

SRSNE Site Group

Remedial Design Work Plan Attachment K

Vapor Intrusion Study Work Plan

Solvents Recovery Service of New England, Inc.
(SRSNE) Superfund Site
Southington, Connecticut

April 2009

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Attachment K**

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Work Plan**

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New England, Inc. (SRSNE)
Superfund Site
Southington, Connecticut

Prepared for:
SRSNE Site Group

Prepared by:
ARCADIS
160 Chapel Road
Suite 201
Manchester
Connecticut 06042-1625
Tel 860.645.1084
Fax 860.645.1090

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Executive Summary

This *Vapor Intrusion Study Work Plan* has been prepared to address Section V.C.1.k of the Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) activities at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. It describes the planned approach for conducting a vapor intrusion (VI) study as part of the remedial design activities for the Site. The primary objective of the VI study is to evaluate the potential migration of Site-related constituents from groundwater into the indoor air of buildings located within or near the zone of groundwater affected by Site-related constituents of concern (COCs). The secondary objective of the VI study is to delineate the eastern extent of the groundwater plume and the extent of the shallow groundwater exceeding proposed Connecticut Department of Environmental Protection (CTDEP) volatilization criteria.

The potential for vapor intrusion at the Site will be evaluated by (1) comparing groundwater data to United States Environmental Protection Agency (USEPA) generic groundwater target concentrations and proposed CTDEP volatilization criteria; (2) comparing groundwater data to USEPA site-specific groundwater target concentrations; and (3) conducting Johnson & Ettinger (J&E) modeling and site-specific risk assessment calculations. Should the results of the site-specific risk assessment (using the J&E model) indicate that cumulative cancer risks are potentially above USEPA's target risk range of 1×10^{-6} to 1×10^{-4} and/or non-cancer hazards are above a hazard index of 1, additional investigations will be conducted to evaluate the vapor intrusion pathway. Specifically, soil gas, sub-slab soil gas, and indoor air sampling may be conducted to further investigate specific areas.

The VI study will be performed following a comprehensive round of groundwater monitoring required by SOW Section IV.B.5.b and a limited follow-up round of sampling at selected wells to support the VI study. The follow-up round of sampling will be performed approximately six months after the initial comprehensive round. The two sampling events will provide temporal and seasonal representation of groundwater quality.

A report detailing the VI study will be provided to the USEPA within 90 days of the follow-up groundwater sampling event. The report will summarize the scope and results of the completed VI study, including delineation of the estimated extent of groundwater areas exceeding CTDEP's residential and/or commercial/industrial volatilization criteria or USEPA target concentrations. If deemed necessary, the report will also include a recommendation for the performance of contingent additional measures (i.e., soil gas, sub-slab soil gas or indoor air sampling).

1. Purpose and Scope

This document has been prepared on behalf of the SRSNE Site Group, an unincorporated association of Settling Defendants to a Consent Decree (CD) and Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut (Site). The CD was lodged on October 30, 2008 with the United States District Court for the District of Connecticut in connection with Civil Actions No. 3:08cv1509 (SRU) and No. 3:08cv1504 (WWE). The CD was entered by the Court on March 26, 2009.

This *Vapor Intrusion Study Work Plan* has been prepared to address requirements of Section V.C.1.k of the SOW. It describes the planned approach for conducting a vapor intrusion (VI) study as part of the remedial design activities for the Site. This plan is supported by the *Monitoring Well Network Evaluation and Groundwater Monitoring Program* (Attachment N to the *Remedial Design Work Plan*), which identifies proposed modifications to the monitoring well network and planned groundwater monitoring programs. Proposed well locations, analytical parameters, and sampling events proposed in the *Monitoring Well Network Evaluation and Groundwater Monitoring Program* were developed, in part, to identify and provide data needs to support the VI study.

The primary objective of the VI study is to evaluate the potential migration of Site-related constituents from groundwater into the indoor air of buildings located within or near the zone of groundwater affected by Site-related constituents of concern (COCs). To meet this objective, the groundwater data from the overburden aquifer west and east of the Quinnipiac River will be compared to United States Environmental Protection Agency (USEPA 2002) and proposed Connecticut Department of Environmental Protection (CTDEP 2003) volatilization criteria to identify VI-related COCs. Potential human health cancer risks and non-cancer hazards will be quantified for those COCs that exceed either USEPA or CTDEP screening criteria.

The secondary objective of the VI study is to delineate the eastern extent of the groundwater plume and the extent of the shallow groundwater exceeding proposed CTDEP (2003) volatilization criteria. This will be accomplished in conjunction with the *Monitoring Well Network Evaluation and Groundwater Monitoring Program*.

2. Methodology

The specific methods to be used to evaluate the potential for vapor intrusion at the Site are presented below. As described in Sections 2.1 and 2.2, the vapor intrusion evaluation consists of three main steps: (1) compare groundwater data to USEPA generic groundwater target concentrations and proposed CTDEP volatilization criteria; (2) compare groundwater data to USEPA site-specific groundwater target concentrations; and (3) conduct Johnson & Ettinger (J&E) modeling and site-specific risk assessment calculations. Section 3 identifies contingent additional measures that may be employed to further assess the potential for VI in the event the proposed initial three-step process does not rule out the potential for VI-related risks above USEPA's target risk range (1×10^{-6} to 1×10^{-4} excess cancer risk or hazard index of 1).

2.1 Data Evaluation

The data evaluation will consist of comparing shallow overburden groundwater data to the groundwater target concentrations from USEPA (2002) *Office of Solid Waste and Emergency Response (OSWER) Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* and proposed CTDEP (2003) groundwater volatilization criteria presented in *Connecticut's Remediation Standard Regulations*.

The USEPA (2002) target concentrations are "generic" media-specific groundwater concentrations that correspond to target indoor air concentrations where the attenuation factor (i.e., the ratio between indoor air and groundwater concentrations) is equal to 0.001. The USEPA target concentrations reflect worst-case residential conditions for various cancer risk levels (i.e., 1×10^{-6} , 1×10^{-5} , and 1×10^{-4}) or a hazard quotient of 1 for non-cancer hazards. USEPA (2002) also provides target groundwater concentrations for scenario-specific vapor attenuation factors based on the soil type and depth to the water table. The CTDEP (2003) groundwater volatilization criteria represent risk-based numerical criteria developed using the J&E model based on the assumption that diffusion and advection are mechanisms of transport from subsurface environment into the indoor air environment. CTDEP (2003) groundwater volatilization criteria have been developed for both residential and industrial exposure scenarios.

The data evaluation will focus on groundwater data collected within 100 feet (laterally or vertically) of existing buildings. This is consistent with USEPA (2002) guidance that indicates the vapor intrusion pathway should be considered if volatile organic compounds (VOCs) are present in soil and/or groundwater above screening criteria within 100 feet of the ground surface and within 100 feet (laterally or vertically) of existing or future buildings. Use of this approach is conservative because CTDEP (2003) guidance only considers depths up to 30 feet for the VI pathway.

The data evaluation will consist of two steps:

- Step 1 – Compare maximum and average constituent concentrations within 100 feet of buildings to USEPA (2002) generic screening levels for target groundwater concentrations at a risk level of 1×10^{-6} and CTDEP (2003) residential groundwater volatilization criteria. If the maximum concentration is below both USEPA (2002) and proposed CTDEP (2003) criteria, no further evaluation of that constituent is necessary.
- Step 2 – For those constituents with maximum concentrations that exceed the USEPA (2002) and/or the CTDEP (2003) volatilization criteria, constituents (maximum and average concentrations) will be compared to USEPA (2002) target groundwater concentrations using site-specific attenuation factors. Site-specific attenuation factors will be identified from USEPA (2002) guidance based on soil type and the depth the groundwater. If the maximum concentration exceeds the USEPA (2002) screening levels using site-specific attenuation factors, the constituent will be retained as a VI-related COC.

As described below, a site-specific risk assessment will be conducted for COCs in groundwater within 100 feet (laterally or vertically) of an existing building.

2.2 Site-Specific Risk Assessment

The site-specific risk assessment will consist of quantifying potential human health cancer risks and non-cancer hazards for potential receptors exposed to COCs in groundwater by estimating indoor air concentrations using the J&E model (J&E 1991). Receptors may include residents and/or industrial/commercial workers (i.e., indoor workers). Specifically, groundwater data will be used in the advanced groundwater model (GW-ADV-Feb04) to estimate

indoor air concentrations and quantify potential cancer risks and non-cancer hazards. Consistent with USEPA (2004) guidance, the average groundwater concentration for wells within 100 feet of each building or residential area will be used in the J&E model as the initial input into the model. When available, site-specific parameters (e.g., soil types, building specifications) will also be used in the J&E model to calculate the attenuation factor and estimated indoor air concentrations. Toxicity values will also be updated with currently available data from the Integrated Risk Information System (IRIS) or other applicable USEPA sources. For example, consistent with USEPA (2009) recent guidance on trichloroethylene (TCE), the unit risk estimate and reference concentration for TCE will be updated in the J&E model. Default values will be used in the model for those parameters lacking site-specific information.

The estimated indoor air concentrations will be used in the J&E model to predict potential cancer risks and non-cancer hazards for each COC. The quantitative estimates for cancer risk will be summed for all COCs carried through the risk assessment process. Likewise, non-cancer hazards for constituents with similar target organs will be summed to produce a hazard index. These cancer risks and non-cancer hazards will then be compared to USEPA's target risk range (1×10^{-4} to 1×10^{-6} for excess cancer risk and hazard index of 1) to determine if additional studies are warranted. Additional studies are discussed in the following section.

3. Additional Studies

Should the results of the site-specific risk assessment (i.e., application of the J&E model) indicate that cumulative cancer risks are potentially above USEPA's target risk range of 1×10^{-6} to 1×10^{-4} and/or non-cancer hazards are above a hazard index of 1, additional investigations will be conducted to evaluate the vapor intrusion pathway. Specifically, soil gas, sub-slab soil gas, and indoor air sampling may be conducted to further investigate specific areas. These investigations are described separately below, and would be performed in an iterative process until the potential for Site-related risks above USEPA levels can be ruled out, or a determination is made that mitigation and/or institutional control measures are necessary.

3.1 Soil Gas Sampling Outside Buildings

If determined necessary, soil gas samples will be collected outside existing buildings where shallow overburden groundwater VOC concentrations result in excess cancer risks and/or non-cancer hazards above USEPA's target risk range. Soil gas samples will be collected in either 1-liter or 6-liter SUMMA[®] canisters for the analysis of site-specific VOCs using USEPA Method TO-15. The list of site-specific VOCs will be identified based on the constituents previously detected in groundwater in or near the specific investigation area. Soil vapor samples will be installed as temporary points using the methodology described in the standard operating procedure (SOP) provided in the *Field Sampling Plan* (FSP), which is provided as Attachment B to the *Remedial Design Project Operations Plan*. Prior to collecting any samples, a helium test will be conducted to ensure the integrity of the seal around the probe point. The helium SOP is also provided in the FSP.

The location and number of soil gas samples will be determined based on the delineation of COCs within the shallow overburden groundwater plume, accessibility, and the proximity of occupied structures.

3.2 Sub-Slab Soil Gas Sampling

Sub-slab soil gas samples may be collected from buildings, if determined necessary based on soil gas results. In preparation for sub-slab soil gas sampling, a reconnaissance will be conducted to evaluate the condition of the building slab and identify subsurface utilities, basements, and other structures that may act as preferential vapor migration pathways within the building(s)

subject to investigation. The building reconnaissance will include the following tasks:

- Completion of a building survey that identifies building construction and uses.
- Creation of a photograph library that documents current building conditions and potential chemical background sources.
- Identification of potential background chemical sources (i.e., VOCs). A hand-held photoionization detector (PID) may be used to characterize overall VOC concentrations.
- Identification of the heating, ventilation, and cooling system(s) and their operating parameters including the number of units, percent fresh air intake, and flow rates.
- A qualitative assessment of ambient air flows between various areas of the building.

Sub-slab soil gas samples will be collected in either 1-liter or 6-liter SUMMA[®] canisters for the analysis of site-specific VOCs using USEPA Method TO-15. The list of site-specific VOCs will be identified based on the constituents previously detected in groundwater or soil gas in the vicinity of the structure(s) being investigated. All sub-slab soil gas samples will be collected as temporary points unless soil gas data indicate that more than one round of sampling may be necessary (e.g., soil gas concentrations are higher than screening benchmarks). Under these conditions permanent sampling points may be established to allow for additional sub-slab samples to be collected. Sub-slab soil gas samples will be collected using the SOP for temporary sub-slab sampling points. If sub-slab soil gas samples are collected from permanent sampling points, the SOP for permanent sub-slab sampling points will be followed instead. Prior to collecting any samples, a helium test will be conducted to ensure the integrity of the seal around the probe point. All SOPs are included in the FSP.

The location and number of sub-slab soil gas samples will be determined based on the delineation of COCs within the shallow overburden groundwater plume and the results of soil gas sampling. Once sampling is completed and prior to closing any temporary sample ports, a pressure differential reading will be collected at each sample location using a micro-manometer. All measurements will be collected consistent with the manufacturer's instructions.

3.3 Indoor Air Sampling

Based on the results of sub-slab soil gas sampling, indoor air samples may be collected within target buildings. Indoor air samples will be collected in 6-liter SUMMA[®] canisters and analyzed for site-specific VOCs using USEPA Method TO-15. The list of site-specific VOCs will be identified based on the constituents previously detected in either groundwater or soil gas in the vicinity of the structure(s) being investigated. Prior to the collection of indoor air samples, a building inventory will be conducted to identify the presence of items or materials that may produce or emit constituents of concern (i.e., background sources) and therefore contribute to indoor air concentrations. Indoor air samples will be collected from the breathing zone (i.e., 3 to 5 feet above ground surface) from the lowest level of the building (i.e., basement or first floor for slab-on-grade buildings). Samples will be collected for a duration of 24 hours for residential buildings and 8 hours for commercial/industrial buildings. Attempts will be made to collect indoor air samples during the heating season (i.e., November 15 to March 31) because this represents the period of greatest VI potential. Indoor air samples may be collected coincident with sub-slab soil gas samples and multiple sampling events may be employed if indoor air concentrations are above screening benchmarks. The SOP for indoor air sampling is presented in the FSP.

The location and number of indoor air samples will be determined based on the delineation of COCs within the shallow overburden groundwater plume.

3.4 Mitigation

If the site-specific risk assessment and subsequent investigations (i.e., soil gas, sub-slab soil gas, and indoor air) indicate there is potential for human health risks via the vapor intrusion exposure pathway, the SRSNE Site Group will propose, for review and approval by the USEPA and CTDEP, mitigation measures for affected buildings. Mitigation may include installation of vapor barriers or passive or active sub-slab depressurization systems.

4. Reporting and Schedule

The VI study will be performed following a comprehensive round of groundwater monitoring required by SOW Section IV.B.5.b and a limited follow-up round of sampling at selected wells to support the VI study. The follow-up round of sampling will be performed approximately six months after the initial comprehensive round. The two sampling events will provide temporal and seasonal representation of groundwater quality.

A report detailing the VI study will be provided to the USEPA within 90 days of the follow-up groundwater sampling event. The report will summarize the scope and results of the completed VI study, including delineation of the estimated extent of groundwater areas exceeding CTDEP's residential and/or commercial/industrial volatilization criteria or USEPA target concentrations. If deemed necessary, this report will include a recommendation for the performance of contingent additional measures as described in Section 3, including a work plan indicating the proposed nature, location(s), schedule, and reporting approach for additional investigations.

Completion of the VI study activities, including any contingent additional measures that may be necessary, triggers submittal of the *Institutional Control Plan* required by SOW Section V.B.7. If the results of the VI study indicate the potential for human health risks via the vapor intrusion exposure pathway, the *Institutional Control Plan* will address the types of measures to be implemented to address the potential risks, and the areas within which those measures will be employed.

5. References

CTDEP. 2003. Proposed Revisions, Connecticut's Remediation Standard Regulations, and Volatilization Criteria. March 2003.

Johnson, P.C. and R.A. Ettinger. 1991. Heuristic model for predicting the intrusion rate of contaminant vapors in buildings. *Environ. Sci. Technol.* 25:1445-1452.

USEPA. 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). EPA530-D-02-004. November 2002.

USEPA. 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February 22, 2004.

USEPA, 2009. Interim Recommended Trichloroethylene (TCE) Toxicity Values to Assess Human Health Risk and Recommendations for Vapor Intrusion Pathway Analysis. OSWER Memorandum, January 15, 2009.