APPENDIX III

RESPONSES TO U.S. EPA'S DRAFT COMMENTS TO PHASE II RFI REPORT

David C. Contant

From: Fisher Doug [DougFisher@vernay.com]
Sent: Friday, July 29, 2005 10:04 AM
To: David C. Contant; Kevin D. Kallini
Subject: FW: risk assessment issue

As we discussed.

-----Original Message-----
From: Polston.Patricia@epamail.epa.gov
[mailto:Polston.Patricia@epamail.epa.gov]
Sent: Friday, July 29, 2005 9:45 AM
To: Fisher Doug
Cc: Olsberg.Colleen@epamail.epa.gov
Subject: risk assessment issue

Greeting Doug, As I mentioned in the phone message I left you, here is the comment from Colleen regarding the response dated 6/7/05 to our 3/24/05 comments:

As per our recent phone call with Vernay, the response states that the facility will "delete references to occupational criteria for assessing current conditions." They do indeed delete these references from the text in Section 5.5.2.1. They don't delete these references from Appendix VI, which is where the risk calculations for vapor intrusion are located. The revised text in Section 5.5.2.1 refers to this nonrevised Appendix VI, which includes the OSHA-PELs. Basically what this means is that while the text has been revised, the risk calculations have not.

Further, I would like more information on their new screening levels, how their detection limits match up with the new screening levels, and whether there are any volatiles included in these risk calculations that don't have URF or RfC values.

If possible maybe we can discuss this either before or after the groundwater conference call that's set up for Monday 8/1/05. If that's not possible, let's talk about another time or day. Thanks Trish

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August 30, 2005

Response to U.S. EPA's July 29, 2005 Draft Comments

"U.S. EPA RCRA Corrective Action Facility Investigation, Phase II Report"
Vernay Laboratories, Inc.
Yellow Springs, Ohio

EPA ID: OHD 004 243 002

U.S. EPA comment:

As per our recent phone call with Vernay, the response states that the facility will "delete references to occupational criteria for assessing current conditions." They do indeed delete these references from the text in Section 5.5.2.1. They don't delete these references from Appendix VI, which is where the risk calculations for vapor intrusion are located. The revised text in Section 5.5.2.1 refers to this nonrevised Appendix VI, which includes the OSHA-PELs. Basically what this means is that while the text has been revised, the risk calculations have not.

Further, I would like more information on their new screening levels, how their detection limits match up with the new screening levels, and whether there are any volatiles included in these risk calculations that don't have URF or RfC values.

Vernay Response:

Revision to Appendix VI
As discussed in Vernay's June 7, 2005 Response to U.S. EPA's March 24, 2005 Draft Comments on Vernay's Phase II RFI Report, the risk assessment presented in Section 5 of the Phase II RFI Report was revised to remove references to occupational criteria for assessing current conditions. As noted in Section 5, supporting risk calculations are presented in Appendix VI of the Phase II RFI Report. Additionally, Appendix VI provides supporting documentation for the final data screening documented in Section 3 of the Report. As described in Section 3, one of the screening criteria utilized by Vernay during the RFI to assess the adequacy of sampling data (and in support of the approved RCRA CA725 Environmental Indicators Report) was a set of vapor intrusion to indoor air values calculated based on occupational criteria for acceptable air concentrations in the workplace (e.g., OSHA PELs). As indicted in Chapter 3, the derivation of these screening criteria is provided in Appendix VI. Because Section 3 of the Phase II RFI Report provides documentation of the RFI screening evaluation, including comparisons with the occupational-based criteria to assess the adequacy of the RFI sampling, those portions of Appendix VI that reference the occupational criteria are necessary to support the screening evaluation provided in Chapter 3.

Vernay recognizes that the introduction to Appendix VI as currently presented in the Phase II RFI Report indicates that Appendix VI serves only to provide information and calculations that support the discussion of the human health risk assessment in Section 5 of the Phase II RFI Report; however, it should also indicate that this appendix provides information pertinent to

Chapter 3. Therefore, Vernay revised Appendix VI to: 1) indicate in the introduction that the information presented in this appendix supports the data evaluation presented in Chapter 3 and the risk assessment presented in Chapter 5; and, 2) clarify the sections of the appendix that discuss the occupational criteria to indicate that these values are being presented to support the screening evaluations in Chapter 3. The revised text for Appendix VI is provided herein as Attachment A.

Notwithstanding this clarification of the purpose of Appendix VI, the revisions to the risk assessment presented in Section 5 of the Phase II RFI Report provided in Vernay's June 7, 2005 Response to U.S. EPA's March 24, 2005 Draft Comments had removed all references to the use of occupational criteria. Changes to Appendix VI were determined to be unnecessary because it already presented the necessary supporting risk calculations based on EPA health-based values, as referenced in the original and revised versions of Section 5. Therefore, it should be clear in the revised Phase II RFI Report that Vernay is making corrective action decisions based on the EPA health-based criteria and not occupational criteria, which is consistent with the Region 5 RCRA program policy as it was described to Vernay. Vernay has always maintained that it would make final corrective action decisions, in part, based on the results of the vapor intrusion pathway conducted using the EPA health-based values.

Screening Levels

In this comment U.S. EPA has requested information on Vernay's "new" screening levels. However, no new screening levels were generated for the revised RFI Report (as indicated above, the original Phase II RFI Report contained screening values developed based on both occupational criteria and EPA health-based criteria).

Review of Detection Limits

In response to U.S. EPA's request regarding a review of detection limits, the method detection limits (MDLs) provided in Vernay's February 2003 Quality Assurance Project Plan (QAPP) were compared to the EPA health-based screening levels used in the risk assessment. As shown on Table 1, the screening levels for two constituents, acrolein and 1,2-dibromoethane are lower than the MDLs provided in the QAPP. However, as discussed in the RFI Report, although acrolein was detected in indoor air, this constituent was not known to be used at the Facility and, therefore, was not analyzed for in soil or ground water (see Vernay's June 2003 Technical Memorandum No. 1 Facility Investigation Sampling List). As past site activities did not include the use of acrolein, this constituent is not reasonably expected to be related to environmental contamination observed at the Facility. In contrast, 1,2-dibromoethane was analyzed for as part of the RFI analyte list, but it was not detected in any media (soil, subsurface water, ground water, surface water, sediment and air) at the Facility. Therefore, 1,2-dibromoethane is not an environmental contaminant at the Facility, and therefore, the MDL value relative to the screening level should not impact the results of the risk evaluation.

Review of Toxicity Factors

In response to U.S. EPA's request for information regarding VOCs that do not have toxicity values, as presented on Table 2, screening levels could not be calculated for a total of nine VOCs because there are no available URF or RFC values for those constituents. Of these nine constituents, only two, chlorodifluoromethane and n-heptane were detected in indoor air at the

Facility. Neither of these constituents, however, were known to be used at the Facility and, in accordance with Vernay's June 2003 Technical Memorandum No. 1 Facility Investigation Sampling List, were not analyzed for in soil or ground water. As past site activities did not include the use of chlorodifluoromethane and n-heptane, these constituents are not reasonably expected to be related to environmental contamination observed at the Facility. Therefore, the lack of toxicity data for these constituents is not expected to have an impact on the results of the risk evaluation conducted to assess the need for corrective measures.

ATTACHMENT A

APPENDIX VI

RFI ~~RESULTS AND EVALUATION~~SCREENING CRITERIA DEVELOPMENT
AND
HUMAN HEALTH RISK ASSESSMENT
SUPPORTING INFORMATION AND CALCULATIONS

CONTENTS

TABLES

ATTACHMENTS

VI-1 INTRODUCTION

This appendix to the RFI Phase II Report (RFI Report) for Vernay Laboratories, Inc., in Yellow Springs, Ohio provides information and calculations that support the discussion of the data results and evaluation provided in Chapter 3 and the human health risk assessment in Section 5 of the RFI Report. The information in this appendix is organized in sections that correspond to the potentially exposed populations, ~~and~~ exposure pathways and scenarios defined in the Conceptual Site Model provided in Table 29 of the ~~for the following potentially exposed populations discussed in Section 5 of the~~ RFI Report~~:~~.

- ~~Routine Workers~~
- ~~Construction Workers~~
- ~~Trespassers~~
- ~~Residents~~
- ~~Recreational Waders~~

The references cited in this appendix are included in Section 8 of the RFI Report. Detailed calculation sheets, toxicity values, physical chemical data, and various model input parameters are provided in attachments to this appendix. A summary of the toxicity data, and physical and chemical properties used in the human health risk assessment calculations are provided on Tables VI-1 and VI-2.

As noted on the tables in Appendix VI, where appropriate, the estimates of cancer risk and noncancer HQ for trichloroethene (TCE) are calculated using the USEPA Region 9 cancer and noncancer PRGs for TCE from November 2000 instead of those from October 2002. The November 2000 PRGs for TCE are used because the 2002 PRGs for TCE are based on draft toxicity values that are currently under USEPA review and subject to significant ongoing scientific and regulatory debate regarding their appropriateness. As such, the PRGs based on these draft toxicity values are not appropriate for use in risk assessments to support RCRA corrective action decisions.

VI-2 BACKGROUND SOIL CONCENTRATIONS

Background soil samples were collected during the Phase I RFI to characterize naturally occurring levels of inorganics in soil at the Facility. Background soil samples were collected from 9 locations from an area approximately 200 feet east of the Facility. The background sampling locations were selected based on proximity and historical site use (vegetable farming) that was similar to the Facility. The background soil sampling locations are listed in Attachment VI-1-1. At each location, one sample was collected from 0 to 2 feet bgs. Deeper samples, from 6-8 feet bgs, were collected at these locations but are not included in the calculations because they represent soil that would be rarely, if ever, encountered as part of background exposures to metals in soil. The boring logs for these locations and the analytical data for these samples were provided in the Phase I Facility Investigation Report (Payne, 2004).

The concentrations of inorganics in the samples from the 0 to 2 ft bgs interval are the most representative of background exposures to inorganics in soil because the general population encounters soil from this interval more often than deeper soil. The inorganic concentrations in background soil from this interval are summarized in Attachment VI-1-1, which also includes summary statistics describing the concentration distributions and the 95% upper confidence limits (UCLs) on the means for Facility-specific background inorganics.

Attachment VI-1-2 summarizes the UCLs on the mean background levels of inorganics in the off-Facility area. Concentrations of inorganics in soil at an AOI that are below these levels are considered to be within background and not Facility-related; concentrations higher than these levels are considered Facility-related. The cumulative cancer risks and hazard quotients that are associated with the naturally-occurring background levels, based on the exposure and toxicity assumptions that USEPA Region 9 (2002) used in deriving its Preliminary Remediation Goals (PRGs) for industrial soils are also presented in Attachment VI-1-2. These background levels of risks are not included in estimates of Facility-related risks.

VI-3 ROUTINE WORKERS

As discussed in Section 5.3 of the RFI Report, the risk assessment evaluates potential exposure of on-Facility routine workers via contact with outdoor soil and via vapor intrusion from soil and ground water. Potential exposures of on- and off-Facility construction workers and on-Facility trespassers via contact with outdoor soil are also evaluated using routine workers as a surrogate. The computation of risk estimates associated with exposure via contact with outdoor soil is discussed in Section VI-3.1, and the computation of risk estimates associated with exposure via vapor intrusion is discussed in Section VI-3.2. These risk estimates include only Facility related contributions of constituents and do not consider naturally occurring levels of inorganics. The evaluation to characterize naturally occurring levels of inorganics in soil on the Facility is discussed in Section VI-2.

VI-3.1 Contact with Outdoor Soil

As noted in Section 5.5 of the RFI Report, upper bound estimates of cumulative cancer risk and hazard index (HI) associated with potential exposure of routine workers to outdoor soil at the Facility are derived based on the risk-based USEPA Region 9 Preliminary Remediation Goals (PRGs) (2002) for soil at commercial/industrial sites and the highest detected constituent concentrations. For those AOIs where the upper bound risk estimates exceed USEPA's acceptable risk thresholds for corrective action (USEPA, 1991b), then high end risk estimates are calculated by substituting the 95% upper confidence limits (UCLs) on the mean as the exposure concentration for those constituents that contribute most significantly to the risk estimates. In this risk assessment, the UCLs presented are nonparametric bootstrap confidence limits on the mean (Efron and Tibshirani 1998) calculated from 4,000 bootstrap replications and at a 0.05 level of significance as discussed in Section 5.3.4 of the RFI Report. Nonparametric bootstrap statistical limits are more reliable than parametric statistical limits because, unlike parametric limits, they do not rely on assumptions about distribution shapes that are often difficult to justify. As discussed in Section 5.5.2.1 of the RFI Report, for such AOIs, UCLs on the mean are calculated using data from surface soil (0 to 2 feet bgs; the depth interval that routine workers are expected to encounter in unpaved areas), and soil data from sampling depths down to 15 feet (to allow for assessment of the excavation worker exposures). The UCL used to further evaluate the significance of potential exposure in these AOIs was the higher of these two values. Computation of risk estimates for this exposure scenario is discussed below.

Estimates of cancer risk and noncancer hazard quotients (HQ) are typically calculated as discussed in Section 5.5.1 of the RFI Report:

$$\text{Risk} = \text{LADD} \cdot \text{SF}$$

$$\text{HQ} = \frac{\text{ADD}}{\text{RfD}}$$

where *LADD* is the lifetime average daily dose, *SF* is the cancer slope factor, *ADD* is the average daily dose, and *RfD* is the reference dose.

In this risk assessment, the estimates of cancer risk and HQ are calculated using the following equivalent forms of these equations, which take advantage of the availability of existing PRGs for this scenario:

$$\text{Risk} = \frac{\text{C} \cdot \text{LADD}^* \cdot \text{SF}}{\text{TR}} \cdot \text{TR} = \frac{\text{C}}{\text{PRG}} \cdot \text{TR}$$

$$\text{HQ} = \frac{\text{C} \cdot \text{ADD}^*}{\text{RfD} \cdot \text{THQ}} \text{THQ} = \frac{\text{C}}{\text{PRG}} \cdot \text{THQ}$$

where *C* is the exposure concentration, *LADD** and *ADD** are doses that are normalized to a unit concentration, and *TR* and *THQ* are the target cancer risk and target hazard quotient used in calculating the PRGs.

The computation of upper bound risk estimates using the above equations for each area investigated during the RFI are shown in Attachment VI-2-1. For AOIs 1 and 2S, the upper bound risk estimate exceeded USEPA's acceptable risk threshold, therefore, high end risk estimates were calculated using 95% UCLs for certain constituents. The 95% UCLs are calculated as described in Section 5.3.4 of the RFI Report, and are highlighted with shading on the tables in Attachment VI-2-2.

VI-3.2 Vapor Intrusion

~~As noted in Section 35.5 of the RFI Report, t~~The significance of potential exposure of routine workers to constituents in soil and ground water via assumed vapor intrusion is evaluated by dividing the highest concentrations of constituents in soil and groundwater by their corresponding vapor intrusion criteria, and then summing the resulting ratios.

Occupational Criteria

The~~is~~ approach to developing and applying occupational-based criteria is equivalent to the approach described in Occupational Safety and Health Administration (OSHA) regulations at 29 CFR 1910.1000(d)(2)(i) for assessing compliance with inhalation exposure limits for a mixture of air contaminants, which uses an equivalent exposure for the mixture (E_m) given by the following:

$$E_m = \sum_i \frac{C_{air,i}}{L_i}$$

where $C_{air,\,i}$ and L_i are the indoor air concentration and exposure limit for chemical i, respectively. Exposure is within acceptable limits when E_m does not exceed 1. In applying this approach to assess the significance of contributions from vapor intrusion to indoor air exposures, the contribution to E_m due to vapor intrusion should be much less than 1 (e.g., less than 0.01).

~~In this risk assessment, t~~The contribution to E_m from vapor intrusion for constituents in soil are calculated as follows:

$$E_m = \sum_i \frac{C_{air,i}}{L_i} = \sum_i \frac{C_{soil,i}}{OBC_i}$$

where $C_{soil,\,i}$ is the concentration of constituent i in soil and OBC is the occupational-based criterion for constituent i. The equation for calculating the contribution to E_m from vapor intrusion for constituents in groundwater is the same except $C_{soil,\,i}$ is replaced with $C_{gw,\,i}$ and OBC (occupational based criteria) becomes the ground water vapor intrusion criterion. The exposure limits L_i in the above equation are the permissible exposure limits (PELs) established by OSHA (DHHS 1997), or threshold limit values (TLVs) recommended by the American Conference of Government Industrial Hygienists (ACGIH 2003) for chemicals without PELs.

The soil and ground water vapor intrusion OBCs used in the above calculations are derived using a vapor intrusion modeling approach recommended by USEPA (2003) for screening-level analysis. The model parameters related to soil properties are based on Facility-specific soil properties reported from the RFI sampling. Model parameters related to building characteristics are based on conservative regulatory default assumptions for a hypothetical commercial/industrial building (discussed below). ~~Derivation of these OBCs is discussed below.~~Computations of the OBC are presented in Attachment VI-3-3.

In addition, as discussed in Section 3.6 of the RFI Report, direct measurement of indoor air concentrations were performed at the Facility. Similar to the evaluation of indoor air concentrations estimated from soil and ground water sampling as discussed above, the indoor air sampling results were compared with the occupational criteria to calculate a ratio sum to assess potential concerns under current conditions. The occupational criteria and the ratio sums are shown in Attachment VI-3-5.

Health-Based Criteria

To assess the future scenario in which Vernay no longer operates the Facility~~and for corrective action decision making~~, estimates of cumulative cancer risk and HI associated with potential exposure of on-Facility routine workers via vapor intrusion from ground water are calculated using Facility-specific vapor intrusion criteria. ~~In this case, r~~Risk-based criteria (RBCs) are calculated using unit risk factors (URFs) and reference concentrations (RfCs)~~, rather than occupational exposure limits,~~ and the cancer risk and HQ estimates are calculated using equivalent forms of the inhalation risk equations that make use of Facility-specific vapor intrusion RBCs for soil as follows:

$$Risk = C_{building} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT \cdot TR} \cdot TR = \frac{C_{soil}}{RBC} \cdot TR$$

$$HQ = \frac{C_{building}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT \cdot THQ} \cdot THQ = \frac{C_{soil}}{RBC} \cdot THQ$$

where $C_{building}$ is concentration in indoor air, C_{soil} is concentration in soil, ET is a normalized exposure time, EF is exposure frequency, and ED is exposure duration (see Attachment VI-3-1 for exposure factors). The equation for calculating the contribution to risk and HQ from vapor intrusion for constituents in ground water is the same except C_{soil} is replaced with C_{gw} and RBC becomes the ground water vapor intrusion criterion.

The indoor air concentrations in the above equations are estimated using the following relationships described by Johnson and Ettinger (1991):

$$C_{building} = \alpha \, C_{source}$$

where $C_{building}$ is the indoor air concentration, C_{source} is the source vapor concentrations, and α is an attenuation coefficient that is given by the following equation:

$$\alpha = \frac{\left[\frac{D_T^{eff} A_B}{Q_{building} L_T}\right] \exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right)}{\exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right) + \left[\frac{D_T^{eff} A_B}{Q_{building} L_T}\right] + \left[\frac{D_T^{eff} A_B}{Q_{soil} L_T}\right]\left[\exp\left(\frac{Q_{soil} L_{crack}}{D^{crack} A_{crack}}\right) - 1\right]}$$

Derivation of this equation and definition of the equation parameters can be found in Johnson and Ettinger's 1991 journal article, and therefore, is not repeated here.

The source vapor concentration C_{source} for a constituent in soil is calculated from the constituent's concentration in soil C_{soil} based on three-phase equilibrium, as follows:

$$C_{source} = C_{soil}\left(\frac{K_d}{H} + \frac{\theta_w}{\rho_b H} + \frac{\theta_a}{\rho_b}\right)^{-1}$$

where K_d is the equilibrium-partition coefficient (estimated as the product of the organic carbon partition coefficient K_{oc} and the soil organic carbon fraction f_{oc}), H is the Henry's law constant, θ_w is the water-filled soil porosity, ρ_b is the soil bulk density, and θ_a is the air-filled soil porosity.

The source vapor concentration for a constituent in ground water is calculated from the constituent's concentration in ground water C_{gw} using Henry's law, as follows:

$$C_{source} = H \cdot C_{gw}$$

In ~~this~~ the risk assessment, the soil and ground water concentrations used for the C_{soil} and C_{gw} terms in the above equations are the highest detected concentrations of each constituent in soil and subsurface water or sewer backfill water at each area.

The effective diffusion coefficient term D_T^{eff} in the equation for the attenuation coefficient α is calculated based on a "sand" soil type. Based on the soil boring logs and the geologic cross sections for on-Facility and off-Facility, the unconsolidated unit generally consists of silt and clay material with sporadic, discontinuous sand seams. Although limited in extent and generally intermixed with silt and clay soil horizons, in some on-Facility soil boring locations, sandy materials represent the majority of the soil profile. Therefore, as a conservative assumption, a continuous sand profile is used to represent soil in the vadose zone soils. The soil-water profile in the vadose zone is estimated using the van Genuchten soil-water retention curve, and water retention parameters appropriate for sand. These parameters and the resulting soil-water profile in the vadose zone are shown in Attachment VI-3-2.

The distance between ground water and a building foundation L_T is estimated to be approximately 3.5 m, which is conservatively based on the soil boring location with the shallowest depth to the top of the Cedarville Aquifer at the Facility. The remaining parameters in the equation for α, which relate to the characteristics of a hypothetical commercial/industrial building and the distance between contaminated soil and the building foundation L_T, are based on conservative default values that the Michigan Department of Environmental Quality (2002) used in deriving the Michigan Part 201 generic vapor intrusion criteria for commercial/industrial sites. The MDEQ default values for these parameters are used because USEPA guidance does not provide default values for these parameters for commercial/industrial buildings. These values are shown in Attachment VI-3-2; their bases are discussed in MDEQ guidance (1998). Computations of the RBC and the related incremental cancer risk and HI estimates are presented in Attachment VI-3-4.

~~Computations of the OBC are presented in Attachment VI-3-3. Computations of the RBC and the related incremental cancer risk and HI estimates are presented in Attachment VI-3-4.~~

In addition, as discussed in Section ~~5.5.2.1~~3.6 of the RFI Report, direct measurement of indoor air concentrations were performed at the Facility. Similar to the evaluation of indoor air concentrations estimated from soil and ground water sampling as discussed above, the indoor air sampling results were compared with the ~~occupational criteria~~RBCs ~~to calculate a ratio sum~~

to assess potential concerns under current conditions. The occupational criteria and the ratio sums are shown in Attachment VI-3-5.

As discussed in Section 5.5.2.1 of the RFI Report, to assess potential future risks for the scenario in which Vernay no longer operates the Facility, direct measurement indoor air criteria were computed based on URFs and RfCs(see Section 5.5.2.1 of the RFI Report).

The risk-based criteria for direct measurements of indoor air concentrations are calculated as follows:

$$RBC_{indoor\ air\,(cancer)} = \frac{TR \cdot AT}{URF \cdot ET \cdot EF \cdot ED}$$

$$RBC_{indoor\ air\,(non-cancer)} = \frac{THQ \cdot RfC \cdot AT}{ET \cdot EF \cdot ED}$$

These criteria are shown in Attachment VI-3-6. The incremental risk estimates based on the measured indoor air concentrations are also presented in Attachment VI-3-6.

VI-4 CONSTRUCTION WORKERS

As discussed in Section 5.3 of the RFI Report, potential exposures of on-Facility and off-Facility construction workers to soil during excavations are evaluated indirectly in the risk assessment by using estimates of cumulative cancer risk and HI for routine workers. For on-Facility construction workers, bounding estimates of cumulative cancer risk HI are used at AOI 2N, but at AOIs 1 and 2S these estimates are higher than USEPA's acceptable risk threshold (USEPA 1991b). As discussed in Section 5.5.2.1 of the RFI Report, for such AOIs, UCLs on the mean were calculated using data from surface soil (0 to 2 feet bgs; the depth interval that routine workers are expected to encounter in unpaved areas), and soil data from sampling depths down to 15 feet (to allow for assessment of the excavation worker exposures). The UCL used to further evaluate the significance of potential exposure in these AOIs was the higher of these two values; in this case, the UCL for data collected from surface and subsurface samples was higher than the UCL based on surface soil data only.

For off-Facility construction workers, bounding estimates for soil at AOI 3 and AOI 3A and sediment at AOI 4 are also evaluated based on routine worker exposures to soil as a surrogate as discussed in Section VI-3.1. The cumulative risk estimates based on the screening criteria for routine workers conservatively estimate potential risks to construction workers as discussed in Section VI-4.1.

Risk estimates for on-Facility and off-Facility construction worker exposures to subsurface water and surface water are also directly calculated using exposure assumptions specific to construction workers. For on-Facility construction workers, risk estimates are directly calculated for potential exposures to subsurface water, and storm water and for off-Facility construction workers for potential exposures to subsurface water, storm water and surface water in the Unnamed Creek. Computation of these risk estimates is discussed in Section VI-4.2.

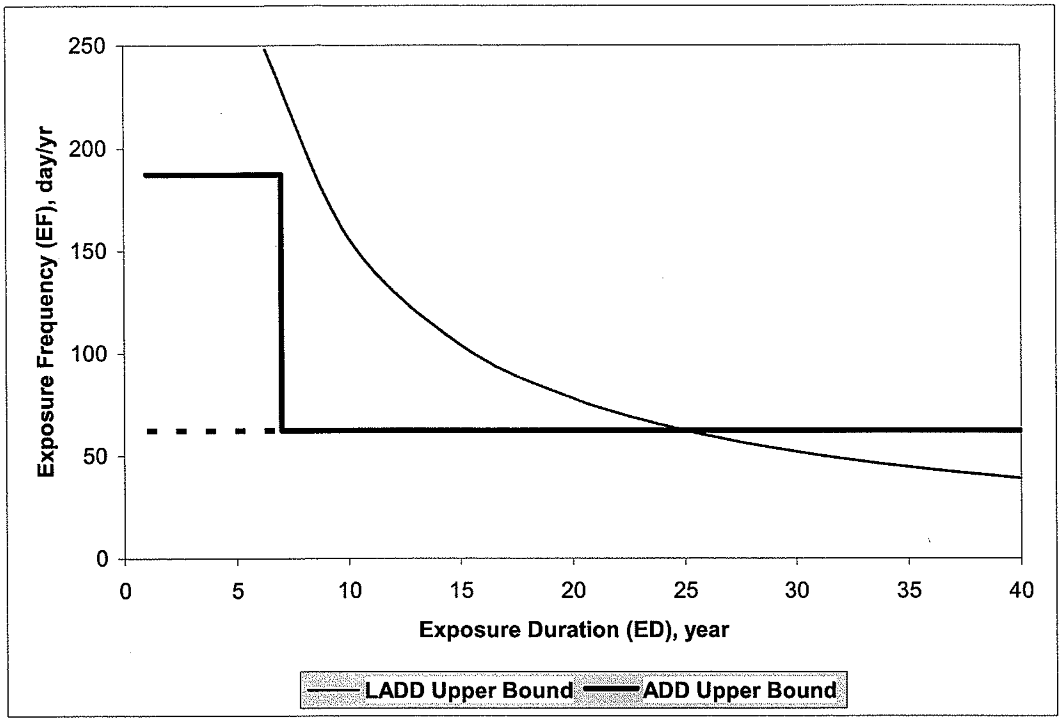
VI-4.1 Contact with Soil

As described in the Conceptual Site Model for the Vernay Facility, a small fraction of the workers may conduct occasional subsurface construction or maintenance that puts them in contact with both surface and subsurface soil in paved and unpaved areas of the Facility (e.g., during installation or repair of underground utilities, or during removal or repair of pavement). These types of subsurface activities are typically of limited size and duration. Typical excavations are expected to be approximately 5 m by 5 m, and the maximum excavation depth would be approximately 3 to 4 m. Potential routes of exposure to surface and subsurface soil would include incidental ingestion, dermal contact, and inhalation of soil vapor and airborne particulates.

The specific values of exposure frequency (EF) and exposure duration (ED) that are used in assessing potential short duration excavation exposures were selected because they conservatively represent the typical excavation/maintenance construction scenario at the Vernay Facility. As discussed below, these exposures may conservatively be assessed using the risk estimates developed for a routine worker which are based on the exposure assumptions used in developing the Region 9 PRGs for routine workers. In particular, much higher values of EF and ED would also give exposure estimates for construction workers that are lower than those assumed in the Region 9 PRGs for routine workers. In other words, the screening criteria based on the Region 9 PRGs are conservative for a much wider range of construction scenarios that may occur at the Vernay Facility under current and reasonably likely future use conditions.

For the short term construction worker, using an EF of 5 days/year and an ED of 10 years gives normalized lifetime average daily dose (LADD) and average daily dose (ADD) for construction workers that are approximately 30 to 100 times lower and 10 to 50 times lower, respectively, than those assumed in deriving the routine worker PRGs. This means values of EF and ED higher than that for the typical construction scenario at the Vernay Facility could be used to demonstrate that the Region 9 PRG-based are adequately conservative to cover potential exposure of construction workers at this Facility.

An example of the possible combinations of EF and ED for the construction scenario that would give normalized LADDs and ADDs that are lower than those assumed in the Region 9 PRGs is shown in the following graph.



The points on and below the lines labeled as "LADD Upper Bound" and "ADD Upper Bound" represent all the EF and ED combinations that would ensure that the construction workers' exposures via soil ingestion do not exceed the corresponding normalized LADD and ADD assumed in the PRGs.

The equation for "LADD Upper Bound" line is derived by solving the following equation for the product of EF and ED:

$$LADD_{rw} = \frac{IR\ CF\ FC\ EF\ ED}{BW\ AT_C}$$

The variables on the right hand side and their values are as defined in Attachment VI-4-1, except EF and ED which are the variables being solved for in this case. $LADD_{rw}$ is the normalized ingestion LADD of 1.74 x 10^{-7} mg/kg/day per mg/kg assumed in the PRGs. Solving this equation gives:

$$EF = \frac{1556}{ED}$$

Similarly, the "ADD Upper Bound" line is derived by solving the following equation for EF:

$$ADD_{rw} = \frac{IR\ CF\ FC\ EF}{BW\ 365}$$

The variables on the right hand side and their values are as defined in Attachment IV-4-1, except EF which is the variable being solved for in this case. ADD_{rw} is the normalized ingestion ADD of 4.89 x 10^{-7} mg/kg/day per mg/kg assumed in the PRGs. Solving this equation gives an EF of 62.5 days/year. For subchronic EDs which EPA defines as two weeks to seven years, the use of subchronic RfDs which are up to 10 times higher than chronic RfDs would increase the EF limit from 62.5 days/year to 365 days/year, depending on the ratio of a chemical's subchronic RfD to its chronic RfD. In the above graph, the "ADD Upper Bound" line is conservatively based on subchronic RfDs that are up to only three times higher than the chronic RfDs (i.e., the EF can be up to approximately 190 days/year for subchronic EDs).

It should be recognized that the EF for the construction scenario refers to the days on which workers are engaged in actual soil excavation or similar intrusive activities, rather than the days on which workers are engaged in other construction activities (e.g., building above-ground structures). This means the EFs bounded by the "ADD Upper Bound" line in the above example represent a number of days of actual soil excavation and other intrusive activities that is large enough to cover a wide range of construction scenarios. This range includes not only the specific construction scenario that was used in Attachment VI-4-1, but also the entire reasonably expected range of construction that might be associated with site redevelopment or building new buildings at the Facility. Therefore, the routine worker screening criteria are in fact adequately conservative to cover all reasonably expected construction scenarios at this Facility. The routine worker screening criteria and incremental risk estimates for off-Facility routine workers as a surrogate for construction workers are shown in Attachment VI-4-2.

VI-4.2 Contact with Subsurface Water and Surface Water

As discussed in Section 5.3 of the RFI Report, construction workers could be exposed to subsurface water, or surface water (in storm sewers or Unnamed Creek) via incidental ingestion, dermal contact, and inhalation of vapors during excavations that extend to the water table or exposures to surface water. The cancer risk and HQ estimates for these exposure routes are calculated using risk-based criteria in a manner analogous to the method discussed in Section VI-2.1.

In this case, the risk-based criteria for the ingestion, dermal, and inhalation routes of exposure are calculated as discussed below using the exposure factors for ground water contact discussed in Section 5.3.6.2 of the RFI Report:

$$RBC = \frac{TR}{LADD^{*} \cdot SF}$$

$$RBC = \frac{THQ \cdot RfD}{ADD^{*}}$$

The *TR* and *THQ* are 10^{-5} and 1, respectively. The *LADD** and *ADD** are calculated using the exposure factors for ground water contact discussed in Section 5.3.6.2 of the RFI Report.

The risk-based criteria for the inhalation route are calculated as follows:

$$RBC = \frac{TR \cdot AT}{URF \cdot ET \cdot EF \cdot ED}(J \cdot C/Q)^{-1}$$

$$RBC = \frac{THQ \cdot RfC \cdot AT}{ET \cdot EF \cdot ED}(J \cdot C/Q)^{-1}$$

where the product $J \cdot C/Q$ is an air concentration that is normalized to unit concentration in ground water. The *J* term is the normalized average vapor, and the *C/Q* term is a normalized air concentration.

The normalized vapor flux *J* of a chemical from exposed water in an excavation pit, storm sewer or Unnamed Creek is estimated using an overall mass transfer coefficient that is recommended by USEPA (1995c):

$$K_L = \left(\frac{1}{k_l} + \frac{1}{Hk_g}\right)^{-1}\left(\frac{m}{10^2 cm}\right)\left(\frac{10^3 L}{m^3}\right)$$

where *H* is the Henry's law constant, and k_l and k_g are the liquid-phase and gas-phase mass transfer coefficients (in cm/s) given by the following:

$$k_l = \left(\frac{MW_o}{MW}\right)^{0.5}\left(\frac{T}{298°K}\right)k_{l,o}$$

$$k_g = \left(\frac{MW_w}{MW}\right)^{0.335}\left(\frac{T}{298°K}\right)^{1.005}k_{g,w}$$

where MW, MW_o, and MW_w are the molecular weights of the chemical, oxygen, and water, T is the water's absolute temperature, $k_{l,o}$ is the liquid-phase mass transfer coefficient for oxygen (0.002 cm/s), and $k_{g,w}$ is the gas-phase mass transfer coefficient for water vapor (0.833 cm/s).

The *C/Q* term is a normalized air concentration estimated using SCREEN3 (USEPA 1995a) for a 15-foot by 15-foot area. The SCREEN3 area-source algorithm is used with worst-case meteorological conditions selected by the model to estimate a maximum 1-hour air concentration at ground level. The maximum 1-hour air concentration is converted to a maximum 24-hour air concentration using a conservative factor of 0.4, because workers are conservatively assumed to have inhalation exposure over the entire work day while working around the area. This air concentration is expected to be higher than actual air concentrations to which workers would be exposed during excavation activities.

The risk-based criteria for each route of exposure are then combined to give cancer and noncancer criteria that are based on the combination of all three routes, as follows:

$$RBC = \left(\sum_i RBC_i^{-1}\right)^{-1}$$

The cancer risk and HQ are estimated using these RBC in the following equations:

$$Risk = \frac{C}{RBC} \cdot TR$$

$$HQ = \frac{C}{RBC} \cdot THQ$$

Estimates of cancer risk and HQ are calculated using RBCs for the combined routes. In this risk assessment, the estimates are based on the highest detected concentration of each constituent in subsurface ground water, sewer water or surface water at a given area. The computation of RBCs, incremental cancer risk and HI estimates for this scenario is shown in Attachment VI-5.

VI-4.3 Contact with Sediment in Unnamed Creek

As discussed in Section 5.5 of the RFI Report, potential exposure of construction workers to sediment is evaluated indirectly in the risk assessment by using risk estimates for exposures of routine workers to soil. These estimates are discussed in Section VI-3.1.

VI-5 TRESPASSERS

As discussed in Section 5.5 of the RFI Report, potential exposure of trespassers to soil is evaluated indirectly in the risk assessment by using risk estimates for exposures of routine workers to soil. The EPA Region 9 Preliminary Remediation Goals (PRGs) for soil at industrial sites are based on standard default exposure factors that EPA (1991) recommends for evaluating reasonable maximum exposures (RME) to soil in commercial/industrial settings. As such, the PRGs are appropriate for evaluating potential exposures of workers to soil during routine activities at industrial facilities. In addition, the PRGs are also appropriate for evaluating potential exposure of other receptors that may be present at industrial facilities and have lower potential exposures to soil such as trespassers. The typical activities of potential trespassers at the Vernay Facility are unlikely to exceed the exposures assumed in deriving the PRGs as discussed below.

Based on the location of the Facility and information provided by Facility personnel, trespassing at the Vernay property is not common. The duration of any unauthorized access as well as the types of activities while on-Facility are expected to be limited. Trespassers are assumed to be adolescents between ages 9 to 18. While trespassing, they could come into contact with surface soil in unpaved areas. Potential routes of exposure would include incidental ingestion, dermal contact, and inhalation of soil vapor and airborne particulates.

Exposure factors appropriate for quantifying trespassers' potential exposures are summarized in Attachment VI-6 and discussed below. Also included in Attachment VI-6 for comparison are the exposure factors used in deriving the PRGs for commercial/industrial settings.

- Ingestion rate: The soil ingestion rate of 50 mg/day is based on EPA's recommended value for evaluating RME in industrial settings (EPA 1991).
- Dermal contact rate: The exposed skin surface area of 5,700 cm^2 is conservatively based on EPA's recommend value for evaluating RME of adults in residential settings (EPA 1991). The adherence factor of 0.2 mg/cm^2 is EPA's recommended value for evaluating RME in industrial settings (USEPA 2001).

- Breathing rate: The breathing rate of 20 m^3/day is EPA's recommended value for evaluating RME in industrial settings (EPA 1991).

- Fraction contacted: The fraction contacted term is 0.25 (or 2/8) because trespassers are assumed not to spend more than a couple hours in one particular area.

- Exposure frequency: The frequency of 100 days/year is based on professional judgment considering the Vernay Facility location and reported infrequency of trespassers. This value assumes 2 days per week and 50 weeks per year.

- Exposure duration: The duration of 10 years corresponds to the number of years from ages of 9 to 18.

- Body weight: The body weight of 51 kg is the average for adolescents between the ages of 9 to 18 (EPA 1997).

- Averaging time: The averaging time for evaluating exposures to carcinogens is 70 years. The averaging time for evaluating exposures to noncarcinogens is the exposure duration (EPA 1989).

Using these exposure factors, the doses per mg/kg of chemical in soil or per mg/m^3 in air have been calculated and are shown in Attachment VI-6 to facilitate comparison of the exposures assumed for trespassers with the exposures assumed in the PRGs. These cancer- and noncancer-based doses are shown on Attachment VI-6 in bold and are labeled as normalized LADD and ADD, respectively.

The normalized cancer- and noncancer-based doses for trespassers can be compared with the corresponding normalized doses assumed in the PRGs. A direct comparison of the normalized doses in Attachment VI-6 shows that the normalized cancer- and noncancer-based doses for each route for trespassers are lower than the corresponding normalized doses assumed in derivation of the PRGs. For routine workers, the normalized doses are lower than those assumed in the PRGs because these workers do not spend an entire work day at one area of exposed soil. For trespassers, the normalized LADDs are approximately 10 to 20 times lower than those assumed in the PRGs, and the normalized ADDs are approximately 4 to 7 times lower.

These comparisons show that the exposure frequency (EF) and/or exposure duration (ED) for trespassers shown on Attachment VI-6 can be increased significantly without affecting the outcome of the comparisons. A trespasser would have to have an exposure frequency higher than the routine worker in order to equal the exposure of a routine worker.

VI-6 RESIDENTS

As discussed in Section 5.3 of the RFI Report, the risk assessment evaluated potential exposure of off-Facility residents to on-Facility surface soil via inhalation of vapors and airborne particulates, ground water via vapor intrusion, and potential non-potable ground water use are discussed below.

VI-6.1 Inhalation of Soil Constituents

As discussed in Section 5.5 of the RFI Report, potential inhalation exposure of off-Facility residents to airborne constituents from on-Facility soil is evaluated indirectly in the risk assessment by using risk estimates for exposures of on-Facility routine workers to soil. This approach streamlines the risk assessment and is conservative because airborne exposures off-Facility are expected to be lower than exposures on-Facility due to much greater air dispersion between an on-Facility emission source and off-Facility receptors as compared to air dispersion directly over an emission source. These estimates are discussed in Section VI-3.1.

VI-6.2 Vapor Intrusion

Estimates of cumulative cancer risk and HI associated with potential exposure of residents via vapor intrusion from ground water are calculated using Facility-specific vapor intrusion criteria in a manner similar to that discussed in Section VI-3.2.

The indoor air concentrations are estimated based on the same modeling approach and soil properties discussed in Section VI-3.2, except regulatory default assumptions for a hypothetical residential building are used in place of the assumptions for a hypothetical commercial/industrial building with a basement. The calculated soil moisture profile and effective diffusion coefficients are presented in Attachment VI-7-1. Computation of the RBCs and the related incremental cancer risk and HI estimates are shown in Attachment VI-7-2.

VI-6.3 Non-Potable Ground Water Use

Potential non-potable ground water use exposures of off-Facility residents to constituents detected in Cedarville Aquifer ground water are evaluated using conservative risk-based screening criteria. The derivation of these criteria for assessing residential exposures via direct contact and inhalation associated with use of ground water in a residential “kiddie” pool is presented in this Section.

The criteria are based on inhalation exposure to vapor, dermal contact, and incidental ingestion of ground water in a kiddie pool. Conservative exposure factors for a resident were applied (see Attachment VI-8-1). Air concentrations resulting from the volatilization of constituents were determined using the model presented below.

The vapor emission rate from the kiddie pool at a specific time (t) is calculated by the following equation (USEPA 1995a, Equation 11):

$$N = (1 - \exp[-k \cdot A \cdot t / V]) \cdot V \cdot C_0 / t$$

where:

N:	Emission rate for a tank filled with water (g/s)
k:	Overall mass transfer coefficient (m/s)
t:	Time (seconds)
A:	Surface area of the pool (m^3)
V:	Volume of water in the pool (m^3)
C_o:	Initial concentration in water (g/m^3)

The average emission rate over the exposure period from t = 0 to t_{max} is directly proportional to the average concentration in the water during the same time, and is calculated by integrating the concentration in the kiddie pool during the averaging period:

$$C_{avg} / C_0 = \frac{V}{k \cdot A \cdot t} [(1 - \exp[-k \cdot A \cdot t / V])$$

where:

C_{avg}:	Average concentration in water over the period (g/m^3)
t:	Averaging period (seconds)

The concentration in air is calculated by multiplying the average emission flux over the exposure period by the dispersion factor using the following equation:

$$C_{Air} = \frac{N \cdot \frac{C_{avg}}{C_0} \cdot C/Q}{A}$$

where:

C/Q: Maximum normalized air concentration (g/m^3 per g/m^2-s)

A: Surface area of the pool (m^2)

The normalized air concentration (C/Q) is estimated using EPA's SCREEN3 air dispersion model (USEPA 1995b) using a pool size of 6 ft by 6 ft as a source area. The estimated normalized air concentration is the ground level maximum annual average concentration, calculated by multiplying the hourly maximum normalized air concentration (based on worst-case meteorological conditions as selected by the model) by a conversion factor of 0.08 (USEPA 1995b). The model parameters and the values used in the evaluation are summarized in Attachment VI-8-2.

The criterion associated with potential exposure to a carcinogenic chemical, via dermal contact, is estimated based on the target cancer risk of 10^{-5} and the dermal cancer slope factor (SF) for the chemical. The criterion associated with potential exposure to a carcinogenic chemical, via inhalation, is estimated based on the target cancer risk of 10^{-5} and the unit risk factor (URF) for the chemical. The criterion associated with potential exposure to a carcinogenic chemical, via incidental ingestion, is estimated based on the target cancer risk of 10^{-5} and the oral cancer slope factor (SF) for the chemical.

The risk-based criteria for potential exposure to a carcinogenic chemical, via multiple exposure routes, is estimated as follows:

$$RBC_{Carc} = \frac{1}{1/RBC_{route\,1} + \cdots 1/RBC_{route\,N}}$$

The criterion associated with potential exposure to a noncarcinogenic chemical, via dermal contact, is estimated based on the target hazard quotient (HQ) of 1 and the dermal reference dose (RfD) for the chemical. The criterion associated with potential exposure to a noncarcinogenic chemical, via incidental ingestion, is estimated based on the target hazard quotient (HQ) of 1 and the oral reference dose (RfD) for the chemical. The criterion associated with potential exposure to a noncarcinogenic chemical, via inhalation, is estimated based on the target hazard quotient (HQ) of 1 and the reference concentration (RfC) for the chemical.

The risk-based criteria for potential exposure to a noncarcinogenic chemical, via multiple exposure routes, is estimated as follows:

$$RBC_{NCarc} = \frac{1}{1/RBC_{route\,1} + \ldots\, 1/RBC_{route\,N}}$$

The screening criteria for assessing residential exposures via direct contact and inhalation associated with use of ground water in a "kiddie" pool are calculated by taking the minimum of the cancer and the noncancer risk-based criteria.

The calculation of the cancer and non-cancer risk based criteria are presented in Attachment VI-8-3.

VI-7 RECREATIONAL WADERS

As discussed in Section 5.3 of the RFI Report, the risk assessment evaluates potential exposure of recreational waders in the Unnamed Creek located to the northeast of the Facility. The computation of risk estimates associated with exposure to sediments is discussed in Section VI-7.1, and the evaluation of potential exposure to surface water is discussed in Section VI-7.2.

VI-7.1 Contact with Sediment

As discussed in Section 5.3 of the RFI Report, recreational waders in the Unnamed Creek could be exposed to sediments in creek via incidental ingestion and dermal contact. The cancer risk and HQ estimates for these potential exposures are calculated using the same risk equations discussed in Section 5.5.2.4, and the exposure factors discussed in Section 5.3.6.4 of the RFI Report. The cancer risk and HQ estimates are based on the highest detected concentrations of each constituent in the Unnamed Creek sediment. The computations are shown in Attachment VI-9.

VI-7.2 Contact with Surface Water

As discussed in Section 5.3 of the RFI Report recreational waders in the Unnamed Creek could be exposed to surface water in the creek via incidental ingestion, dermal contact and inhalation of vapors. The cancer risk and HQ estimates for these potential exposures are calculated using the same risk equations discussed in Section 5.5.2.4, and the exposure factors discussed in Section 5.3.6.4 of the RFI Report. The cancer risk and HQ estimates are based on the highest detected concentrations of each constituent in the Unnamed Creek sediment and surface water. The computations are shown in Attachment VI-9.

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TABLES

Table 1: Comparison of Indoor Air Criteria and QAPP MDLs
Vernay Laboratories Inc. Yellow Springs, Ohio

Area	Chem Group	Chemical	CASRN	Analyzed	Detected	Indoor Air Criteria (TR=E-5 & HQ =1) (mg/m3)		QAPP Method Detection Limit (mg/m3)	Ratio QAPP MDL to Criteria
2S	VOC	Acetone	67-64-1	8	8	5.5E+00	NC	2.6E-03	4.7E-04
2S	VOC	Acetonitrile	75-05-8	8		1.1E-01	NC	5.9E-04	5.6E-03
2S	VOC	Acrolein	107-02-8	8	2	3.5E-05	NC	5.3E-04	**1.5E+01**
2S	VOC	Acrylonitrile	107-13-1	8		6.0E-04	C	3.9E-04	6.5E-01
2S	VOC	Benzene	71-43-2	8	8	5.2E-03	C	3.0E-04	5.7E-02
2S	VOC	Benzyl chloride	100-44-7	8		1.8E-02	NC	4.6E-04	2.6E-02
2S	VOC	Bromodichloromethane	75-27-4	8		2.3E-03	C	5.5E-04	2.4E-01
2S	VOC	Bromoform	75-25-2	8		3.7E-02	C	1.0E-03	2.8E-02
2S	VOC	Bromomethane	74-83-9	8		8.8E-03	NC	3.8E-04	4.4E-02
2S	VOC	1,3-Butadiene	106-99-0	8		1.4E-03	C	3.5E-04	2.6E-01
2S	VOC	1-Butanol	71-36-3	8	3	1.6E-02	NC	1.1E-03	6.8E-02
2S	VOC	2-Butanone	78-93-3	8	7	8.8E+00	NC	9.4E-04	1.1E-04
2S	VOC	Carbon Disulfide	75-15-0	8	3	1.2E+00	NC	2.4E-04	2.0E-04
2S	VOC	Carbon Tetrachloride	56-23-5	8		2.7E-03	C	6.9E-04	2.5E-01
2S	VOC	3-Chloro-1-propene	107-05-1	8				4.4E-04	
2S	VOC	Chlorobenzene	108-90-7	8		1.1E-01	NC	4.0E-04	3.8E-03
2S	VOC	Chlorodifluoromethane	75-45-6	8	8			2.8E-04	
2S	VOC	Chloroethane	75-00-3	8		1.8E+01	NC	3.7E-04	2.1E-05
2S	VOC	Chloroform	67-66-3	8		1.8E-03	C	4.0E-04	2.3E-01
2S	VOC	Chloromethane	74-87-3	8	7	1.6E-01	NC	4.5E-04	2.9E-03
2S	VOC	Cumene	98-82-8	8		7.0E-01	NC	4.4E-04	6.2E-04
2S	VOC	Cyclohexane	110-82-7	8	2	1.1E+01	NC	4.1E-04	3.9E-05
2S	VOC	Dibromochloromethane	124-48-1	8		1.7E-03	C	8.5E-04	5.0E-01
2S	VOC	1,2-Dibromoethane	106-93-4	8		1.9E-04	C	6.0E-04	**3.2E+00**
2S	VOC	Dibromomethane	74-95-3	8				6.0E-04	
2S	VOC	1,2-Dichlorobenzene	95-50-1	8		3.5E-01	NC	5.6E-04	1.6E-03
2S	VOC	1,3-Dichlorobenzene	541-73-1	8		2.5E-01	NC	6.0E-04	2.4E-03
2S	VOC	1,4-Dichlorobenzene	106-46-7	8	6	6.5E-03	C	6.6E-04	1.0E-01
2S	VOC	Dichlorodifluoromethane	75-71-8	8	8	3.5E-01	NC	4.4E-04	1.2E-03
2S	VOC	1,1-Dichloroethane	75-34-3	8		8.8E-01	NC	2.5E-04	2.9E-04
2S	VOC	1,2-Dichloroethane	107-06-2	8		1.6E-03	C	2.2E-04	1.4E-01
2S	VOC	1,1-Dichloroethene	75-35-4	8		3.5E-01	NC	4.0E-04	1.1E-03
2S	VOC	cis-1,2-Dichloroethene	156-59-2	8	4	6.1E-02	NC	2.3E-04	3.8E-03
2S	VOC	trans-1,2-Dichloroethene	156-60-5	8		1.2E-01	NC	4.8E-04	3.9E-03
2S	VOC	1,2-Dichloropropane	78-87-5	8		7.0E-03	NC	4.5E-03	6.4E-01
2S	VOC	1,3-Dichloropropene (total)	542-75-6	8		1.0E-02	C		
2S	VOC	Ethyl Benzene	100-41-4	8	1	1.8E+00	NC	4.0E-04	2.3E-04
2S	VOC	Freon 114	76-14-2	8				6.9E-04	
2S	VOC	n-Heptane	142-82-5	8	7			4.1E-04	
2S	VOC	n-Hexane	110-54-3	8	7	3.7E-01	NC	2.3E-04	6.3E-04
2S	VOC	2-Hexanone	591-78-6	8		8.8E-03	NC	7.8E-04	8.9E-02
2S	VOC	Methanol	67-56-1	8	8	3.1E+00	NC	1.2E-03	3.9E-04
2S	VOC	Methyl tert-butyl ether	1634-04-4	8		4.1E-01	C	7.9E-04	1.9E-03
2S	VOC	4-Methyl-2-pentanone	108-10-1	8	2	5.3E+00	NC	8.6E-04	1.6E-04
2S	VOC	Methylene Chloride	75-09-2	8	1	8.7E-02	C	2.5E-04	2.9E-03
2S	VOC	n-Propylbenzene	103-65-1	8		2.5E-01	NC	4.9E-04	2.0E-03
2S	VOC	Styrene	100-42-5	8		1.8E+00	NC	4.3E-04	2.4E-04
2S	VOC	1,1,2,2-Tetrachloroethane	79-34-5	8		7.0E-04	C	5.6E-04	7.9E-01
2S	VOC	Tetrachloroethene	127-18-4	8	8	1.3E-02	C	7.5E-04	5.6E-02
2S	VOC	Toluene	108-88-3	8	8	7.0E-01	NC	4.9E-04	7.0E-04
2S	VOC	1,2,4-Trichlorobenzene	120-82-1	8		3.5E-01	NC	7.4E-04	2.1E-03
2S	VOC	1,1,1-Trichloroethane	71-55-6	8	7	3.9E+00	NC	3.9E-04	1.0E-04
2S	VOC	1,1,2-Trichloroethane	79-00-5	8		2.6E-03	C	7.1E-04	2.8E-01
2S	VOC	Trichloroethene	79-01-6	8	4	2.4E-02	C	4.7E-04	1.9E-02
2S	VOC	Trichlorofluoromethane	75-69-4	8	7	1.2E+00	NC	5.1E-04	4.1E-04
2S	VOC	1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	8	2	5.3E+01	NC	7.7E-04	1.5E-05
2S	VOC	1,2,4-Trimethylbenzene	95-63-6	8	5	1.0E-02	NC	4.8E-04	4.6E-02
2S	VOC	1,3,5-Trimethylbenzene	108-67-8	8		1.0E-02	NC	4.1E-04	3.9E-02
2S	VOC	Vinyl Acetate	108-05-4	8	1	3.5E-01	NC	7.0E-04	2.0E-03
2S	VOC	Vinyl Chloride	75-01-4	8		4.6E-03	C	1.5E-04	3.1E-02
2S	VOC	Xylenes (total)	1330-20-7	8	8	1.8E-01	NC	3.7E-04	2.1E-03

c - The Screening Criterion is based on cancer risk.
nc - The Screening Criterion is based on noncancer effects.
Chem Group - Chemical Group
Carc Class - EPA Weight-of-Evidence Cancer Classification

Table 2: Volatile Organic Compounds Without URFs or RFCs
Vernay Laboratories, Inc. Yellow Springs, Ohio

Chem Group	Chemical	Casrn	Analyzed	Detected	Cancer Class	URF (m^3/mg)	Cancer Criteria (mg/m^3)	RfC (mg/m^3)	NonCancer Criteria (mg/m^3)	Air Criteria Combined (mg/m^3)
VOC	Acetone	67-64-1			ID			3.15E+00	5.52E+00	5.52E+00
VOC	Acetonitrile	75-05-8			D			6.00E-02	1.05E-01	1.05E-01
VOC	Acrolein	107-02-8			ID			2.00E-05	3.50E-05	3.50E-05
VOC	Acrylonitrile	107-13-1			B1	6.80E-02	6.01E-04	2.00E-03	3.50E-03	6.01E-04
VOC	Benzene	71-43-2			A	7.80E-03	5.24E-03	3.00E-02	5.26E-02	5.24E-03
VOC	Benzyl chloride	100-44-7						1.02E-02	1.78E-02	1.78E-02
VOC	Bromochloromethane	74-97-5	8							
VOC	Bromodichloromethane	75-27-4			B2	1.77E-02	2.31E-03	7.00E-02	1.23E-01	2.31E-03
VOC	Bromoform	75-25-2			B2	1.10E-03	3.72E-02			3.72E-02
VOC	Bromomethane	74-83-9			D			5.00E-03	8.76E-03	8.76E-03
VOC	1,3-Butadiene	106-99-0			HC	3.00E-02	1.36E-03	2.00E-03	3.50E-03	1.36E-03
VOC	1-Butanol	71-36-3			D			9.10E-03	1.59E-02	1.59E-02
VOC	2-Butanone	78-93-3			ID			5.00E+00	8.76E+00	8.76E+00
VOC	Carbon Disulfide	75-15-0						7.00E-01	1.23E+00	1.23E+00
VOC	Carbon Tetrachloride	56-23-5			B2	1.50E-02	2.73E-03			2.73E-03
VOC	3-Chloro-1-propene	107-05-1	8							
VOC	Chlorobenzene	108-90-7			D			6.00E-02	1.05E-01	1.05E-01
VOC	Chlorodifluoromethane	75-45-6	8	8						
VOC	Chloroethane	75-00-3						1.00E+01	1.75E+01	1.75E+01
VOC	2-Chloroethylvinyl ether	110-75-8	8							
VOC	Chloroform	67-66-3			B2	2.30E-02	1.78E-03	5.00E-02	8.76E-02	1.78E-03
VOC	Chloromethane	74-87-3			D			9.00E-02	1.58E-01	1.58E-01
VOC	Cumene	98-82-8			D			4.00E-01	7.01E-01	7.01E-01
VOC	Cyclohexane	110-82-7			ID			6.00E+00	1.05E+01	1.05E+01
VOC	1,2-Dibromo-3-chloropropane	96-12-8			B2	6.86E-04	5.96E-02	2.00E-04	3.50E-04	3.50E-04
VOC	Dibromochloromethane	124-48-1			C	2.40E-02	1.70E-03	7.00E-02	1.23E-01	1.70E-03
VOC	1,2-Dibromoethane	106-93-4			B2	2.20E-01	1.86E-04			1.86E-04
VOC	Dibromomethane	74-95-3	8							
VOC	1,2-Dichlorobenzene	95-50-1			D			2.00E-01	3.50E-01	3.50E-01
VOC	1,3-Dichlorobenzene	541-73-1			D			1.40E-01	2.45E-01	2.45E-01
VOC	1,4-Dichlorobenzene	106-46-7			C	6.29E-03	6.50E-03	8.00E-01	1.40E+00	6.50E-03
VOC	Dichlorodifluoromethane	75-71-8						2.00E-01	3.50E-01	3.50E-01
VOC	1,1-Dichloroethane	75-34-3			C			5.00E-01	8.76E-01	8.76E-01
VOC	1,2-Dichloroethane	107-06-2			B2	2.60E-02	1.57E-03	5.00E-03	8.76E-03	1.57E-03
VOC	1,1-Dichloroethene	75-35-4			C			2.00E-01	3.50E-01	3.50E-01
VOC	1,2-Dichloroethene (total)	540-59-0						3.15E-02	5.52E-02	5.52E-02
VOC	cis-1,2-Dichloroethene	156-59-2			D			3.50E-02	6.13E-02	6.13E-02
VOC	trans-1,2-Dichloroethene	156-60-5						7.00E-02	1.23E-01	1.23E-01
VOC	1,2-Dichloropropane	78-87-5			B2			4.00E-03	7.01E-03	7.01E-03
VOC	1,3-Dichloropropene (total)	542-75-6			B2	4.00E-03	1.02E-02	2.00E-02	3.50E-02	1.02E-02
VOC	cis-1,3-Dichloropropene	10061-01-5				4.00E-03	1.02E-02	2.00E-02	3.50E-02	1.02E-02
VOC	trans-1,3-Dichloropropene	10061-02-6	8							
VOC	Ethyl Benzene	100-41-4			D			1.00E+00	1.75E+00	1.75E+00
VOC	Freon 114	76-14-2	8							
VOC	n-Heptane	142-82-5	8	7						
VOC	n-Hexane	110-54-3						2.10E-01	3.68E-01	3.68E-01
VOC	2-Hexanone	591-78-6						5.00E-03	8.76E-03	8.76E-03
VOC	Methanol	67-56-1						1.75E+00	3.07E+00	3.07E+00
VOC	Methyl Acetate	79-20-9						3.50E+00	6.13E+00	6.13E+00
VOC	Methyl tert-butyl ether	1634-04-4				1.00E-04	4.09E-01	3.00E+00	5.26E+00	4.09E-01
VOC	4-Methyl-2-pentanone	108-10-1			ID			3.00E+00	5.26E+00	5.26E+00
VOC	Methylcyclohexane	108-87-2						3.00E+00	5.26E+00	5.26E+00
VOC	Methylene Chloride	75-09-2			B2	4.70E-04	8.70E-02	3.00E+00	5.26E+00	8.70E-02
VOC	n-Hexane Extractable Material	NHEXEEXTMAT	8							
VOC	n-Propylbenzene	103-65-1						1.40E-01	2.45E-01	2.45E-01
VOC	Styrene	100-42-5						1.00E+00	1.75E+00	1.75E+00
VOC	1,1,2,2-Tetrachloroethane	79-34-5			C	5.80E-02	7.05E-04			7.05E-04
VOC	Tetrachloroethene	127-18-4			C-B2	3.06E-03	1.34E-02	4.00E-01	7.01E-01	1.34E-02
VOC	Toluene	108-88-3			D			4.00E-01	7.01E-01	7.01E-01
VOC	1,2,4-Trichlorobenzene	120-82-1			D			2.00E-01	3.50E-01	3.50E-01
VOC	1,1,1-Trichloroethane	71-55-6			D			2.20E+00	3.85E+00	3.85E+00
VOC	1,1,2-Trichloroethane	79-00-5			C	1.60E-02	2.56E-03			2.56E-03
VOC	Trichloroethene	79-01-6			C-B2	1.70E-03	2.40E-02			2.40E-02

Table 2: Volatile Organic Compounds Without URFs or RFCs Vernay Laboratories, Inc. Yellow Springs, Ohio										
Chem Group	**Chemical**	**Casrn**	**Analyzed**	**Detected**	**Cancer Class**	**URF** (m^3/mg)	**Cancer Criteria** (mg/m^3)	**RfC** (mg/m^3)	**NonCancer Criteria** (mg/m^3)	**Air Criteria Combined** (mg/m^3)
VOC	Trichlorofluoromethane	75-69-4						7.00E-01	1.23E+00	1.23E+00
VOC	1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1						3.00E+01	5.26E+01	5.26E+01
VOC	1,2,4-Trimethylbenzene	95-63-6						5.95E-03	1.04E-02	1.04E-02
VOC	1,3,5-Trimethylbenzene	108-67-8						5.95E-03	1.04E-02	1.04E-02
VOC	Vinyl Acetate	108-05-4						2.00E-01	3.50E-01	3.50E-01
VOC	Vinyl Chloride	75-01-4			A	8.80E-03	4.65E-03	1.00E-01	1.75E-01	4.65E-03
VOC	Xylenes (total)	1330-20-7			ID			1.00E-01	1.75E-01	1.75E-01

David C. Contant

From: David C. Contant
Sent: Friday, August 19, 2005 9:23 AM
To: 'Fisher Doug'; 'dfisher3@woh.rr.com'
Subject: FW: Wells for quarterly monitoring

-----Original Message-----
From: Polston.Patricia@epamail.epa.gov [mailto:Polston.Patricia@epamail.epa.gov]
Sent: Friday, August 19, 2005 8:50 AM
To: dougfisher@vernay.com; Kevin D. Kallini; David C. Contant
Cc: Petrovski.David@epamail.epa.gov; Cygan.Gary@epamail.epa.gov; Olsberg.Colleen@epamail.epa.gov
Subject: Wells for quarterly monitoring

We are following up on our August 3, 2005, conference call regarding the groundwater issues. Here's the list of the wells that should be monitored quarterly. These wells were selected with time-dependency and area coverage in mind and are given below.

The data from the first set of wells (listed immediately below) should be used to construct hydrogeologic cross-sections depicting contaminant-concentration contours perpendicular to the plume (further information on this is provided below). Like the monitoring, these cross-sections should be prepared quarterly.

MW02-08
MW02-08CD
MW02-08SE
MW02-13
MW02-03
MW02-03CD
MW02-03SE
MW02-11
MW02-11CD

The data from the next set of wells should be used to construct hydrogeologic cross-sections depicting the contaminant concentrations parallel to the direction of the plume migration. These cross sections should also be prepared quarterly.

MW01-02
RW01-05
MW01-04
MW01-04CD
MW02-08*
MW02-08CD*
MW02-08SE*
MW02-06
MW02-06CD
MW02-09
MW02-10
MW01-10

*data from these wells to be used in constructing both sets of cross-sections.

MW01-13 is selected for time-dependency backfill monitoring well.

There's a total of 20 wells that will need to be monitored quarterly.
The separate perpendicular and parallel contaminant-concentration cross sections should be prepared depicting; total chlorinated compounds, total parent compounds and total daughter compounds.

I would also like to start the planning for a conference call to address the risk assessment outstanding issue. As per our recent phone call with Vernay, the response

states that the facility will "delete references to occupational criteria for assessing current conditions."
They do indeed delete these references from the text in Section 5.5.2.1.
They don't delete these references from Appendix VI, which is where the risk calculations for vapor intrusion are located. The revised text in Section 5.5.2.1 refers to this nonrevised Appendix VI, which includes the OSHA-PELs. Basically what this means is that while the text has been revised, the risk calculations have not. We need to resolve this issue.

How does the last week in August or beginning September sound?

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Kevin D. Kallini

From: Fisher Doug [DougFisher@vernay.com]
Sent: Friday, September 02, 2005 1:05 PM
To: Polston.Patricia@epamail.epa.gov
Cc: David C. Contant; Kevin D. Kallini
Subject: FW: Trish Email
Importance: Low
Attachments: Post-RFI List.pdf

Trish:

Sorry I was not available to talk to you and Dave Petroski yesterday about the additional well sampling proposed in your August 19th email. I would, however, like to try to schedule a call, including some members of my technical team, next week. We are available on Wednesday, September 7 or Thursday, September 8th for this call. Please let me know if those days are available and what time works best with you.

In preparation for this conference call, I asked the Payne Firm to review your August 19th e-mail that included the list of additional monitoring wells to be sampled on a quarterly basis. They have prepared a summary table (attached) that lists the sampling locations that were identified in the Phase II RFI report for future sampling, as well as the monitoring wells identified in your recent e-mail. The table also presents the data quality objectives for the wells identified in the Phase II RFI report, as well as the apparent data quality objective for the wells EPA identified.
I think that this table will assist in the discussion next week.

Doug

The Payne Firm, Inc.

Vernay Laboratories, Inc.

Plant 2/3 Facility
Yellow Springs, Ohio
Project No. 0292.11.45

TABLE 1: Post-RFI Sampling Locations

Location ID	SAMPLE LOCATIONS			DATA QUALITY OBJECTIVES			
	Current Location to Zone of Influence (ZOI) from Interim Measure Extraction Wells	Current Location to PCE/TCE Contaminant[1] Plume Footprint[2]: Horizontal Extent	Vertical Extent	Upcoming CA750 Stability[3] Demonstration	Confirmation: Efficacy of Interim Measure Extraction Wells[4]	Confirmation: Approved CA725 Demonstration	Verify Contaminant Distribution[5]
CW01-01	Within ZOI	Interior	Extraction Well		X		
CW01-02	Within ZOI	Interior	Extraction Well		X		
MW01-01	Proximal to ZOI	Upgradient to Fringe	Upper	X		X	
MW01-02	Upgradient to ZOI	Upgradient to Fringe	Upper				X
MW01-03	Proximal to ZOI	Fringe	Upper	X		X	
MW01-03CD	Proximal to ZOI	Fringe	Base	X		X	
MW01-04	Within ZOI	Interior	Upper		X		X
MW01-04CD	Within ZOI	Interior	Middle		X		X
MW01-04SE	Within ZOI	Interior	Base	X		X	
MW01-07	Upgradient to ZOI	Upgradient to Fringe	Upper	X		X	
MW01-10	Within ZOI	Interior	Upper				X
MW02-03	Proximal to ZOI	Fringe	Upper		X		X
MW02-03CD	Proximal to ZOI	Fringe	Base		X		X
MW02-03SE	Proximal to ZOI	Fringe	Base				X
MW02-04	Distal to ZOI	Fringe	Upper	X		X	
MW02-04CD	Distal to ZOI	Fringe	Base	X		X	
MW02-06	Distal to ZOI	Interior	Upper				X
MW02-06CD	Distal to ZOI	Fringe	Base				X
MW02-08	Proximal to ZOI	Interior	Upper		X		X
MW02-08CD	Proximal to ZOI	Interior	Middle		X		X
MW02-08SE	Proximal to ZOI	Fringe	Base				X
MW02-09	Distal to ZOI	Interior	Upper				X
MW02-10	Distal to ZOI	Fringe	Upper	X		X	X
MW02-10CD	Distal to ZOI	Fringe	Base	X		X	
MW02-11	Proximal to ZOI	Fringe	Upper		X		X
MW02-11SE	Proximal to ZOI	Fringe	Base				X
MW02-13	Distal to ZOI	Interior	Upper				X
MW02-14	Distal to ZOI	Fringe	Upper	X		X	
MW02-14CD	Distal to ZOI	Fringe	Base	X		X	
MW02-15	Distal to ZOI	Fringe	Upper	X		X	
MW02-15CD	Distal to ZOI	Fringe	Base	X		X	
MW02-17	Proximal to ZOI	Fringe	Upper	X		X	
MW02-17CD	Proximal to ZOI	Fringe	Base	X		X	
RW01-05	Proximal to ZOI	Interior	Upper				X
860 Dayton Street Non-Potable Water Well	Proximal to ZOI	Upgradient to Fringe	No Log			X	
850 Dayton Street Potable Water Well	Proximal to ZOI	Upgradient to Fringe	No Log			X	
780 Dayton Street Potable Water Well	Proximal to ZOI	Upgradient to Fringe	No Log			X	
545 Dayton Street Non-Potable Water Well	Distal to ZOI	Downgradient to Fringe	No Log			X	
690 Wright Street Non-Potable Water Well	Distal to ZOI	Upgradient to Fringe	No Log			X	
MW01-13	Storm Sewer Backfill (On-Facility)						X
ST02-05	Storm Sewer Outfall to Surface Water (first sampling location at unnamed creek)					X	

[1] **"Contamination" and "contaminated"** describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

[2] **"existing area of contaminated groundwater"** is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

[3] **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of the CA750 determination).

[4] Water levels from all monitoring wells will be collected quarterly to assist in the validation of the efficacy of the interim measure (extraction wells).

[5] U.S. EPA August 19, 2005 Request for additional monitoring to construct hydrogeologic cross-sections on a quarterly basis.

David C. Contant

From: Fisher Doug [DougFisher@vernay.com]
Sent: Friday, September 16, 2005 10:21 PM
To: David C. Contant; Kevin D. Kallini; cbuzgo@environcorp.com; Mark Nielsen
Subject: FW: 9/16/05 conference call

FYI

Douglas L. Fisher
Environmental Affairs and Safety Manager Vernay Laboratories, Inc.
120 East South College Street
Yellow Springs, Ohio 45387-1623

Phone: (937) 767-9550
Fax: (937) 767-7913
E-mail: DougFisher@Vernay.com

P "Please consider your environmental responsibility before printing this e-mail"

-----Original Message-----
From: Polston.Patricia@epamail.epa.gov
[mailto:Polston.Patricia@epamail.epa.gov]
Sent: Friday, September 16, 2005 3:33 PM
To: Fisher Doug
Cc: dcc@paynefirm.com; kdk
Subject: 9/16/05 conference call

Doug, I just wanted to summarize our understanding of this morning call. We would like to make sure we are all on the same page. Below is what Colleen and Mario are concerned about and what we would like to see as far as clarifying language.

According to the policy of Region 5 RCRA program, OSHA-PELs are recognized as appropriate health based screening levels for Environmental Indicator (EI) determinations (i.e., CA 725), but not for site remedial decisions beyond the EI (i.e., RFI determinations). OSHA-PELs were included in Appendix VI of the RFI for the Vernay facility. According to the response to comments document submitted to EPA regarding this issue, the OSHA-PELs appear to have been used to screen sampling data for the RFI.

On the phone call this morning, the contractor for Vernay explained that not only were OSHA-PELs used to screen groundwater sampling data for the RFI, but Region 9 PRGs and MCLs were also used for this screening. The use of Region 9 PRGs and MCLs for purposes of screening sampling data in an RFI is acceptable to EPA.

EPA proposed that Vernay change the wording in Appendix VI to indicate that the OSHA-PELs were used as the primary screening levels in the EI determination, but only used as a secondary screening tool in the RFI.
Wording changes in Appendix VI should be very specific regarding the following points: 1) Region 9 PRGs and MCLs were the screening levels used in the RFI; 2) OSHA-PELs are being included in the RFI only as part of the summary of the work that was done for the EI.

Thanks for having everyone available to discuss the risk issues and if you have any questions, please give me a call.

Patricia J. Polston
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David C. Contant

From: Fisher Doug [DougFisher@vernay.com]

Sent: Thursday, September 22, 2005 3:56 PM

To: Polston.Patricia@epamail.epa.gov

Cc: David C. Contant; Kevin D. Kallini; Dan D. Weed; cbuzgo@environcorp.com; Mark Nielsen

Subject: Risk Assessment Revisions

Trish;

Attached is the reviesed section we discussed. Please forward to your team for review.

Thanks

Doug

<<Section 3 Revisions_9-21-05.pdf>>

Douglas L. Fisher

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"Please consider your environmental responsibility before printing this e-mail"

3.0 RFI RESULTS AND EVALUATION

The results of the RFI are discussed in this section. The discussion is divided into subsections that correspond to the AOIs that were investigated. Each subsection includes a brief description of the AOI, the scope of the field investigations conducted during the Phase I and Phase II RFI, a summary of the results, and discussion of the results with respect to whether a potentially significant release of hazardous constituents has been identified, and if so, the nature and extent of the release for risk evaluation purposes.

The presence of a potentially significant release at an area was identified based on comparison of the on- and off-Facility characterization data for soil, ground water, sediment, and surface water with conservative, generic screening criteria. These criteria were selected based on the CSM for human exposures to identify contamination in each of the environmental media investigated. Where a potentially significant release was identified, the screening criteria were then used to guide characterization of the extent of the release for risk evaluation purposes in the affected media. It should be noted that the identification of an area with constituents at concentrations that are higher than these screening criteria does not mean that the concentrations necessarily poses an unacceptable risk; it only means that the potential for the area to pose an unacceptable risk should be evaluated considering site-specific factors. For example, the concentration is identified for further review relative to:

- Concentrations of the constituent at other locations and depths;
- Distribution of the constituent in other environmental media;
- Background levels (as described below);
- Field observations; and
- Previously identified or additional areas of interest (based on operational history in the vicinity of the sample).

The RFI data screening results were also utilized in preparing the CA 725 RCRA Environmental Indicator determination for the Facility. In particular, the screening approach described in this section was used to support the demonstration that current human exposures are under control. This demonstration was documented in the *Resource Conservation and Recovery Act CA725 Environmental Indicators Report* ("CA725 Report"; ENVIRON and Payne Firm, 2004, approved by the U.S. EPA on September 29, 2005). Since completion of the CA275 Report, additional data were collected as part of the RFI. Therefore, the screening evaluation discussed in this section provides an update to the screening results presented in support of the CA725 Environmental Indicators determination.

The screening criteria used for evaluating RFI (Phase I and Phase II) data are discussed in

Sections 3.1 to 3.7. Results of the data comparison are summarized in Table 9 and are also shown on Figures 8 and 9, which are used to facilitate discussion of the characterization results for each investigated area in Sections 3.8 to 3.16. A sample by sample comparison of the results to the screening criteria is provided in Appendix VII. A discussion on the use of the screening criteria for evaluating RFI data quantitatively on the screening summary tables and spatially on the figures is provided in Section 3.7. As depicted on Sheet 1, each AOI includes an approximately 30 foot "buffer zone" that extends into adjacent AOIs. Sample locations that fall within the buffer zone are conservatively included in the screening evaluation for each of the designated AOIs.

Appendix VII describes the characterization of background inorganics concentrations, including sampling locations, and upper confidence limits (UCLs) on the mean for background levels of inorganics in the off-Facility area. Concentrations of inorganics in soil at an AOI that are below these levels are considered to be within background and not Facility-related and not included in the total inorganics concentrations in the screening evaluation. Concentrations higher than these levels are considered Facility-related and are included in the screening evaluation. In addition, the cumulative cancer risks and hazard quotients that are associated with the naturally-occurring background levels, based on the exposure and toxicity assumptions that U.S. EPA Region 9 (2002) used in deriving its PRGs, are also presented in Appendix VII. These background levels of risks are not included in estimates of Facility-related risks.

3.1 Soil Screening Criteria

Based on the CSM, the soil characterization data were compared with the following three types of soil screening criteria: 1) criteria based on direct contact with soil; 2) criteria based on vapor intrusion into indoor air, and 3) criteria based on migration of soil constituents to ground water.

3.1.1 Direct Contact

The primary set of direct contact soil screening criteria used to guide the RFI field investigation was derived from the U.S. EPA Region 9 risk-based preliminary remediation goals (PRGs) for industrial soil (U.S. EPA, 2002). U.S. EPA Region 9 calculated these PRGs using conservative exposure factors for estimating high-end exposure of workers via incidental ingestion, dermal contact, and inhalation of airborne soil constituents in commercial/industrial settings. The risk-based PRGs published by U.S. EPA Region 9 are based on a target cancer risk of 10^{-6} and a target hazard quotient (HQ) of 1.

These PRGs were chosen as the basis for deriving the primary set of direct contact soil screening criteria because they are based on an exposure scenario that is consistent with the current and reasonably expected future land use at the Facility (see discussion in RFI Phase I). The exposure factors used in these U.S. EPA Region 9 PRGs are conservative assumptions about the magnitude, frequency, and duration of exposures, which in combination are expected to provide estimates of exposures that are higher than actual exposures to a large portion (90% to 99%) of worker populations.

The target cancer risk of 10^{-6} used in the U.S. EPA Region 9 cancer-based PRGs is based on the assumption that workers at a site would be exposed to a large number of carcinogenic chemicals in soil. According to U.S. EPA, a target risk of 10^{-6} can be used to develop soil screening criteria (like the PRGs) to ensure that cumulative cancer risk from exposure to multiple human carcinogens in soil at a particular site would not exceed the acceptable cumulative risk limit of 10^{-4} (61 FR 19432, May 1, 1996; U.S. EPA 1996; U.S. EPA 1991b). Using a target cancer risk of 10^{-6} actually means that an individual can be simultaneously exposed to as many as 100 human carcinogens at concentrations equal to the PRGs, and the cumulative cancer risk estimate for the exposure would not exceed 10^{-4}.

At many sites, including the Vernay Facility, workers are potentially exposed to far fewer human carcinogens in soil (i.e., closer to 10 than 100) so that the PRGs calculated using a target cancer risk of 10^{-6} are far more conservative than necessary to protect for simultaneous exposures to multiple carcinogens in soil. As such, the cancer-based PRGs were adjusted to a target cancer risk of 10^{-5} before they were used as screening criteria for guiding the RFI field investigation at the Facility. The appropriateness of making this adjustment was verified by calculations of cumulative cancer risks based on actual RFI soil characterization data, which are discussed in Section 5.

Additionally, because of the current residential land use surrounding the Facility, off-Facility soil samples collected in residential areas were also evaluated by comparing the detected concentrations with soil screening criteria derived from the U.S. EPA Region 9 risk-based PRGs for residential soil (U.S. EPA, 2002). U.S. EPA Region 9 calculated these PRGs using conservative exposure factors for estimating high-end exposure of residents via incidental ingestion, dermal contact, and inhalation of airborne soil constituents in commercial/industrial settings. The risk-based PRGs published by U.S. EPA Region 9 are based on a target cancer risk of 10^{-6} and a target hazard quotient (HQ) of 1. For the off-Facility sewer lines area (AOI 3A), both industrial and residential PRGs are used to evaluate these data, although residential exposure to subsurface soils is not expected. Potential exposures in this area are expected to be limited to occasional excavation workers.

3.1.2 Vapor Intrusion

The vapor intrusion soil screening criteria were derived to identify on-Facility soil conditions that might result in unacceptable exposure of workers to indoor air concentrations if constituents in the soil were to volatilize and migrate through industrial building foundation cracks into indoor air. These criteria were derived using a vapor intrusion modeling approach recommended by U.S. EPA (2003) for screening-level analysis. The model parameters related to soil properties were based on Facility-specific soil conditions and those related to building characteristics were based on conservative regulatory default assumptions for a hypothetical commercial/industrial building.

To assessUnder current conditions of Vernay's Facility operations for the CA725 Report, the vapor intrusion criteria were calculated using permissible exposure limits (PELs) established by the Occupational Safety and Health Administration (DHHS, 1997), or threshold limit values (TLVs) recommended by the American Conference of Government Industrial Hygienists (ACGIH, 2003) for chemicals without PELs. Derivation of these screening criteria is discussed in Appendix VI.

To assess soils for the potential future scenario in which Vernay no longer operates the Facility, vapor intrusion criteria were also calculated based on acceptable risk-based air concentrations. Consistent with the approach described for developing the direct contact screening criteria, these values were calculated using U.S. EPA-derived inhalation unit risk factors (URFs) and inhalation reference concentrations (RfCs), with a target cancer risk of 10^{-5} and a target HQ of 1. Derivation of these screening criteria is discussed in Appendix VI.

3.1.3 Migration to Ground Water

Migration to ground water soil screening criteria were utilized to identify on-Facility soil concentrations that may represent a source of ground water contamination. These criteria are based on the protection of ground water as a drinking water source, and were derived using the procedure outlined in U.S. EPA's Soil Screening Guidance, and incorporate a default dilution-attenuation factor of 20 (U.S. EPA 1996).

The data that screen above the migration to ground water criteria were utilized during the field investigation activities to identify if further investigation of ground water quality (i.e., additional ground water monitoring wells) was necessary in the individual AOIs. Although those soil samples immediately above the Cedarville Aquifer are thought to better represent this potential leaching pathway for use in identifying the need for additional monitoring wells, all samples were conservatively screened for this criteria.

3.2 Cedarville Aquifer Ground Water Screening Criteria

The ground water characterization data collected from monitoring wells screened in the Cedarville Aquifer were compared with the following three types of ground water screening criteria: 1) criteria based on drinking water consumption; 2) criteria based on nonpotable use of ground water, and 3) criteria based on vapor intrusion into indoor air. In addition, based on the water well survey conducted during the RFI (Payne Firm et al., 2004), off-Facility ground water data were compared with conservative nonpotable water use criteria.

3.2.1 Drinking Water

The drinking water criteria were based on Ohio or federal maximum contaminant levels (MCLs) established under the Safe Drinking Water Act, and equivalent drinking water concentrations for constituents without MCLs. The equivalent drinking water concentrations are generic risk-based drinking water limits calculated using conservative standard default exposure factors for estimating high-end exposures via daily drinking water consumption (U.S. EPA, 1991), and target cancer risk and target HQ of 10^{-5} and 1, respectively.

3.2.2 Nonpotable Ground Water

The water well survey conducted during the Phase I RFI (Payne Firm et al., 2004) identified the potential for ground water to be used for nonpotable purposes (e.g., watering lawns, washing cars, filling swimming pools). Therefore, conservative nonpotable water criteria were derived to identify potentially significant exposure to off-Facility ground water used for non-potable purposes. These criteria are based on inhalation exposure to vapor, dermal contact, and incidental ingestion of ground water that may be used to fill a child's play pool (i.e. "kiddie" pool). Derivation of these criteria is described in
Appendix VI.

3.2.3 Vapor Intrusion

~~Two sets of g~~Ground water screening criteria ~~based on vapor intrusion~~ were derived to identify ground water conditions that might result in potentially significant indoor air exposures if constituents in ground water were to volatilize and migrate through cracks in industrial building foundations into indoor air. These criteria were derived in a manner similar to the derivation of the vapor intrusion criteria for soil. To assess current conditions of Vernay's Facility operations for the CA725 Report, ~~O~~one set of ~~these criteria was used to identify such ground water conditions on-Facility, and were derived in a manner similar to the derivation of the vapor intrusion criteria for soil. These~~ criteria ~~were~~ was derived using the same vapor intrusion modeling approach, the same soil properties, the same building characteristics, and the same PELs/TLVs. Similar to the soils evaluation, a second set of criteria were used to identify the potential for significant vapor intrusion at the Facility to assess potential future exposure conditions for the potential scenario in which Vernay no longer operates the Facility. These values were calculated using U.S. EPA-derived inhalation ~~unit risk factors (~~URFs~~)~~ and inhalation ~~reference concentrations (~~RfCs~~)~~, with a target cancer risk of 10^{-5} and a target HQ of 1. Derivation of these screening criteria for ground water is discussed in Appendix VI.

The criteria for evaluating off-Facility areas were derived in a manner similar to the derivation of the on-Facility risk-based criteria, except the building characteristics were based on conservative regulatory default assumptions for a hypothetical residential building. These criteria were calculated using U.S. EPA-derived inhalation ~~unit risk factors (~~URFs~~)~~ and inhalation ~~reference~~

~~concentrations (~~RfCs~~)~~, with a target cancer risk of 10^{-5} and a target HQ of 1. Derivation of these screening criteria for ground water is discussed in Appendix VI.

3.3 Unconsolidated Unit Subsurface Water Screening Criteria

As described in Section 1.4, subsurface water occurs within discontinuous saturated sand seams or saturated sewer backfill of the Unconsolidated Unit. These water bearing zones are not a source of potable or non-potable water because of the extremely low yield and poor water quality (i.e., high turbidity and suspended solids), and the presence of usable ground water in the Cedarville Aquifer. Potential on- and off-Facility worker exposures to subsurface water in these discontinuous locations may occur during occasional excavation activities. In addition, exposures may occur via vapor intrusion into on- and off-Facility buildings.

3.3.1 Construction Worker Contact

The ground water screening criteria based on construction worker contact were derived to identify conditions that might result in significant exposure of construction workers during excavations that extend into the discontinuous saturated zones of the Unconsolidated Unit. These criteria were derived using conservative exposure factors for incidental ingestion, dermal contact, and inhalation of vapors from ground water. They were calculated using a target cancer risk of 10^{-5} and a target HQ of 1. Derivation of these screening criteria is discussed in Appendix VI.

3.3.2 Vapor Intrusion

~~Two sets of s~~Screening criteria ~~based on vapor intrusion~~ were derived to identify conditions in discontinuous saturated zones in the Unconsolidated Unit that might result in potentially significant indoor air exposures if constituents were to volatilize and migrate through cracks in building foundations into indoor air. These criteria were derived following the approach used for the derivation of the vapor intrusion criteria for soil. To assess current conditions of Vernay's Facility operations for the CA725 Report, o~~O~~ne set of these criteria was ~~used to identify such conditions on-Facility, and were derived in a manner similar to the derivation of the vapor intrusion criteria for Cedarville Aquifer ground water. These criteria were~~ derived using the same vapor intrusion modeling approach, the same soil properties, the same building characteristics, and the same PELs/TLVs. Similar to the soil ~~Cedarville Aquifer ground water~~ evaluation, a second set of criteria was used to identify the potential for significant vapor intrusion at the Facility to assess potential future exposure conditions for the potential scenario in which Vernay no longer operates the Facility. These values were calculated using U.S. EPA-derived inhalation ~~unit risk factors (~~URFs~~)~~ and inhalation ~~reference concentrations (~~RfCs~~)~~, with a target cancer risk of 10^{-5} a target HQ of 1. Derivation of both sets of vapor intrusion screening criteria for ground water is discussed in Appendix VI.

The criteria for evaluating off-Facility areas were derived in a manner similar to the derivation of the on-Facility risk-based criteria, except the building characteristics were based on conservative regulatory default assumptions for a hypothetical residential building. These criteria were calculated using U.S. EPA-derived inhalation unit risk factors (URFs) and inhalation reference concentrations (RfCs) with a target cancer risk of 10^{-5} a target HQ of 1. Derivation of both sets of vapor intrusion screening criteria for ground water is discussed in Appendix VI.

3.4 Sediment Screening Criteria

Generic risk-based screening criteria for evaluating the significance of potential exposure to sediments are not well established. Therefore, as a conservative approach to the identification of a potentially significant release to sediment, the sediment characterization data collected during the RFI were compared with the generic risk-based screening criteria described above for evaluating direct contact exposures to soil.

Specifically, sediment samples collected from the unnamed tributary were compared to the soil screening criteria derived from the U.S. EPA Region 9 industrial and residential soil PRGs. Use of these soil screening criteria for evaluating potential exposures to sediments is highly conservative because potential exposures to sediments are expected to be much lower than potential residential exposures to soil.

3.5 Surface Water Screening Criteria

Water samples were collected during the RFI from the Facility's storm sewers and from the Unnamed Creek, as discussed in Section 2.0. Generic risk-based screening criteria for evaluating the significance of potential exposure to surface water are not well established. Therefore, as a conservative approach to the identification of a potentially significant release to surface water, the storm water and surface water characterization data were compared with the ground water screening criteria described above. Specifically, data from the sewers and the Unnamed Creek were compared with criteria developed for evaluating potential exposures via drinking water, exposures to workers during excavation activities, and/or non-potable water ("kiddie pool").

3.6 Indoor Air Screening Criteria

As described above, risk-based screening criteria were derived to identify conditions in soil and/or ground water that might result in potentially significant indoor air exposures if constituents were to volatilize and migrate through cracks in building foundations into indoor. In addition to modeling soil and ground water concentrations that theoretically could result in significant indoor air concentrations, direct indoor air measurements were conducted inside the on-Facility buildings during the RFI to assess the potential significance of this pathway. These direct measurements were compared to the criteria discussed below.

To assessUnder current conditions of Vernay's Facility operations for the CA725 Report, the data were compared with applicable indoor air criteria are PELs established by the Occupational

Safety and Health Administration (DHHS, 1997), or TLVs recommended by the American Conference of Government Industrial Hygienists (ACGIH, 2003) for chemicals without PELs.

To assess indoor air concentrations for the potential scenario in which Vernay no longer operates the Facility, risk-based indoor air screening criteria were derived to evaluate the potential significance of concentrations identified via direct measurement of indoor air constituents within Facility buildings. These values were calculated using U.S. EPA-derived inhalation unit risk factors (URFs) and inhalation reference concentrations (RfCs), with a target cancer risk of 10^{-5} a target HQ of 1. Derivation of these criteria is discussed in Appendix VI.

3.7 Interpretation of Screening Results

As explained in the introductory text in Section 3.0, the screening criteria discussed described in Sections 3.1 through 3.6above were used during the RFI field investigation to guide data collection and support the CA725 Environmental Indicators determination. Soil, ground water, sediment, subsurface water, indoor air and surface water data collected from each phase of the field investigation were compared with these screening criteria to facilitate judgment regarding whether sufficient characterization data have been collected to support a risk assessment to determine whether corrective measures are warranted. As such, the comparison results were used during the RFI field investigation to distinguish constituents, media, and areas where further data collection should be considered from those where further data collection was not necessary. The comparison results were not used to eliminate constituents, media, or areas from a baseline risk assessment. All constituents positively identified in soil, ground water, sediment, subsurface water, indoor air and surface water at the Facility and all investigated areas are included in the baseline human health risk assessment discussed in Section 5.0.

The comparison results for each investigated area are presented in screening summary tables discussed below for each AOI. For each AOI, the comparison results for each matrix are presented on a separate screening summary table, which lists all the target constituents, the number of analyses for each constituent, the number of detections, the range of detected concentrations, the screening criteria, and the ratios of the highest detected concentration for each constituent to the screening criteria. An area is identified to have a potentially significant release if it has at least one ratio that exceeds 1.

To facilitate judgment regarding whether the lateral and vertical extent of contamination has been adequately characterized, the data for certain constituents were selected for display on site figures.