



DNAPL REMEDIATION

In the Saturated Zone

Client: Fortune 500 Company

**Commercial site,
Skokie, Illinois**

June 1998 – October 1999

Current Environmental Solutions (CES) successfully used Six-Phase Heating (SPH) to remediate soil containing dense non-aqueous phase liquid (DNAPL) at a former manufacturing facility near Skokie, Illinois.

Others had been working at removing solvents from the subsurface of the site since 1991. These chemicals, used in various manufacturing processes, were released when underground storage tanks leaked between 1958 and 1988.

After seven years, technologies including steam injection combined with various extraction technologies and bioremediation had reduced the level of soil pollution on the site. The remaining DNAPL was present as pools of trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA) to 21 ft below grade (bg). The remaining pollutants were removed within less than a year using SPH.

SITE

The lithology of the site consisted of a shallow groundwater table at 7 ft bg, heterogeneous sandy silts to 18 ft bg, and a dense clay till aquitard from 18-25 ft bg. Hydraulic conductivity through the remediation zone ranged from 10^{-4} to 10^{-8} cm/s.

As DNAPL migrated downward, it was trapped in silt-rich stringers or on top of the clay aquitard. Over time, pockets of elevated chloride ions were created from the biological dechlorination of the solvents.

TECHNOLOGY

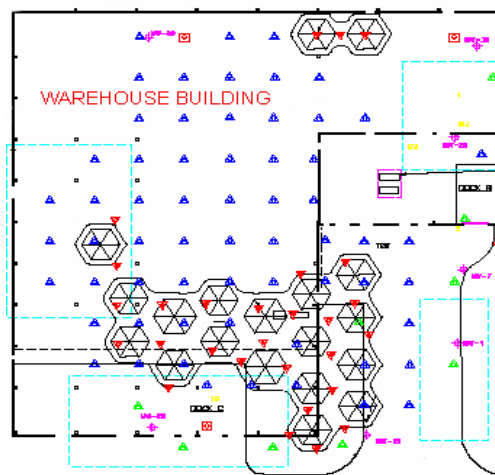
SPH is emerging as a leading technology in difficult in-situ soil and groundwater remediation. It has proved an efficient, rapid means of remediating soil contaminated by volatile and semi-volatile organic contaminants. The in situ cleanup of DNAPL remains one of the toughest challenges facing the remediation industry. Traditional remediation technologies require years of continued application to produce even marginal results at DNAPL sites.

SPH uses polyphase electricity to resistively heat the soil and groundwater to the boiling point of water. This increases the volatility of contaminants, which improves the effects of vacuum extraction. Once steam is generated in situ, it acts as a carrier gas which strips out contaminants from the soil or groundwater. The steam is collected from the subsurface by a soil vapor extraction process, and treated aboveground by conventional means such as activated carbon and catalytic oxidization.

APPLICATION

To ensure complete treatment of the DNAPL pools, 107 electrodes were placed across two-thirds of an acre, covering the site (see Figure 1). Of these, 85 were located beneath a warehouse, having been constructed directly through the floor of the building.

These electrodes were electrically conductive from 11-21 ft bg, and were designed to increase subsurface temperatures from 5-24 ft bg to the boiling point of groundwater. Within 60 days, temperatures throughout the entire 23,100 yd³ treatment volume had reached the boiling point of water. At this stage, steam laden with chlorinated solvents rose to the surface and was collected by a network of 37 soil vapor extraction wells, screened to 5 ft



SPH ELECTRODE LAYOUT

Subsurface regions displaying higher electrical conductivity, such as clay-rich soil lenses and pockets where the concentration of chloride ion was elevated, were preferentially heated. As a result, SPH specifically targeted those subsurface locations, which held most of the remaining DNAPL mass.

RESULTS

For 70 days, temperatures throughout the treatment volume were maintained at 100 °C. All the separate phase DNAPL was removed from the area, and overall groundwater concentrations of TCE and TCA was reduced to below the standards specific to the site.

TYPICAL GROUNDWATER CLEANUP RESULTS

Well	Compound	March 1998 (µg/l)	November 1998 (µg/l)	Reduction (%)
B-3	TCE	34,000	120	99.6
	TCA	82,000	31	99.9
Fa2	TCE	22,000	70	99.7
	TCA	24,000	24	99.9
C4	TCE	76,000	280	99.9
	TCA	11,000	15	99.9

The cleanup goal for the site was based on the State of Illinois RBCA Tier III standards, but in fact most of the area was cleaned to the more stringent Tier I standards.

CONCLUSIONS

SPH successfully remediated this site within 130 days. After four quarters of post-remediation monitoring, no rebound was detected. The Illinois Environmental Protection Agency issued a letter of **"No Further Action"** for the site on 10 Aug 1999.

**PROPERTY OWNER CERTIFICATION OF THE NFR LETTER
UNDER THE SITE REMEDIATION PROGRAM**

If the Remediation Applicant is not the sole owner of the remediation site, include the full legal name, title, the company, the street address, the city, the state, the ZIP code, and the telephone number of all other property owners. Include the site name, street address, city, ZIP code, county, Illinois inventory identification number and real estate tax index/parcel index number. The property owner(s), or the duly authorized agent of the owner(s) must certify, by original signature, the statement appearing below.

A duly authorized agent means a person who is authorized by written consent or by law to act on behalf of a property owner including, but not limited to:

1. For corporations, a principal executive officer of at least the level of vice-president;
2. For a sole proprietorship or partnership, the proprietor or a general partner, respectively; and
3. For a municipality, state or other public agency, the head of the agency or ranking elected official.

For multiple property owners, attach additional sheets containing the information described above, along with a signed, dated certification for each. All property owner certifications must be recorded along with the attached NFR letter.

Property Owner Information	
Owner's Name:	<u>Skokie Development, L.L.C.</u>
Title:	<u>Managing Member</u>
Company:	<u>c/o Hamilton Partners, Inc.</u>
Street Address:	<u>300 Park Boulevard, Suite 201</u>
City:	<u>Itasca</u> State: <u>IL</u> Zip Code: <u>60143</u> Phone: <u>630/250-9700</u>
Site Information	
Site Name:	<u>Village Crossing Shopping Center</u>
Site Address:	<u>5555 W. Touhy Avenue</u>
City:	<u>Skokie</u> State: <u>IL</u> Zip Code: <u>60077</u> County: <u>Cook</u>
Illinois inventory identification number:	<u>0312880005</u>
Real Estate Tax Index/Parcel Index No.	<u>10-33-101-017/085/086 & 10-33-100-005</u>
I hereby certify that I have reviewed the attached No Further Remediation Letter, and that I accept the terms and conditions and any land use limitations set forth in the letter.	
Owner's Signature: <u>Todd Berlinghof</u>	Date: <u>Aug 10 / 1999</u>
Todd Berlinghof, Managing Member	
SUBSCRIBED AND SWORN TO BEFORE ME	
this <u>10th</u> day of <u>August</u> , 19 <u>99</u>	
<u>Joan Sabourin</u> Notary Public	<div style="border: 2px dashed black; padding: 5px; width: fit-content; margin: auto;"> <p align="center">OFFICIAL SEAL JOAN SABOURIN NOTARY PUBLIC, STATE OF ILLINOIS MY COMMISSION EXPIRES: 05/05/02</p> </div>

The Illinois EPA is authorized to require this information under Sections 1-10 of the Environmental Protection Act and regulations promulgated thereunder. If the Remediation Applicant is not also the sole owner of the remediation site, this form must be completed by all owners of the remediation site and recorded with the NFR Letter. Failure to do so may void the NFR Letter. This form has been approved by the Forms Management Center. All information submitted to the Site Remediation Program is available to the public except when specifically designated by the Remediation Applicant to be treated confidentially as a trade secret or secret process in accordance with the Illinois Compiled Statutes, Section 7(a) of the Environmental Protection Act, applicable Rules and Regulations of the Illinois Pollution Control Board and applicable Illinois EPA rules and guidelines.



217/782-6761

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276

THOMAS V. SKINNER, DIRECTOR

July 29, 1999

Certified # 416 152 704

Richard H. Bennett
 Lucent Technologies, Inc.
 475 South Street
 Morristown, New Jersey 07962-1971



Re: 0312880005 -- Cook County
 Skokie/AT&T (Lucent)
 Site Remediation/Technical Reports

Dear Mr. Bennett:

The Remedial Action Completion Report for the Former AT&T Skokie Works (06/14/99 / log #99-1103) as prepared by ENSR for the AT & T property has been reviewed by the Illinois Environmental Protection Agency ("Illinois EPA") and demonstrates that the remedial action was completed in accordance with the Remedial Action Completion Report (as above).

The remediation site, consisting of 62.4 acre(s), is located at 7003 N. Central Ave., Skokie, Illinois. Pursuant to Section 58.10 of the Illinois Environmental Protection Act ("Act") (415 ILCS 5/1 et.seq.), your request for a no further remediation determination is granted under the conditions and terms specified in this letter. The Remediation Applicant, as identified on the Illinois EPA's Service Agreement (04/10/91), is Richard H. Bennett.

This focused No Further Remediation Letter ("Letter") signifies a release from further responsibilities under the Act for the performance of the approved remedial action and shall be considered prima facie evidence that the remediation site described in the attached Illinois EPA Site Remediation Program environmental notice and shown in the attached site base map does not constitute a threat to human health and the environment and does not require further remediation under the Act if utilized in accordance with the terms of this Letter.

WWW.CESIWEB.COM

TEL: (215) 741-6123

FAX: (215) 741-6124