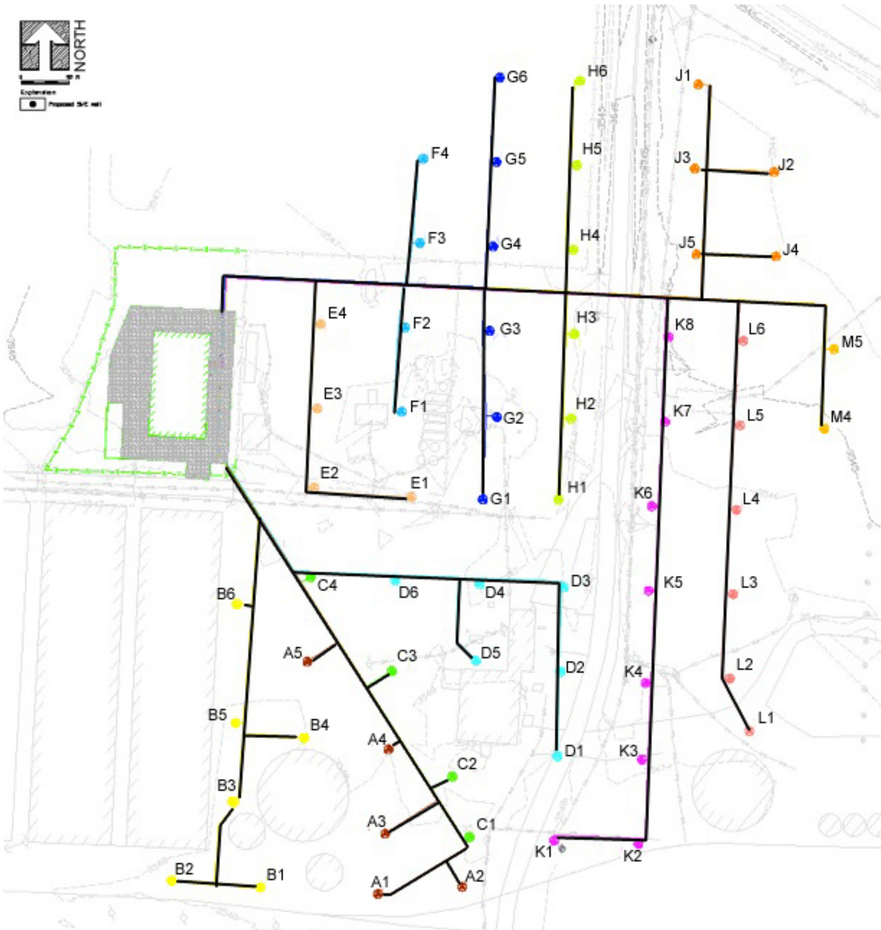
Contaminants of Concern

Gasoline range petroleum hydrocarbons

Vapor Treatment System Design

The 2,000 SCFM system operated solely for soil vapor extraction and a smaller 500 SCFM system operated in conjunction with a Munters Zeolite rotary concentrator for hydrocarbon recovery of vapors derived from a groundwater treatment air stripping system.

A total of 62 dual nested SVE wells were installed at 50-foot intervals. Each well was dual-nested, with a shallow screened interval from approximately 70- to 90-feet bgs and a second deeper interval from approximately 110- to 140-feet bgs.



Site Plan showing the soil vapor and groundwater extraction well network and treatment systems location.

The vadose zone treatment systems are comprised of: One SVE system rated at 475 cfm (C3-500 System), which extracts and processes off gas from the shallow nested SVE well circuits; and one SVE system rated at 1,425 cfm (C3-1500 System), which extracts and processes off gas from the deep nested SVE well circuit.

Shallow Soil Vapor Treatment Unit

The C3-500 System consists of:

- One skid-mounted vacuum and compression module, capable of applying a vacuum of up to 15" Hg. while producing 475 scfm flow;
- One refrigerated condensation and regenerative adsorber module, housed in an enclosed unit;

Deep Soil Vapor Treatment Unit

The C3-1500 System consists of:

- Three skid-mounted vacuum and compression modules, each capable of applying a vacuum of up to 15" Hg. while producing 475 cfm flow;
- One refrigerated condensation and regenerative adsorber module, housed in an enclosed unit;

Air Stripper for Groundwater Treatment System

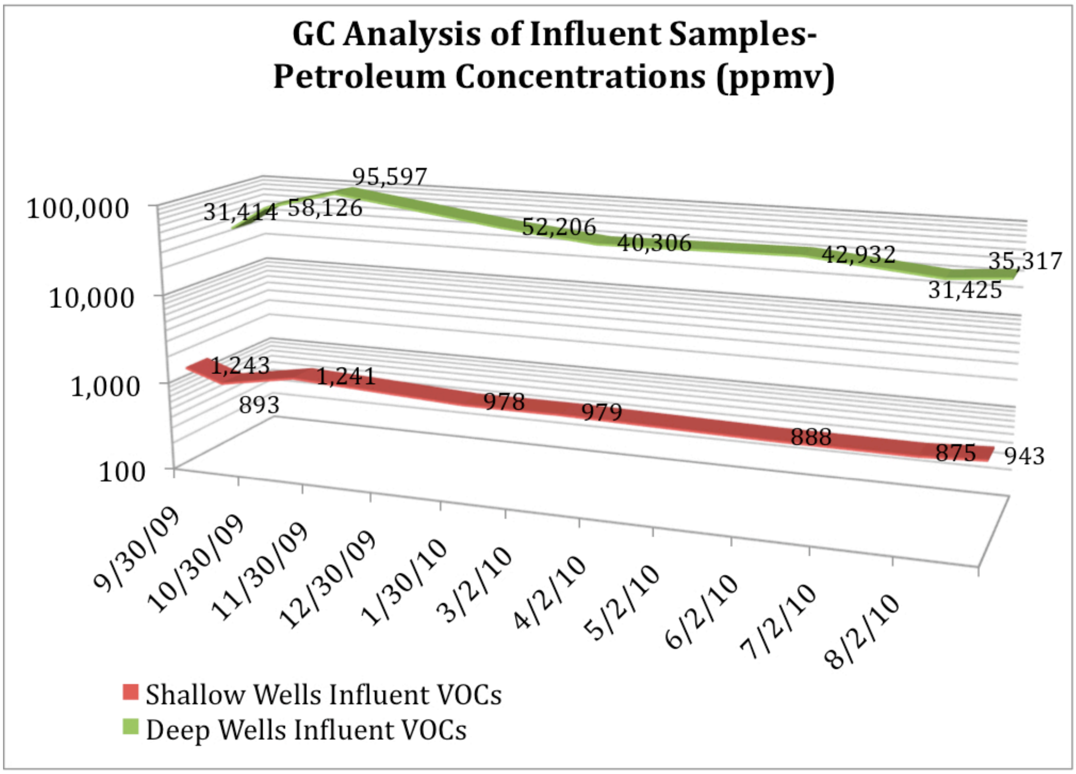
- Munters regenerative zeolite concentrator (5,200 scfm capacity)
- C3-500 system capable of up to 475 scfm flow;
- One refrigerated condensation and regenerative adsorber module, housed in an enclosed unit;

In addition to the treatment systems described above, one 5,500-gallon double-walled aboveground storage tank and two 6,500-gallon double-walled aboveground storage tanks are utilized for collection and storage of recovered petroleum condensate from both the SVE and groundwater treatment systems.

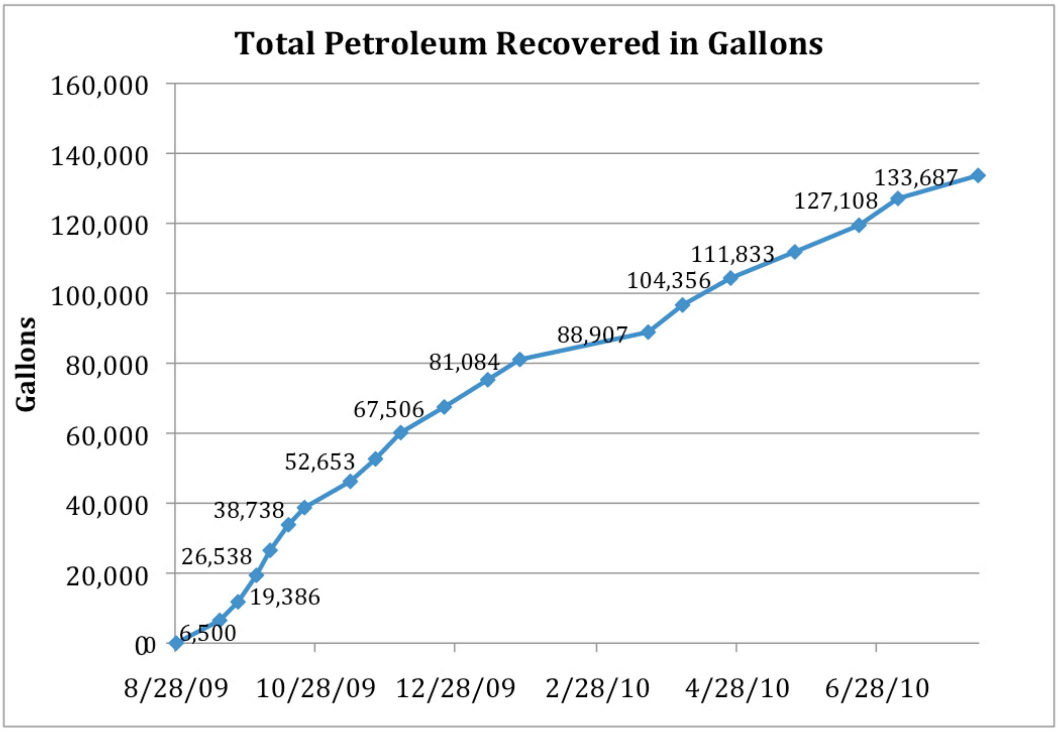
The two systems effluent flow are combined and directed to two 8,000-pound GAC adsorption vessels operated in a lead-lag (series) configuration for redundant secondary and tertiary polishing.

Performance Evaluation and Results

During the first five months of operation, the two treatment systems successfully recovered in excess of 81,000 gallons of product condensate. The initial recovery rate soon after startup was approximately 1,200 gallons per day during the first few days of operation however reduced soon afterwards resulting in a five-month steady average recovery rate of approximately 540 gallons per day. Maximum influent hydrocarbon concentrations from the deep soil vapor extraction wells of 95,597 ppmV with moderate variation in mass recovery during the 5 month period. The concentrations of influent hydrocarbons in the shallow screened vapor extraction wells remained steady for 7 months with very little fluxuation and a maximum recorded concentration of 1,243 ppmV.



Graph illustrating the influent vapor concentrations in log scale vs date of sampling for the three treatment processes at the site.



Graph illustrating cumulative gallons of recovered hydrocarbons from the vapor recovery systems at the site. Recovery of hydrocarbons appears to be fairly constant.