STAR (*In Situ*) Pilot Test to Treat Navy Special Fuel Oil (NSFO)

Naval Facility in Virginia

Overview

The subject site is a Naval Facility in Virginia. Navy Special Fuel Oil (NSFO) has impacted a highly heterogeneous medium- to fine-grained sand with varying amounts of silt, coarse sand, and clay in the vicinity of a former tank farm. The NSFO plume is approximately 13 acres in size and is located at a depth of approximately 17 to 21 feet below ground surface (ft bgs) in the pilot test area (water table at 16 ft bgs), bisected by a stiff plastic clay pan approximately one foot thick located at a depth of 17 to 18 ft bgs. A STAR Pre-Design Evaluation (PDE) was conducted to evaluate Radius of Influence (ROI), combustion front propagation rate, and volatile mass loading. (IMAGE 1).

IMAGE 1: PDE test area showing the ignition/air injection well, associated thermocouple network, and the STAR control trailer.

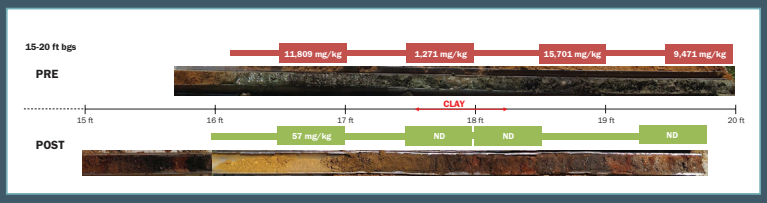

IMAGE 3a: Pre- and Post-PDE soil cores indicating TPH concentrations and the location of the clay layer for the 15-20 ft bgs interval.

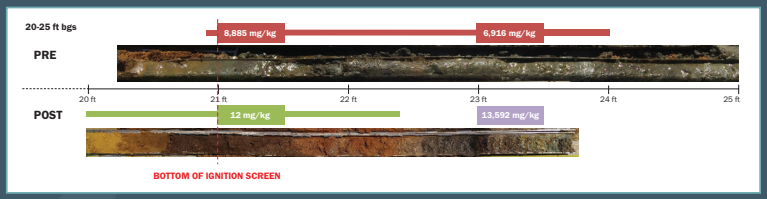

IMAGE 3b: Pre- and Post-PDE soil cores indicating TPH concentrations and the location of the clay layer for the 20-25 ft bgs interval.

Pre-Design Evaluation (PDE)

Self-sustaining smoldering combustion was achieved during the test. Combustion was initiated at the base of the impacted zone (20-21 ft bgs) yet the smoldering reaction successfully treated contaminated soil both above and below the stiff plastic clay layer. A combustion ROI of approximately 7.5 feet with an average propagation rate of 0.8 feet per day led to Total Petroleum Hydrocarbon (TPH) concentration reductions within the target treatment zone from over 14,000 milligrams per kilogram to a few hundred milligrams per kilogram (IMAGE 2). However, samples collected from the clay layer showed limited treatment, as the combustion front was unable to penetrate this material as a result of its low permeability.

Photographs of 'Before' and 'After' soil cores confirm the degree of treatment within the target treatment interval (IMAGE 3a and 3b). These photographs also indicate the location of the clay layer and the TPH concentrations in soils both before and after treatment.

Approximately 633 kilograms (kg) of NSFO were destroyed by the combustion process during the PDE over a ten-day period, providing an average mass destruction rate of 63 kilograms per day.

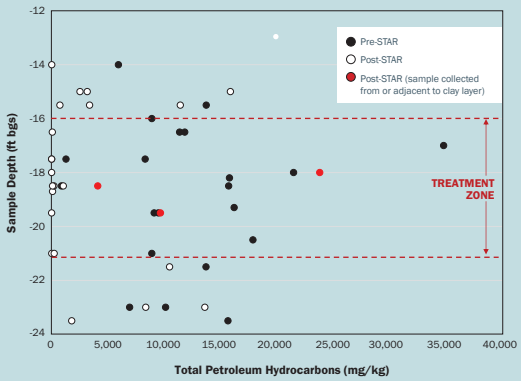

IMAGE 2: Pre- and post-STAR Total Petroleum Hydrocarbon concentrations.

Conclusions

The STAR technology is a rapid, safe, and low cost remedial alternative for source areas. The STAR PDE at the Naval Facility:

- Demonstrated self-sustaining smoldering combustion (i.e., no energy input into the system following ignition);
- Targeted impacted soils both above and below a stiff plastic clay pan bisecting the impacted zone;
- Showed an ROI of approximately 7.5 feet with a combustion front propagation rate of approximately 0.8 feet per day; and
- Resulted in TPH concentration reductions of two to three orders of magnitude in the treatment zone.