



7421 A Warren Ave. SE  
Snoqualmie, WA 98065  
Phone: 425.396.4266  
Fax: 425.396.5266  
dfleming@thermalrs.com

**Guaranteed Remediation Certainty**  
**Our Word Is Who We Are**

**Project Example - Guaranteed Performance Based Full Scale Remediation of PCE using ERH under an Operating Shopping Mall, Chicago, IL**

*This was a guaranteed performance based remediation of PCE in clay soil underneath an operating retail shopping mall.*

**Project Reference:** Mr. Jeff Pope, Clayton Group Services, Chicago, IL (630) 795-3211.  
**Contracting:** Performance Based, Guaranteed Fixed Price.  
**Contaminants Treated:** Tetrachloroethene (PCE).  
**Technology Applied:** Electrical Resistance Heating.  
**Geology:** Clay and silt.  
**Hydrology:** Groundwater at 70 feet bgs.  
**Treatment Area and Depth Interval:** About 1,000 square feet and 4 to 23 feet bgs.  
**Site Constraints:** ERH installation and operations under and active fire alley behind the shopping mall. Guarantee included the alley remaining open to the public during the project.  
**Beginning Contaminant Levels:** 13,000 mg/kg PCE.  
**Cleanup Levels Achieved:** 62 mg/kg PCE in soil.  
**Average % Reduction:** 99%.  
**Remediation Time Period:** Nov. 2002 – Mar. 2003.



**Figure 1.** Installation of ERH Components in Common Utility Trench

**Problems Encountered and Corrective Actions:**



**Figure 2.** The Alley Remained Open during ERH Remediation

TRS guaranteed that the alley behind the retail shopping mall would remain open to the public during ERH system construction and operations. TRS installed the ERH system components below the alley in rated vaults and in the common utility trench (see Figures 1 and 2). The alley remained open during construction and operations to pedestrians and vehicles.

The ERH remediation was operated in the middle of winter in Chicago, IL. TRS freeze protected the ERH system components and equipment to withstand the below freezing temperatures. TRS also improved our water drip system to keep the

electrode soil interface moist in the very low permeability clay lithology with a hydraulic conductivity of  $1 \times 10^{-8}$  cm/sec.

## Background

TRS used ERH to accomplish the *in situ* thermal remediation of PCE at a dry cleaning facility in an operating shopping mall in a suburb of Chicago. TRS performed this remediation project as a subcontractor to Clayton Group Services (Clayton) under a guaranteed, performance-based contract. Prior to ERH being implemented at the site soil vapor extraction had been deployed for a number of years with limited success. Elevated levels of PCE remained in the soil underneath the alley following SVE.

TRS guaranteed that every soil sample (60 total) would meet or exceed the cleanup goal following the ERH remediation.

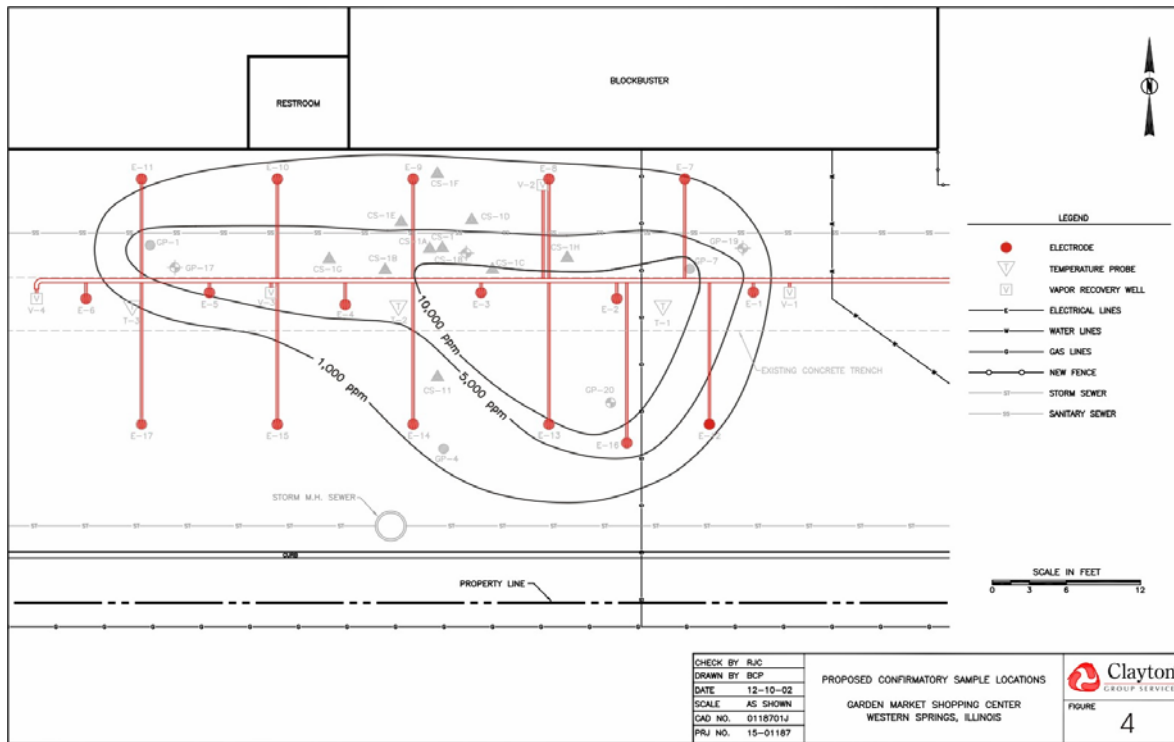
Site geology consists of clay and silt with a hydraulic conductivity of  $10^{-8}$  cm/sec. The groundwater table is located at 70 feet bgs. The area of remediation was 1,200 square feet and the subsurface heating interval extended from 4 to 23 feet bgs. Figure 1 shows the common utility trench in the alley that ran through the treatment area. TRS used this existing utility trench to install ERH system components. There were no adverse effects on the operating utilities during ERH application.

Initial maximum and average concentrations of PCE in soil were 13,600 mg/kg and 5,424 mg/kg, respectively. The cleanup goal required that PCE concentrations in each of 60 soil samples be less than 529 mg/kg. Soil samples were taken from 20 locations using direct push technology. Soil sampling was performed within 72-hours of stopping subsurface heating and samples were removed from three subsurface intervals (11-12, 12-13, and 15-17 feet bgs) at each sampling location.

## Design, Construction and Operations

TRS was responsible for the design, construction and operation of the full-scale ERH remediation system consisting of 17 electrodes, 4 vertical and 9 horizontal vapor recovery wells, and 3 temperature-monitoring points (TMPs). Figure 3 shows the locations of the ERH components in the alley. The PCE source treated was located in the vadose zone beneath an alley just behind the dry cleaning facility. The alley remained open to vehicle and pedestrian traffic during both the construction and operation of the ERH system. Pedestrians were able to walk directly on top of the electrode array throughout the heating process (Fig. 2).

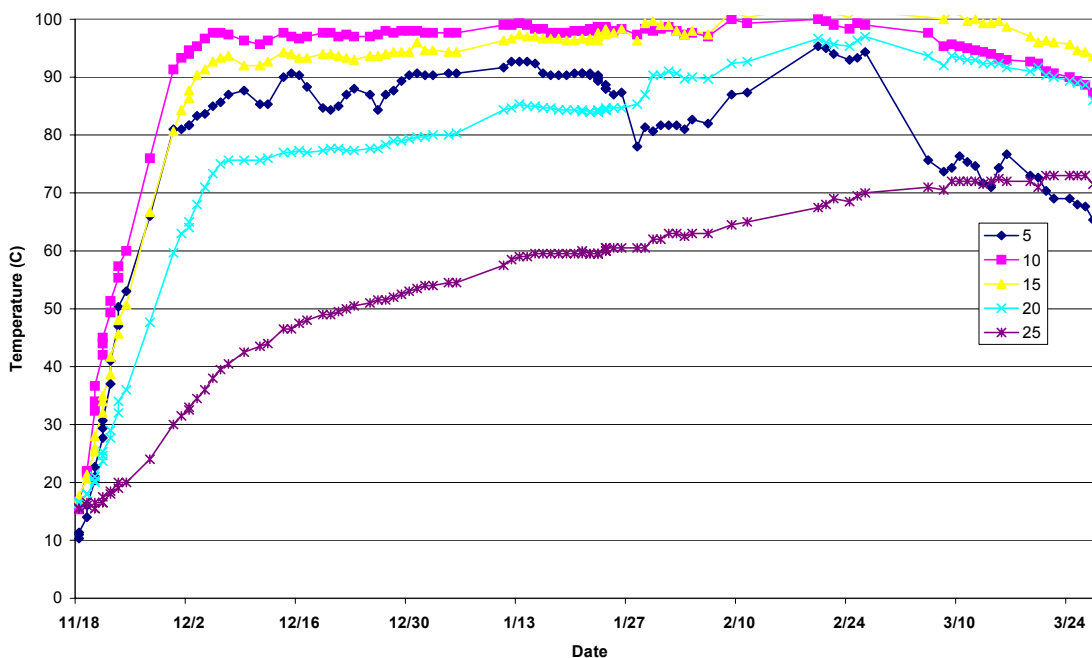
The long narrow shape of the treatment area and the prevalence of underground utilities required TRS to adjust the number and locations of electrodes in the field, while maintaining workable electrode spacing and phasing. The project was performed during winter in the Chicago area and TRS had to address issues caused by freezing of the electrode wetting and vapor/liquid recovery systems. Lessons learned about operations during extreme cold weather have been incorporated into TRS system designs and new TRS equipment. Existing equipment has been retrofitted to perform in extreme weather and to provide automated notification of electrode wetting and effluent (vapor, steam, and liquids) flow rates.



**Figure 3.** Electrode and Conveyance Piping Locations Installed Below the Alley

## Results

Uniform increases in subsurface temperatures in the remediation area are illustrated in Figure 4 below. The subsurface design temperature was achieved rapidly. Within a couple of weeks from the beginning of ERH operations the boiling point of PCE was achieved (87°C).

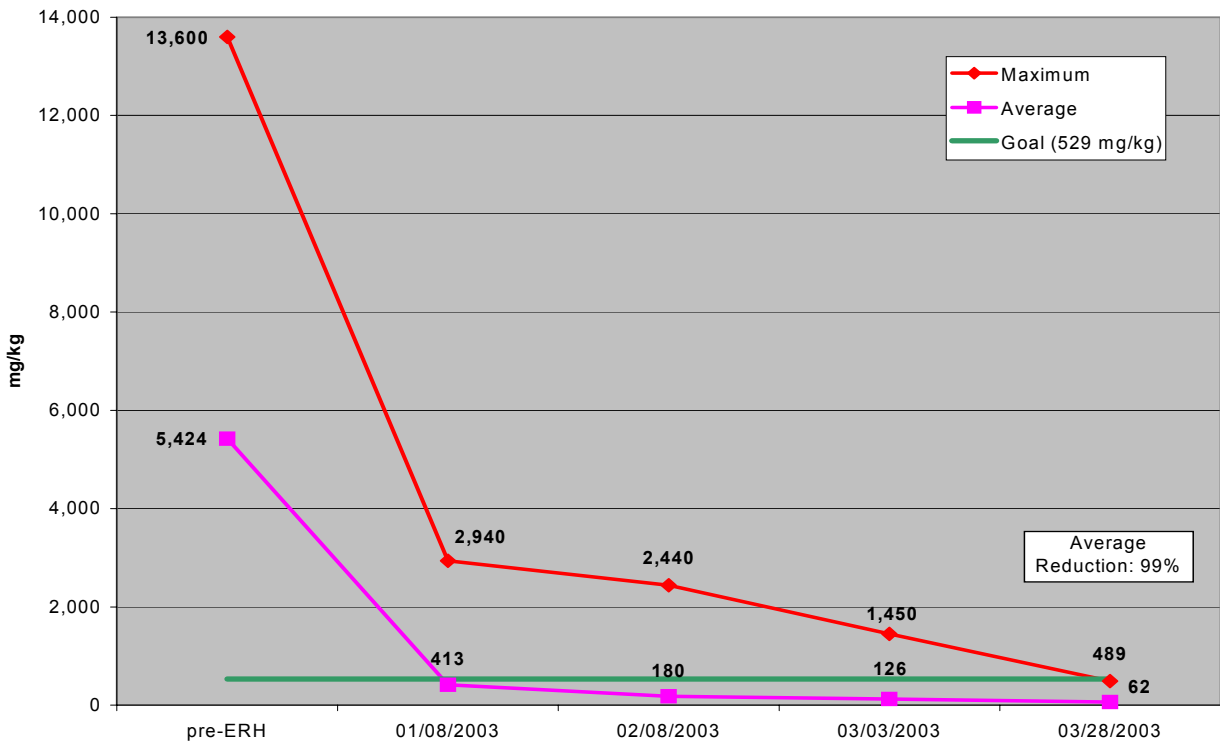


**Figure 4.** Subsurface Temperature at Depth over Time

Following four months of ERH operations, maximum PCE concentrations in all confirmatory soil samples were below the cleanup goal. The average concentration of PCE in the confirmatory soil samples was 62 mg/kg. Several sampling locations showed reductions in PCE concentrations as high as 98-99.6%. Figure 5 illustrates the maximum and average soil concentrations of PCE achieved during site remediation compared to the site cleanup goal. Confirmatory soil sampling data proved that the site cleanup goal had been exceeded and that the average reduction of PCE in soil was 99%.

**Russ Chadwick, Vice President, Midwest Regional  
Director - Environmental Services  
Clayton Group Services**

*"I was very satisfied with the way this project turned out...it was quite a learning experience. I am looking forward to that next project!"*



**Figure 5.** Maximum and Average PCE Soil Concentrations vs. Cleanup Goal