Electro-Thermal Dynamic Stripping Process™ (ET-DSP™):
Silresim Chemical Corporation, Lowell, Massachusetts

Results:

- Approximately 87,600 lbs (39,800 kg) of Volatile Organic Compounds (VOCs) and 3,480 lbs (1,580 kg) of Non-Aqueous Phase Liquid (NAPL) had been removed from the Target Treatment Zone (TTZ).

Approach:

- Electro-Thermal Dynamic Stripping Process™ (ET-DSP™)
- TTZ:
  - ◊ Area: 49,400 square feet (4,590 m^2)
  - ◊ Volume 55,565 cubic yards (42,482 m^3)
- 304 Independently controlled electrodes in 144 electrode borings
- 48 Vapor extraction wells (VEWs)
- 34 Shallow VEWs
- 77 Multi-phase extraction (MPE) wells
- 55 Temperature sensor wells
- 8 Temperature sensor/ pressure monitoring wells
- Vapor cap to cover the TTZ
- Liquid and vapor manifold conveyance system
- Electrode power delivery system
- Vapor treatment system
- Liquid treatment system

For further information:

TERRATHERM, Inc.

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Site Information: The Silresm Superfund Site in Lowell, MA was used for industrial activities since the early 1900s. From 1971 through 1977, Silresim Chemical Corporation operated a chemical waste reclamation facility. Wastes were accepted at the site in drums, tank trucks, railroad tanker cars, and other containers. It is estimated that the facility handled approximately three million gallons of waste per year. Silresim Chemical Corporation filed for bankruptcy in 1977 and abandoned the facility the following year, leaving behind approximately one million gallons of hazardous materials in drums and bulk tanks, including almost 30,000 decaying drums covering virtually all open areas of the property. Over 100 individual contaminants were identified in groundwater and soils.

Aerial view of the Silresim Chemical Corporation filled with abandoned and decaying drums (photo circa 1977)

Contaminants of Concern (COCs): Benzene; chlorobenzene; 1,1-dichloroethene; ethyl benzene; methylene chloride; tetrachloroethene; 1,1,1-trichloroethane; trichloroethene.

Site Geology/Hydrogeology: The Site consisted of six hydrostratigraphic layers numbered one through six from the surface downward.

1. Fine sand or fill (primarily) terminating at approximately 15 ft (4.6 m) below ground surface (bgs). The water table was located at approximately 10 ft (3.0 m) bgs.
2. Varved clayey lacustrine silt extending approximately 15-35 ft (4.6-10.7 m) bgs (layer missing in parts of the northern portion of the site). Characterized by low hydraulic conductivities and high anisotropy ratios.
3. Silty fine sand in the southern and central portions of the site and fine sand in the northern portion of the site extending approximately 35-60 ft (10.6-18 m) bgs. This layer had the highest hydraulic conductivities at the site.
4. Varved clayey lacustrine silt with low hydraulic conductivity and high anisotropy ratios extending approximately 60-90 ft (18-27 m) bgs.
5. Approximately 15 ft (4.6 m) thick till layer (approximately 90-105 ft [27-32 m] bgs) lying on top of the bedrock surface.
6. Bedrock underlying the site below 105 ft (32 m) bgs.

Objectives: The primary goal of the remedial effort at the Site was to reduce contaminant concentrations in the source areas to below performance goals, or until the mass removal rate diminished to the point where it was no longer cost effective to operate.

Electro-Thermal Dynamic Stripping Process™ (ET-DSP™):
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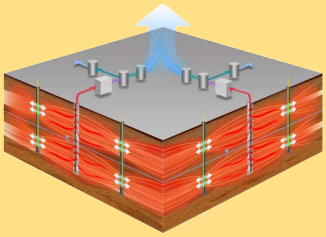
Heating Method:
Electro-Thermal Dynamic Stripping Process™ (ET-DSP™)



Location: Lowell, MA, USA

Time Frame:

July 2010 - June 2012

Regulatory Oversite:

USEPA/MADEP

Project Team:

TerraTherm performed this project under contract to Nobis Engineering, Inc. (Nobis) who in turn was working for USEPA Region 1. TerraTherm's principal teaming partner for the subsurface heating was McMillan-McGee Corporation.

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Challenge/Solution: Due to an unseasonably high water table and record rainfalls during operations, a total of 34 additional shallow VEWs were installed and brought online to reduce subsurface pressure and to ensure sufficient vapor capture.

Project Summary: Soil vapor and groundwater were extracted from the subsurface via the VEWs and MPE wells and conveyed to the vapor liquid treatment system. Extracted vapors passed through a liquid/vapor separator tank to remove entrained liquid and condensate prior to vapor treatment by a thermal oxidizer and acid gas scrubbing. Liquids were phase separated, treated in an air stripper and transferred to the existing Ground Water Treatment Plant for treatment and subsequent discharge to the City of Lowell sewer system. Light and Dense NAPL, if present, were separated and collected in drums.

Monitoring and sampling of the system was conducted to track remediation system progress and efficiency and to ensure proper system operation. System monitoring included recording temperatures, pressures, liquid and vapor flow rates, and electrical power usage from the thermal treatment system and the vapor liquid treatment system. Liquid and vapor phase influent and effluent sampling were conducted in order to calculate the mass removed from the TTZ.

Periodic groundwater samples were collected by Nobis to evaluate the thermal remedy. Nobis also collected soil samples pre- and post-thermal treatment to evaluate the effectiveness of the ET-DSP™ system. It is estimated that upon completion of thermal operations on February 24, 2012, approximately 87,600 lbs (39,800 kg) of VOCs based on caustic usage and 3,480 lbs (1,580 kg) of NAPL had been removed from the TTZ at the Site.

Aerial view of the ET-DSP™ wellfield in operation