Noranda Metal Industries

ERH–Biostimulation–Bioaugmentation–Technical Impracticability Waiver–Monitored Natural Attenuation

Site Name: Noranda Metal Industries
Site Location: Newtown, Connecticut
Technology Used:

- Soil Vapor Extraction (SVE)
- Limited Source Zone Excavation
- Electrical Resistive Heating (ERH)
- Bioaugmentation
- Biostimulation
- Monitored Natural Attenuation (MNA)
- Technical Impracticability (TI) Waiver

Regulatory Program: State-Lead Property Transfer Program
Remediation Scale: Full
Project Duration: 2010 to present

Site Information: The 12-acre former manufacturing facility site is located in a mixed commercial and residential area in Newtown, Connecticut. The principal source area is less than an acre and the area of the groundwater contaminant plume is approximately 15 acres.

Contaminants: The contaminants of concern (COCs) are chlorinated solvents—principally trichloroethene (TCE) and its degradation products, *cis*-1,2-dichloroethene (*cis*-1,2-DCE) and vinyl chloride (VC). The source area contains residual dense non-aqueous phase liquids (DNAPL) that have penetrated to the weathered bedrock. Detected concentrations of total chlorinated volatile organics (CVOCs) ranged from 20 mg/L in the plume to 780 mg/L in the source zone. At a second, significantly smaller plume to the northwest of the building slab, the maximum CVOC concentrations detected were 2 mg/L.

Hydrogeology: The main plant and source area are situated in an upland region that is underlain primarily by a 21 to 42-foot layer of very fine sand and silt. Beneath the sand and silt is weathered gneiss bedrock. Groundwater in this area is found 6-10 feet below ground surface (bgs). The downgradient plume lies within a forested wetland. The lithology in this area consists of a thin layer of wetland soil followed by a very fine sand and silt layer, a fine to medium sand layer, a thin till layer, and weathered gneiss bedrock that generally occurs about 20 to 30 feet bgs.

Project Goals: Table 1 shows the cleanup goals that were developed for the site.

Table 1. Remedial Criteria (µg/L)

COC	Source Area Goal	Wetland Stream	Onsite Pond
tetrachloroethene (PCE)		50.4	504
TCE	760[1]	34.3	343
cis-1,2 DCE		620	6,200
trans-1,2-DCE		560	5,600
1,1-DCE		210	2,100
VC		38.5	385
As[2]		150	150
Fe[2]		2,000	2,000
Mn[2]		1930	1,930

[1] Source area cleanup goal was only developed for TCE
[2] Criteria for temporarily mobilized metals

Source: Panciera et al. 2012

The remedial goals for TCE were obtained by fate and transport modeling. Modeling identified the maximum level of TCE that could be left in the media and still meet both surface water criteria for offsite migration and Maximum Contaminant Levels (MCLs) at a point of compliance downgradient from the plume.

Cleanup Approach: An SVE system was employed earlier at the site with limited success. For this effort, a limited contaminated soil excavation with offsite disposal was carried out in the unsaturated portion of the source zone in the slab area to meet residential direct exposure criteria. The bulk of the contamination in the source zone was addressed by ERH using 89 electrodes installed on 20-foot centers in the

overburden and weathered bedrock. Vapor recovery wells were co-located with the electrodes and screened 3-6 feet bgs. Recovered vapors were treated by thermal oxidation with four backup 2,000-pound vapor carbon filters. Condensate/scrubber wastes were treated by three 2,000-pound liquid carbon filters. Subsurface temperatures in the heated zone achieved an average 95^{o} C; the weathered bedrock areas generally reached 80^{o} C. Groundwater sampling using a protocol designed specifically for hot water sampling was performed during and after the heat application to measure performance. Initial heating of a portion of the well field began in October-November of 2010. The remainder of the field was brought online in February 2011. Heating in both sections continued until July 2011.

Treatment of the downgradient plume was accomplished by diluting approximately 13,800 gallons of emulsified vegetable oil substrate (EVO) in 412,000 gallons of water and injecting it into over 600 wells beginning in June 2010. An additional 800 gallons of EVO was diluted in 12,000 gallons of water and injected in selected wells in June 2011. The wells were installed to form multiple biobarriers and were completed to a maximum depth of 40 feet bgs. A *Dehalococcoides* culture was also injected into 500 of these wells.

The biostimulation activities were expected to mobilize naturally occurring arsenic, manganese, and iron. Periodic injections in selected wells will be performed to ensure reducing conditions are maintained. The site also had a contingency plan to inject oxygen into the last line of wells to arrest the flow of any arsenic or manganese that may have been liberated by the reduced conditions.

As the biobarriers are decommissioned the site will transition into a monitored natural attenuation mode.

Project Results:

The ERH treatment reduced TCE concentrations in most of the monitoring wells to levels below the cleanup criteria (760 ug/L). However, in certain sections of the weathered bedrock, TCE concentrations remained above the cleanup level. Since this area is upgradient of the biotreatment area, any outlier concentrations should be dealt with there.

Concentrations of TCE and degradation products have fallen considerably following the injections of EVO. Cleanup of TCE to target levels is expected to take a number of years. Periodic monitoring is being done to determine when further injections will be required to maintain reduced conditions.

The site has also applied for a TI waiver. The terms of the waiver call for achieving the cleanup goal in the cleanup zone but do not require drinking water MCL standards to be met in the cleanup zone. The state has notified the site that it has approved the waiver, but will not issue it until cleanup levels are met.

Sources:

Panciera, Matthew A., et al. 2012. Performance of a Large-Scale Combined Bioremediation and In Situ Thermal Treatment Project to Remediate CVOCs and DNAPL. Remediation of Chlorinated and Recalcitrant Compounds—2012. Eighth International Conference on Remediation of Chlorinated and Recalcitrant Compounds (Monterey, CA; May 2012).

Personal phone contact with Morris Hamel Connecticut Department of Energy and Environmental Protection August 29, 2013. Phone 860-424-3787.

Taddeo, Art. 2012. Treatment Using Electrical Resistance Heating (ERH) of Source Area CVOCs at a Former Manufacturing Facility, Newtown, CT In-Situ Thermal Remediation Workshop, 13-14 June 2012, Westford, MA. Northeast Waste Management Officials' Association (NEWMOA), 31 slides. http://www.newmoa.org/events/docs/15_21/TaddeoAECOMJune2012.pdf