



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY  
GROUNDWATER, WATERSHED, AND ECOSYSTEM RESTORATION DIVISION  
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OFFICE OF  
RESEARCH AND DEVELOPMENT

Ms. Rodene Lamkin  
Bureau of Waste Site Cleanup  
Massachusetts Department of Environmental Protection  
205B Lowell St.  
Wilmington, MA 01887

SUBJECT: Focused Remedy Evaluation – General Chemical Corporation Site, Framingham,  
Massachusetts 18-R01-004

Dear Ms. Lamkin,

I have reviewed the Focused Remedy Evaluation (FRE) for the General Chemical Corporation (GCC) Site, located in Framingham, Massachusetts. I understand that the goal of the proposed remediation is to remove as much contamination as possible with the limited budget that is available at this time. With this in mind, my review focused on ways in which the proposed thermal remediation could be optimized to achieve the greatest mass removal. Suggestions for optimizing the remediation include limiting unnecessary sampling, exploring the possibility of reducing treatment time in order to increase the treatment area, and limiting the remedial technologies to just thermal remediation. My comments are provided in detail below.

**General Comments**

1. Source Area 2 is defined as a 2,500 square foot area with target depth from 0 to 30 feet below ground surface (bgs) in the Area Southeast of Former Production Area. The area laterally includes MW-23 (although not vertically, as this well is screened 31- 41 feet bgs), MW-114M, MW-113S, and MW-103M (again not vertically, as this well is screened from 31 to 36 feet bgs). I can see that this area was likely targeted for remediation because it has some of the highest contaminant concentrations in soil and groundwater. However, this area will become recontaminated following thermal treatment, as significant contamination exits upgradient, including at MW-110 in the Former AST Containment Area.

2. In order to optimize the remediation to remove as much contaminant mass as quickly as possible (goal stated on page 7 of the FRE), I recommend that bioaugmentation not be included as a 'polishing step', as proposed in the FRE. The main reason for this recommendation is that the groundwater data for the site clearly shows that dechlorination is occurring, as would be expected at a site where chlorinated solvents and petroleum hydrocarbons co-exist dissolved in the groundwater. Biological degradation of the petroleum hydrocarbons creates an anoxic environment that is conducive to biological dechlorination of chlorinated solvents, and the large amounts of cis-1,2-dichloroethene and smaller amounts of vinyl chloride in the groundwater demonstrate that dechlorination is occurring. However, biodegradation is a slow process. Even if bioaugmentation were to double or triple the degradation rates, the rate of contaminant mass removal would still be significantly slower than recovery via thermal remediation. Thus, I recommend that the approximately \$400,000 that is proposed for bioaugmentation instead be used to expand the thermal treatment area(s). See also comment #4.

3. Page 9 states that TerraTherm estimates that 99% of the estimated mass within each treatment area will be removed. This is a reasonable estimate for the manner in which thermal remediations are generally operated. However, in order to achieve 99% mass removal, operation of the system generally continues for 2 – 4 weeks while recovering only small amounts of mass from groundwater. Nonaqueous phase liquids (NAPLs) are relatively easily recovered, but once the NAPL is depleted by the co-boiling process, the recovery of dissolved phase contaminants (which is controlled by Henry's Law) and the slow desorption of contaminants from soil surfaces slows the overall recovery of the small amount of mass remaining. An example of a mass recovery curve from thermal remediation is attached to this letter. Because the goal of this remediation is to maximize mass removal - not achieving low soil and groundwater concentrations - I recommend that consideration be given to terminating the treatment earlier, and the money that will be saved from the shorter treatment time be used to expand the treatment area. This may allow the treatment area to be expanded to include more of the NAPL contaminated area, allowing overall more mass to be recovered.

4. If the currently proposed approach to thermal remediation can be altered to allow the treatment area(s) to be expanded while not exceeding the funding that is available, consideration should be given to expanding Source Area 2 to the northwest towards MW-22 and MW-100M, which are also highly contaminated. Another alternative that should be considered is to increase the depth of the second treatment area, as MW-103M shows that there is considerable contaminant mass below the treatment depth proposed for Source Area 2.

#### **Specific Comments**

5. Page 7 states that thermal remediation is likely to have limited effect on 1,4-dioxane. However, at the South Municipal Well Superfund Site in New Hampshire that was recently treated by thermal remediation, the data shows that low dissolved phase concentrations of 1,4-dioxane were effectively treated by thermal remediation. Many post treatment samples from the treatment area were non detect, all were below 1 microgram per liter (ug/L).



6. Discussion of In-Situ Thermal Treatment on page 8 states, "Installation of additional vapor recovery wells along the radial direction outside the treatment area and toward the school is an extra safeguard that could be implemented." Vapor recovery wells outside of the area to be treated are not recommended, as they would have the effect of pulling vapors from the heated area to cooler areas outside of the treatment zone, where the vapors could condense before they are extracted. In this sensitive area between the thermal treatment zone and the school, additional vapor monitoring points outside of the treatment zone are recommended. If routine (normally weekly) monitoring of these points were to indicate that vapors may be escaping the treatment zone, then the vacuum within the treatment area should be increased until these monitoring points demonstrate that vapors are not escaping the treatment zone. I recommend that the vapor monitoring points be co-located with temperature monitoring points around the outside of the thermal treatment zone. Significant temperature increases outside of the treatment zone would indicate that hydraulic control has been lost, and that contaminants may be escaping the treatment area along with the hot water.

7. Implementation of In-Situ Thermal Treatment on page 8 states, "Ideally, groundwater and soil concentrations should be collected from a number of locations and/or depths for baseline, intermediate (approximately 70% and 90% design energy input), at completion, and 2-3 months post completion." This amount of sampling during and after treatment is generally performed when soil and/or groundwater cleanup criteria must be met. Because the goal of this remediation is to maximize contaminant recovery, less soil and groundwater sampling is recommended in order to be able to put as much money as possible into the actual remediation. Mass recovery rates will be the most important data to collect during operations. Vapor effluent should be monitored via daily photoionization detector (PID) readings and weekly summa canister samples of the effluent vapors to determine when most of the contaminant mass has been recovered, as indicated by extraction rates falling to low levels.

8. Estimation of the Expectations of Contaminant Mass Removal Goal on page 8 states that restoration costs are not included in TerraTherm's Budgetary Proposal. However, page 22 of the Budgetary Proposal states that restoring the site to as near starting condition has been included in the cost estimate, and includes grouting up wells and removal of all equipment.

9. Estimation of the Expectations of Contaminant Mass Removal Goal on page 9 states, "Note it is unlikely that the vapor treatment (i.e., Summa canisters) and condensate sampling will confirm this mass removal. We have found in several applications that the measured physical mass removal by vapor extraction to be up to an order of magnitude less than that supported by soil and groundwater concentration changes post treatment." This statement implies that estimates of contaminant mass in the subsurface are more reliable than estimates of mass recovered during thermal remediation. Due to the heterogeneous distribution of contaminants in the subsurface, contaminant mass in the subsurface estimates are inherently uncertain, particularly prior to thermal treatment. There are also uncertainties in the mass extracted estimates, due to rapidly changing concentrations over time and relatively infrequent monitoring, the varying response of a PID to different contaminants, and our inability to analyze for and accurately quantify all of the

contaminants that are present. However, generally uncertainties in estimating the mass in the subsurface prior to treatment are likely the much greater uncertainty. In my experience, there have been both very significant over- and under-estimations of mass in the subsurface prior to remediation.

10. TerraTherm's Revision 1 Budgetary Proposal for General Chemical Corporation on page 7 states, "Values of 1,4-dioxane were reported as not detected in soil and groundwater in the two areas of concern." This statement appears to be in error. The groundwater data provided on the figures on pages 59 and 60 of the electronic file show 1,4-dioxane concentrations in the range of 0.25 to 0.77 ug/L in MW-112S (Source Area 1), and 95 ug/L to 130 ug/L in monitoring wells MW-114M and MW-113S (Source Area 2). Based on experience at other sites (see comment #5), it is reasonable to expect that the 1,4-dioxane will be recovered by thermal remediation. It is not clear that these small quantities will appreciably affect the design or operation of the vapor or liquid treatment system.

If you would like to discuss any of these comments, I would be happy to do so. I can be reached at (580) 436-8548 or [davis.eva@epa.gov](mailto:davis.eva@epa.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Eva L. Davis".

Eva L. Davis, PhD

cc: Mike Fitzpatrick (5303P)  
Bill Brandon, Region 1  
Jan Szaro, Region 1

