

# ENHANCED REDUCTIVE DECHLORINATION AT GENERAL SERVICES ADMINISTRATION RECLAMATION YARD, KENNEDY SPACE CENTER, FL

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## INTRODUCTION

The General Services Administration Reclamation Yard (GSRY) is located in northern Brevard County on the east coast of Central Florida inside the Kennedy Space Center. Past handling practices resulted in the release of solvents to the environment in the southwest corner of the site. Contaminants of concern include tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cDCE) and vinyl chloride (VC). High resolution baseline direct push technology (DPT) sampling found PCE dense non-aqueous phase liquid (DNAPL) in the 21-22 ft. bgs interval at DPT3005.

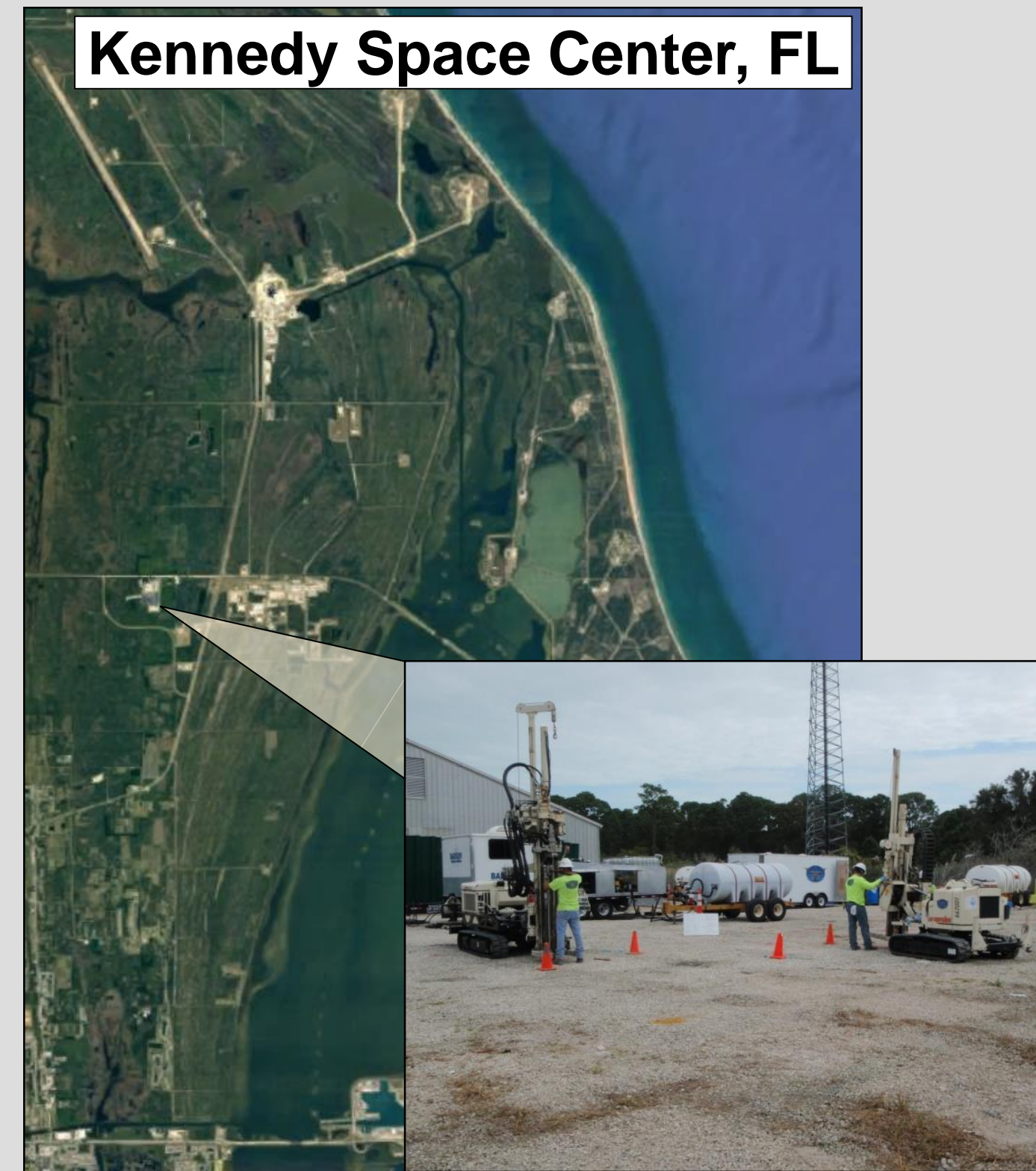
The Southwest Hot Spot source area is in the shallow to intermediate horizon of the aquifer (11-27 ft. bgs). Upper sand unit of the surficial aquifer is composed of fine/medium grain sands, silty sand and shell fragments. Groundwater flow direction is generally north, but sometimes westerly. Depth to groundwater averages +/- 4 ft bgs..

## MATERIALS AND METHODS

An interim measure (IM) was conducted to reduce the PCE mass (DNAPL, sorbed, and dissolved) and accelerate degradation of PCE and daughter product concentrations to promote overall plume collapse. Enhanced reductive dechlorination (ERD) was the selected technology to achieve hot spot objectives.

Initial treatment event in 2013 (Figure 1) combined injection of 10% or 15% emulsified zero valent iron (EZVI) and 6% food grade vegetable oil/lactate (VO/L), based on pore space volume. Total of 9,060 gal of EZVI and 26,000 gal of 6% VO/L injected across 41 locations covering 0.12 acres; targeted varying intervals between 11 and 27 ft bgs.

Performance monitoring (PM) using DPT conducted at 8, 16, 24 and 32 months after initial treatment. Samples collected up-gradient, down-gradient, through the axis and outside of the hot spot. Geochemical and microbial sampling conducted at several locations in 2016 to investigate differing conditions based on initial treatment protocols: 10% EZVI, 15% EZVI and 6% VO/L, compared to an untreated area.



Dual EZVI Injections During Initial Treatment in 2013

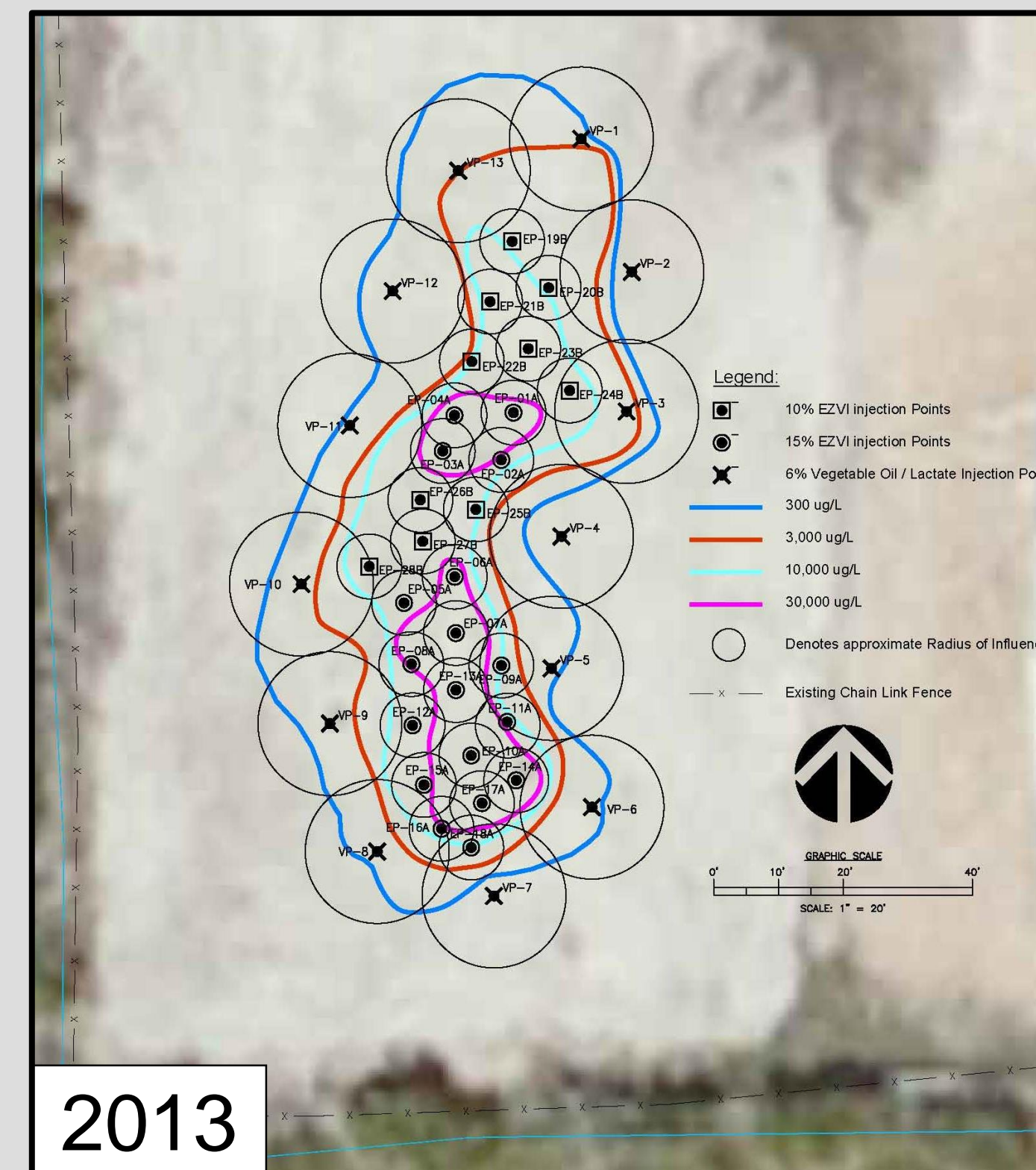


Figure 1. PCE Concentrations and Initial Treatment Layout 2013

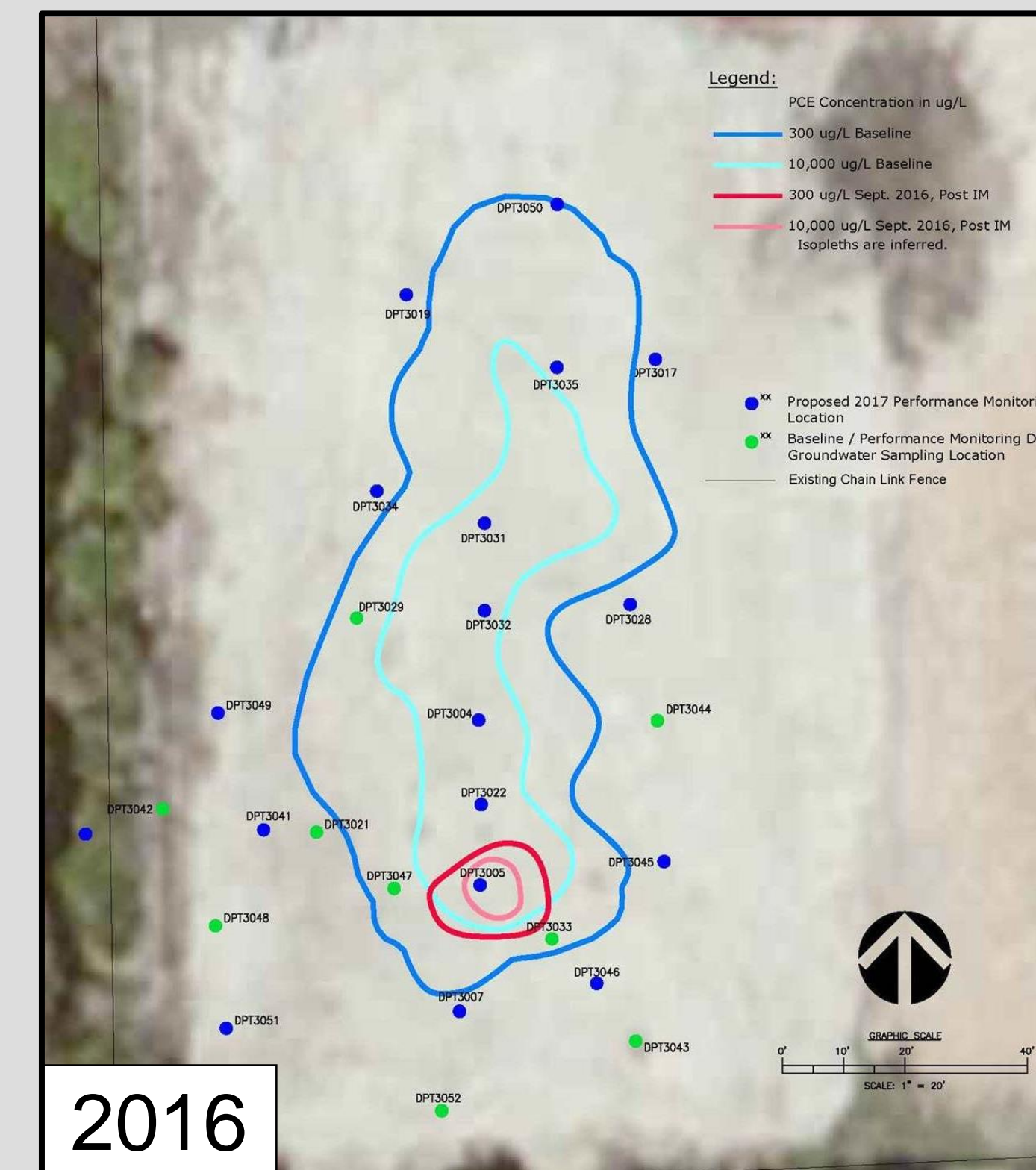


Figure 2. PCE and VC Concentrations 2016

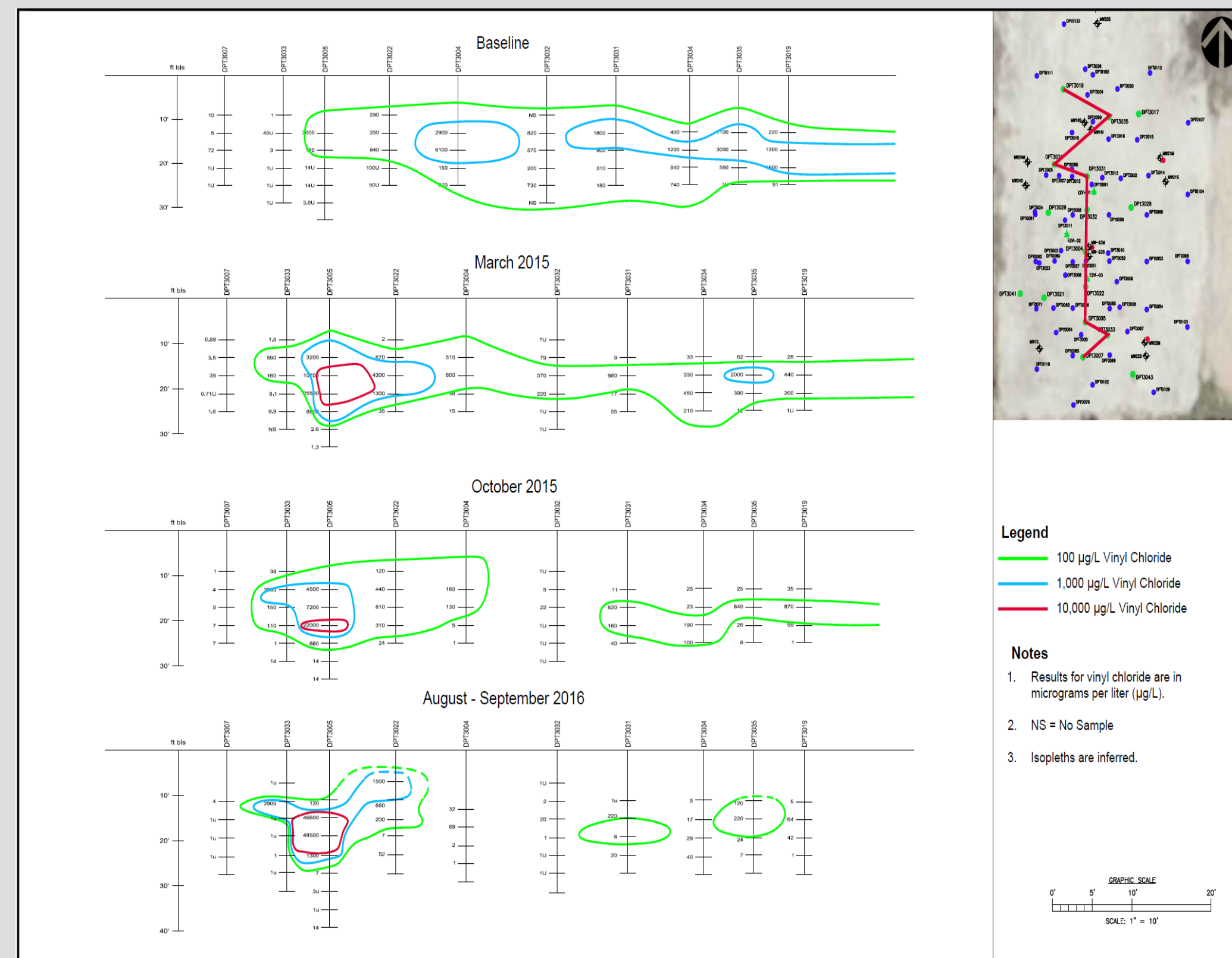


Figure 3. VC Profiles Baseline through 2016

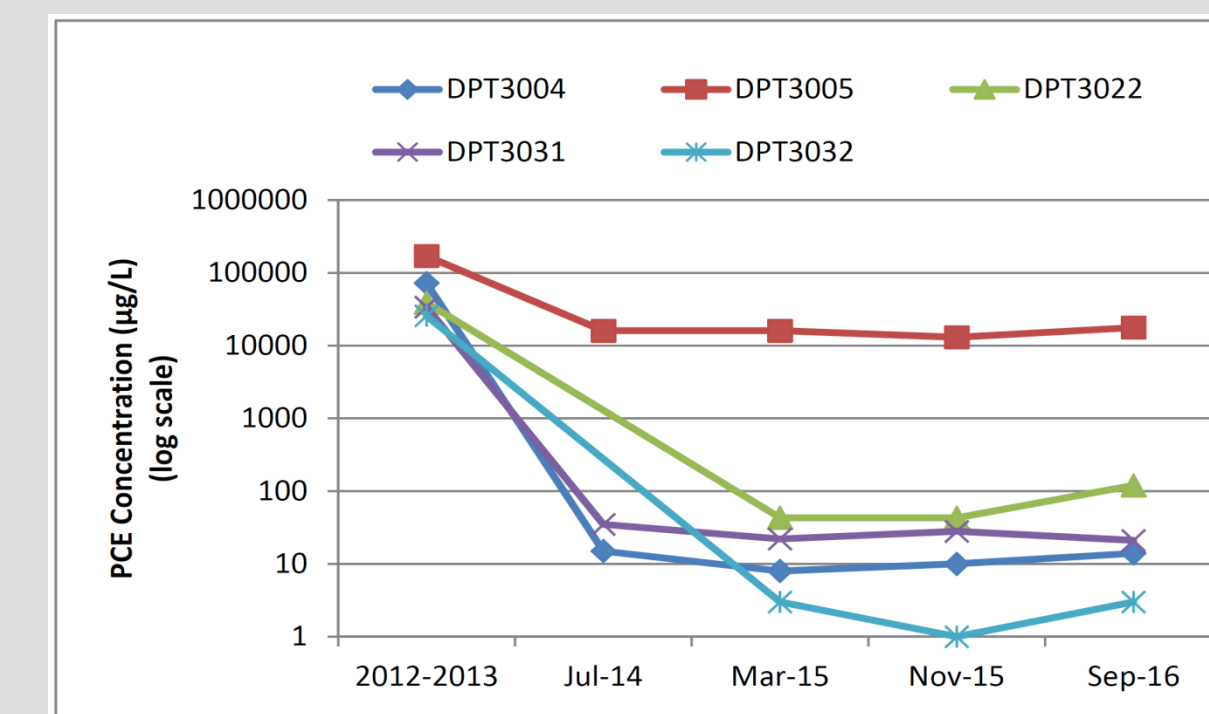


Figure 4. PCE Trends in EZVI Treatment Area

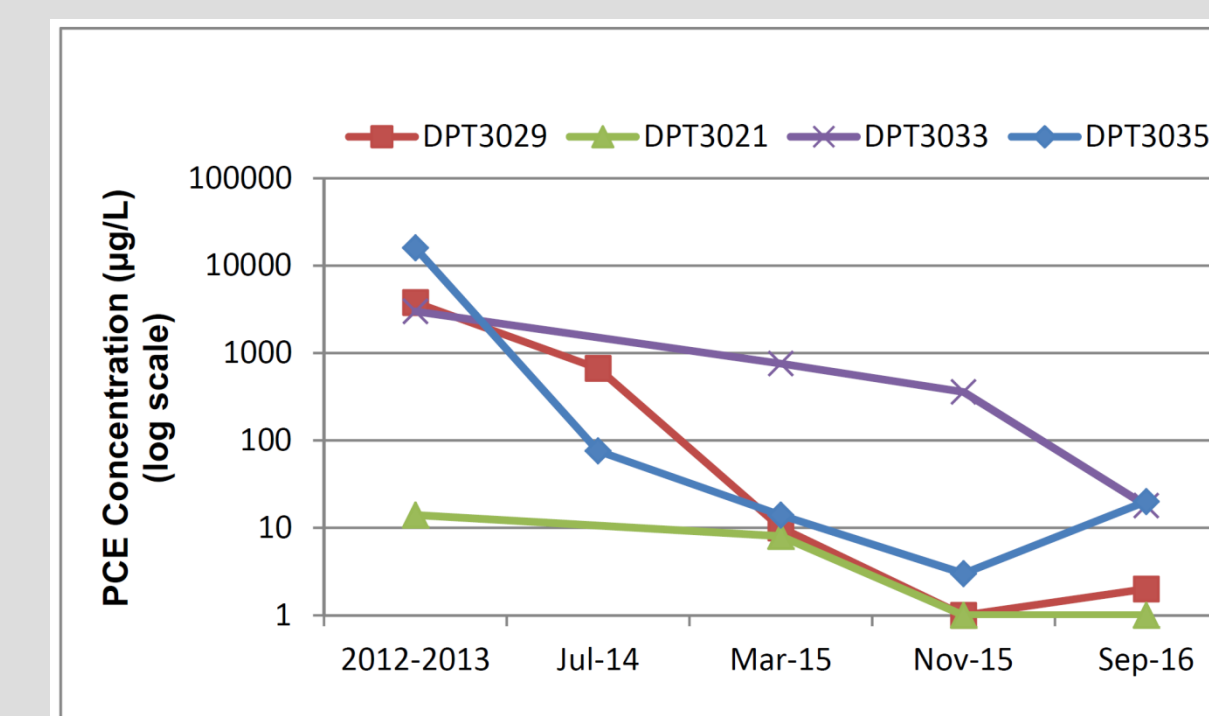


Figure 5. PCE Trends in VO/L Treatment Area

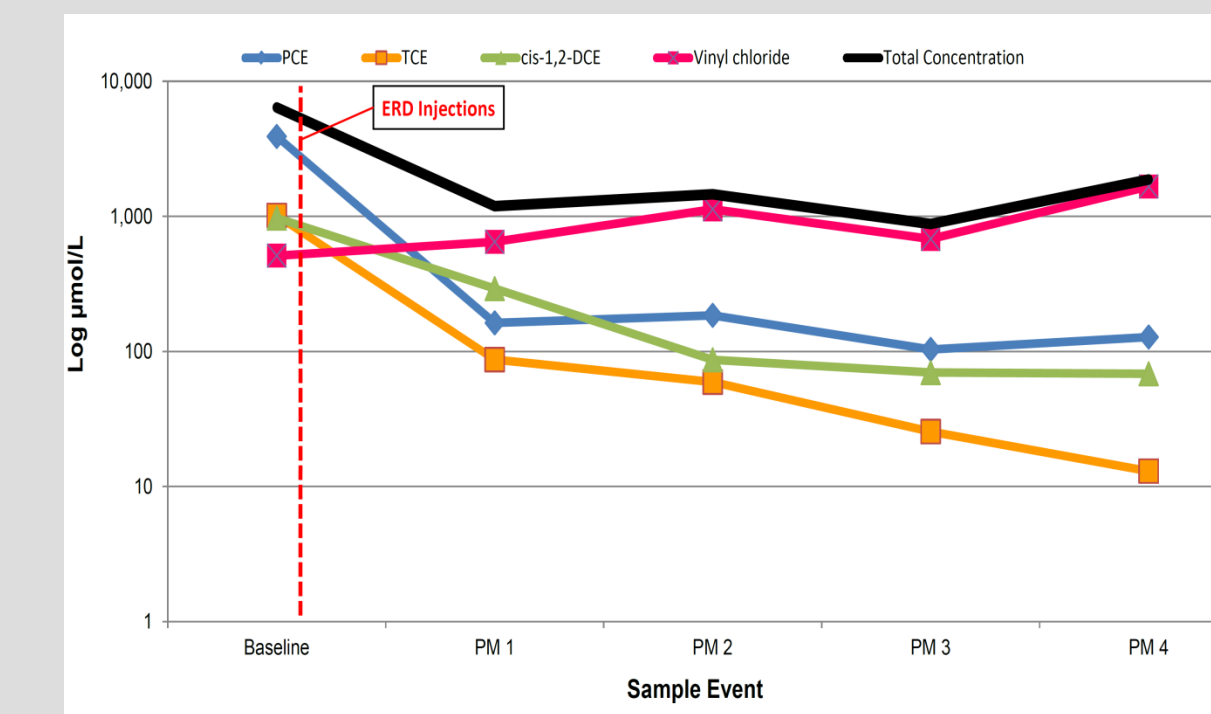


Figure 6. Chlorinated Solvent Trends Baseline to 2016

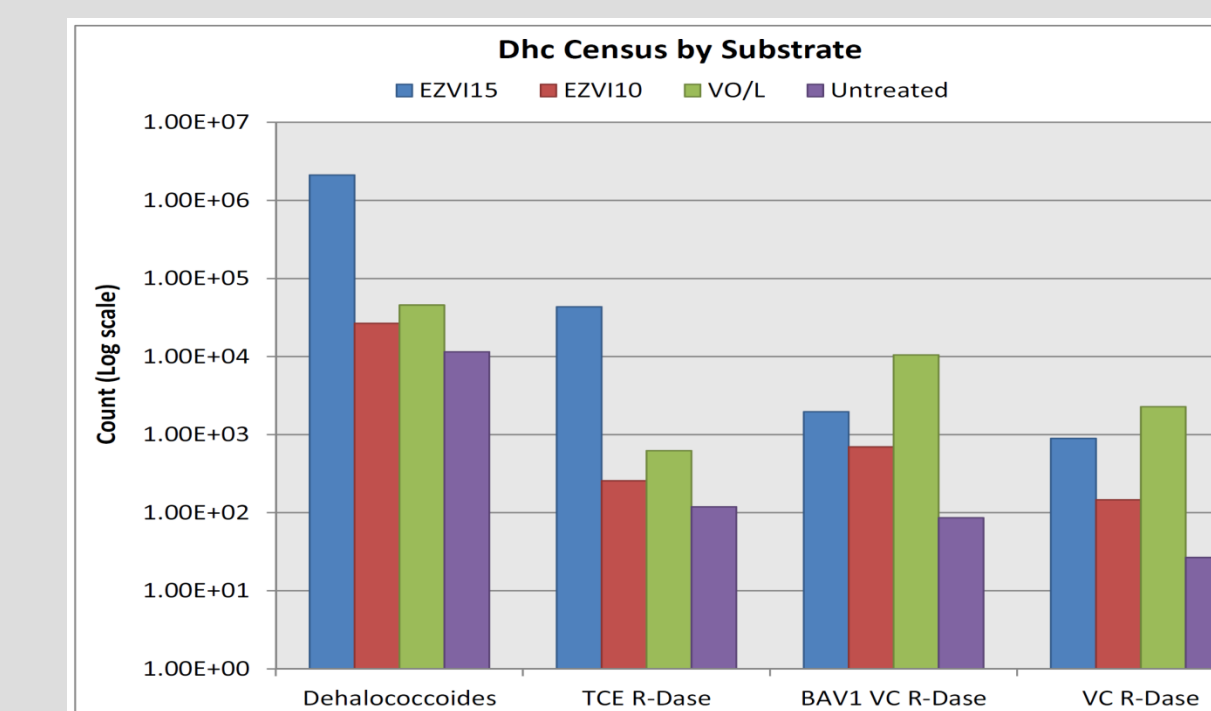


Figure 7. Dhc and Halogenase Genes

## RESULTS

Maximum pre-IM PCE concentration 214,000  $\mu\text{g/L}$ ; 2016 highest PCE detection 17,700  $\mu\text{g/L}$

- Volume of PCE plume  $\geq 10,000 \mu\text{g/L}$  reduced by 93%
- Changes in target VOC concentrations in terms of molarity:
  - PCE 97% reduction; TCE 99% reduction; cDCE 93% reduction
  - VC 325% increase; 92% of 2016 VC mass associated with PCE DNAPL location

Figure 2 presents the 2016 PCE and VC isopleths. Figure 3 depicts the changes in the VC profile over time, and shows the concentration of mass at DPT3005, the point where DNAPL was observed pre-treatment.

Figures 4 and 5 depict PCE trends over time in the EZVI and VO/L treated areas, respectively. The trends for all target compounds demonstrate conversion of PCE to its breakdown products (Figure 6).

Dehalococoides (Dhc) count at EZVI15 location was 2 orders of magnitude higher than EZVI10 or VO/L locations, which were comparable to untreated location (Figure 7). Ethene and ethane were detected only at the EZVI15 location (the location with the 92% increase in VC).

## CONCLUSIONS AND PATH FORWARD

- Use of three treatment scenarios based on parent compound concentration provided effective removal with targeted use of most expensive component (EZVI).
- Substantial, rapid decrease in PCE mass. No evidence of TCE or cDCE accumulation.
- VC concentrations increased, but downgradient VO/L area provided adequate treatment. Presence of ethene and ethane at the location with highest VC concentrations indicates complete dechlorination is occurring.
- Supplemental treatment was completed in March 2017 to sustain ERD.