

DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99

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RCRA Corrective Action  
Environmental Indicator (EI) RCRIS code (CA725)

RDMS DocID 00100114

Current Human Exposures Under Control

Facility Name: Synthetic Products  
Facility Address: 375 Barnum Avenue, Stratford, CT 06615  
Facility EPA ID#: CTD 000844365

1. Has all available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action [e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)], been considered in this EI determination?

- If yes - check here and continue with #2 below.
- If no - re-evaluate existing data, or
- if data are not available skip to #6 and enter "IN" (more information needed) status code.

**BACKGROUND**

**Definition of Environmental Indicators (for the RCRA Corrective Action)**

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

**Definition of "Current Human Exposures Under Control" EI**

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

**Relationship of EI to Final Remedies**

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA. The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

**Duration/Applicability of EI Determinations**

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

RCRA REG. NO. 25 CENTER SPECI  
FACILITY Synthetic Prod Co Div of Plastic  
ID. NO. CTD000844365  
FILE NO. R13  
DATE

**Current Human Exposures Under Control  
Environmental Indicator (EI) RCRIS code (CA725)**

2. Are groundwater, soil, surface water, sediments, or air media known or reasonably suspected to be "contaminated"<sup>1</sup> above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	<u>Yes</u>	<u>No</u>	<u>?</u>	<u>Rationale/Key Contaminants</u>
Groundwater	X			See Section 2.2
Air (indoors) <sup>2</sup>		X		See Section 2.3
Surface Soil (e.g., <2 ft)		X		See Section 2.4
Surface Water		X		There are no surface water bodies at the Site.
Sediment		X		There is no sediment at the Site.
Subsurf. Soil (e.g., >2 ft)		X		See Section 2.5
Air (outdoors)		X		See Section 2.6

\_\_\_\_\_ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

X If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

\_\_\_\_\_ If unknown (for any media) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

2.1 Site History

In the 1970s, Ware Chemical (Dart Industries, Inc.) reportedly discharged unreacted and/or partially reacted chemicals generated in a polymer manufacturing batch process, to a dry well leaching system located at the Synthetic Products site (Site). This practice was reportedly discontinued in the late 1970s. In 1983, Dart & Kraft, Inc. (Kraft) divested the Site to Synthetic Products Company (SynPro). During the 1980s and 1990s SynPro manufactured mixed-metal polyvinyl chloride (PVC) heat stabilizers consisting of intermediate metallic salts of barium, cadmium, zinc and antimony in the building located on the northern portion of the Site. Currently SynPro leases the building (former manufacturing building) at the Site to Hampford Research for general warehousing of dry chemicals and as a general maintenance shop. The Raymark Superfund Site is located directly across the road from the Site, and is a contributor to the groundwater contamination existing on the Synthetic Products Site. The presence of chlorinated organic contaminants in groundwater at the Synthetic Products Site is believed to be a result of groundwater migration from the Raymark Superfund Site and, as identified to Connecticut Department of Environmental Protection (CTDEP), remediation and monitoring activities at the Synthetic Products Site have been conducted on that basis. The conclusion that the presence of chlorinated organic contaminants in groundwater is attributable to the Raymark Superfund Site is supported by the remedial investigation completed for the United States Environmental Protection Agency (USEPA) by Tetra Tech NUS, Inc. (Tetra Tech) for the Raymark Site. Details of the remedial investigation are presented in the document entitled "Draft Final Remedial

<sup>1</sup> "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 appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

<sup>2</sup> Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

Investigation, Raymark - OU2 - Groundwater, Stratford, Connecticut" (hereafter, RI Report), dated November 2000 and prepared by Tetra Tech<sup>3</sup>.

Site investigations during the 1980s and 1990s confirmed the presence of organic and inorganic compounds and light non-aqueous phase liquids (LNAPL) in soils and groundwater on Site. Corrective measures, including but not limited to excavation and disposal of the dry well leaching system and contaminated soil; groundwater extraction and treatment; free product recovery; excavation of contaminated soil within and adjacent to the former manufacturing building as part of SynPro's RCRA closure activities; and construction and operation of a soil vapor extraction (SVE) system have been implemented at the Site.

Kraft constructed the SVE system at the Site in May 1999, and has conducted operation, maintenance, and monitoring activities associated with the SVE system since that time. Based on the results of a 48-hour SVE system shut-down test conducted in June 2001 and the results of monthly and quarterly SVE system monitoring conducted since that time, Kraft believes that the SVE system removal rate of volatile organic compounds (VOCs) in the soils beneath the former manufacturing building at the Site is at or near steady state asymptotic conditions and that continued operation of the SVE system will not result in significant further reduction of Site-related VOCs in soil. Kraft has identified this conclusion to CTDEP in the last several Quarterly Monitoring Reports, with no response received back from CTDEP. Kraft's intention to terminate operation of the SVE system was identified to CTDEP in quarterly monitoring reports submitted to CTDEP on March 25, 2002, July 2, 2002, September 18, 2002, and December 30, 2002, however, no response has been received back from CTDEP. The last quarterly monitoring event of the SVE system was conducted on June 14, 2002, and the results are consistent with the results of the last several monitoring events, indicating that continued operation of the SVE system will not result in significant further reduction of Site-related VOCs in soil. Accordingly, the June 2002 quarterly monitoring event of the SVE system was the last monitoring event where soil vapor samples were collected and submitted for chemical analyses. Kraft will continue to operate the SVE system, with monthly monitoring for operation and maintenance related parameters only, until the time of the March 2003 semi-annual groundwater monitoring event, at which time the SVE system will be shut down.

Kraft has also conducted quarterly groundwater monitoring at the Site from August 1999 to September 2001. In the summer of 2001 Kraft proposed to CTDEP that, in accordance with the provisions of a letter from Conestoga-Rovers & Associates (CRA) to CTDEP dated April 22, 1998, the frequency of groundwater monitoring be revised from quarterly to semi-annually. As no response was received from CTDEP, commencing with the September 2001 groundwater monitoring event the frequency of groundwater monitoring was reduced to semi-annually. The most recent groundwater monitoring event was conducted in September 2002. In accordance with the letter from CRA to CTDEP dated April 22, 1998, groundwater monitoring at the Site is to continue for a maximum of 2 years following shut-down of the SVE system. Assuming the results of the semi-annual groundwater monitoring continue to be generally consistent (or show lower concentrations of Site-related contaminants) with recent groundwater monitoring results, Kraft anticipates that the final semi-annual groundwater monitoring event will be conducted in March 2003. Thereafter, Kraft currently anticipates that groundwater monitoring will be conducted on a frequency yet to be negotiated with CTDEP to monitor groundwater conditions at the Site.

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<sup>3</sup> *Draft Final Remedial Investigation, Raymark - OU2 - Groundwater, Stratford, Connecticut. Dated November 2000 and prepared by Tetra Tech, Inc. for USEPA.*

## Assessment of Media Contamination

### 2.2 Groundwater

The Site is located within an area identified by CTDEP as a "GB" Water Classification Area. A "GB" Water Classification Area is defined as, "Groundwater within highly urbanized area of intense industrial activity and where public water is available. May not be suitable for direct human consumption due to waste discharges, spills or leaks, of chemicals and land impacts. The goal is prevent future degradation by preventing any additional discharges which could cause irreversible contamination"<sup>4</sup>. As identified in the well receptor portions of the RI Report, groundwater in the Site vicinity is not used as a potable source. Considering the "GB" classification, and the presence of existing groundwater contamination, groundwater in the vicinity of the Site likely will not be used as such in the foreseeable future. As a result, there is no potential for the contaminated groundwater detected beneath the Site to migrate to any downgradient potable water supply well, and accordingly, there is no "complete pathway" between contaminated groundwater and human receptors such that exposures can be reasonably expected under the current land and groundwater use conditions. Accordingly, groundwater protection criteria applicable to Water Classification Areas "GA" and "GAA" in the State of Connecticut Remediation Standard Regulations<sup>5</sup> (RSRs) are not applicable to the Site.

The only applicable RSR groundwater criteria from a human health exposure perspective is the CTDEP Volatilization Criteria for Groundwater as these criteria may be related to the exposure of workers in the former manufacturing building and downgradient residents via indoor air. Groundwater samples are currently being collected from Site monitoring wells on a semi-annual basis and analyzed for the compounds benzene, toluene, ethylbenzene, xylenes (BTEX), and heptane. The attached Table 2.1 summarizes the concentrations of these parameters detected in groundwater samples collected during the groundwater quality monitoring program implemented at the Site. Of these parameters, only benzene currently is detected in groundwater at concentrations above the CTDEP Industrial/Commercial Volatilization Criteria for Groundwater<sup>5</sup> applicable to the Site, at monitoring wells CRA4S-95, CRA5S-95, CRA6S-95, and CRA6D-95 as indicated in Table 2.1. Though not analyzed for during routine groundwater monitoring activities conducted at the Site, 1,1-dichloroethene (1,1-DCE) and vinyl chloride (VC) also were detected in groundwater at concentrations above the CTDEP Volatilization Criteria for Groundwater the last time these parameters were analyzed for by Kraft in 1995<sup>6</sup>. However, as identified in Section 2.1, the presence of these chlorinated organic compounds in groundwater at the Site is attributable to the Raymark Superfund Site located across the road and hydraulically upgradient of the Site, and is not related to releases at the Synthetic Products Site. The locations of the Site monitoring wells are shown on Figure 2.1.

Also, as detailed in Section 2.3.1, based on air sampling conducted by USEPA in homes and light commercial buildings in the residential area hydraulically downgradient of the Raymark Superfund Site and the Synthetic Products Site, USEPA, CTDEP, the Connecticut Department of Public Health (CTDPH), the Agency for Toxic Substances and Disease Registry (ATSDR), and the Stratford Health Department (SHD) concur that there is no evidence that Synthetic Products Site-related parameters (benzene) pose an unacceptable risk to occupants of these homes and buildings with respect to indoor air quality, as documented in Raymark Bulletin #37

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<sup>4</sup> Murphy, J.E., 1997. *Water Quality Classification Map of Connecticut, Connecticut Natural Resources Atlas Series, Connecticut Department of Environmental Protection, Water Compliance Unit.*

<sup>5</sup> *State of Connecticut Department of Environmental Protection, Remediation Standard Regulations, January 1996.*

<sup>6</sup> *Supplemental Hydrogeologic Investigation Report, Synthetic Products Company, Stratford, Connecticut, dated May 1996 and prepared by CRA.*

(August 2001)<sup>7</sup>. In particular, while the RI Report presents isopleths for benzene concentrations in groundwater that show concentrations of benzene above the CTDEP Residential Volatilization Criteria beneath a portion of the residential area downgradient of the Site, Raymark Bulletin #377 states that only 1,1-DCE (a non-Synthetic Products-related parameter) has been determined to exceed indoor air criteria.

As detailed in the following section discussing current human exposure to indoor air, air modeling has been conducted to evaluate the potential presence of BTEX, heptane, 1,1-DCE, and VC (although as identified herein, the presence of 1,1-DCE and VC at the Site is attributable to the Raymark Superfund Site) in the air inside the former manufacturing building at the Site, and it is concluded that the presence of these parameters in groundwater (and soil gas) beneath the Site do not pose an unacceptable risk to the health of Site workers within the former manufacturing building.

### 2.3 Air (indoors)

#### 2.3.1 General

A review of existing Site information and evaluation of current Site groundwater and soil gas analytical data was recently conducted to determine whether there may be potential for human exposure to Site contamination through the migration of contaminant vapors from groundwater and soil gas to the indoor air of the former manufacturing building at the Site, and to determine whether this potential for human exposure poses an unacceptable risk to workers within the former manufacturing building. Air sampling also was conducted at the Site to evaluate the indoor (in the former manufacturing building) and outdoor concentrations of airborne benzene relative to the CTDEP Industrial/Commercial Target Indoor Air Concentration<sup>5</sup> of 21.5 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) of air. Details of the evaluation conducted are presented in Sections 2.3.2 and 2.3.3.

As detailed in Sections 2.3.2 and 2.3.3, it is concluded that the presence of Site-related parameters in soil gas and groundwater beneath the Site do not pose an unacceptable risk to the health of Site workers within the former manufacturing building with respect to indoor air quality. As identified in Raymark Bulletin #377, USEPA conducted air sampling in homes and light commercial buildings in the residential area hydraulically downgradient of the Raymark Superfund Site and the Synthetic Products Site to determine whether groundwater contaminants volatilize into occupied structures and present a health risk to the occupants of the buildings tested. As identified in Raymark Bulletin #377, while benzene was detected in indoor air at one or more properties, USEPA et al. concluded that benzene was not a concern for indoor air quality in the neighborhood downgradient of the Site.

#### 2.3.2 Evaluation Of Groundwater and Soil Gas Analytical Data

The evaluation conducted involved the comparison of existing soil vapor data from the SVE wells inside the limits of the former manufacturing building with CTDEP Industrial/Commercial Volatilization Criteria for Soil Vapor<sup>5</sup>, and additionally, the development of Site-specific groundwater and soil gas criteria for protection of indoor air quality. Comparisons of the CTDEP Volatilization Criteria for Soil Vapor and the developed Site-specific criteria for soil gas and groundwater were then made with existing analytical data representative of current Site conditions to assess whether the potential exists for an unacceptable risk to the health of workers within the former manufacturing building due to exposure to indoor air.

Site-specific soil gas and groundwater criteria were developed for BTEX and heptane which have historically been detected in soil gas samples collected from the SVE wells beneath the former manufacturing building at the Site and which also are currently being analyzed for during

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<sup>7</sup> Raymark Bulletin #37, August 2001, United States Environmental Protection Agency.

groundwater monitoring events. Site-specific groundwater and soil gas criteria also were developed for 1,1-DCE and VC, which historically were detected in groundwater at concentrations above the CTDEP Volatilization Criteria for groundwater<sup>5</sup> (although as identified herein, the presence of 1,1-DCE and VC at the Site is attributable to migration from the Raymark Superfund Site).

Details of the development of Site-specific groundwater and soil gas criteria for the VOCs listed above for the protection of indoor air quality are presented in Appendix A. The Site-specific criteria were developed based on the physical characteristics of the existing building, the characteristics of the vadose zone soils beneath the Site, and allowable risk-based target indoor air concentrations based on an industrial indoor air exposure scenario. The development of the Site-specific criteria follows the indoor air migration modeling approach applied by USEPA<sup>8</sup>. Brief descriptions of the modeling approach, applied risk-based target indoor air concentrations, Site-specific input parameters applied to develop the Site-specific criteria, and the calculation of the Site-specific criteria are presented in Appendix A. Of note, the developed Site-specific soil gas criteria are similar to the CTDEP Volatilization Criteria for Soil Vapor, as indicated herein.

**2.3.2.1 Comparison of Site-Specific Groundwater Volatilization Criteria  
For Protection of On-site Indoor Air Quality**

The developed Site-specific groundwater volatilization criteria for protection of on-site indoor air quality are summarized below and are compared to the maximum concentrations of parameters detected in the most recent shallow groundwater samples collected on September 18, 2002 (September 1995<sup>6</sup> for 1,1-DCE and VC), as follows:

<i>Analyte</i>	<i>CTDEP Ind./Comm. Volatilization Criteria for Groundwater (µg/L)</i>	<i>Site-Specific Groundwater Volatilization Criteria (µg/L)</i>	<i>Maximum Concentrations Detected in Groundwater<sup>(1)</sup> (µg/L)</i>
Benzene	530	22,582	4,660 (CRA6D-95: September 18, 2002)
Toluene	50,000	534,918	105 (CRA4S-95: September 18, 2002)
Ethylbenzene	50,000	1,311,383	11.8/ND(20) (CRA6S-95: September 18, 2002)
m-Xylene	50,000*	449,196	2.7 (total xylenes) (CRA4S-95: September 18, 2002)
o-Xylene	50,000*	530,080	2.7 (total xylenes) (CRA4S-95: September 18, 2002)
p-Xylene	50,000*	420,612	2.7 (total xylenes) (CRA4S-95: September 18, 2002)
Heptane	NV	20,995	ND(130) (CRA5S-95: September 18, 2002)
1,1-DCE	6	17	570 (CRA4S-95: September 1995)
VC	2	8.2	150 (CRA4S-95: September 1995)

Notes:

µg/L Micrograms per liter.

ND Not detected at the reporting limit indicated in parentheses.

(1) Maximum concentrations detected in the most recent groundwater samples collected from shallow monitoring wells and the location of the maximum detected concentration.

\* Criteria are for total xylenes.

NV No value.

<sup>8</sup> *User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Intrusion into Buildings (Revised)*, USEPA Office of Emergency and Remedial Response, Washington, DC. December 2000.

As identified in the above table, none of the above parameters currently being monitored for in groundwater (BTEX, heptane) were detected at maximum concentrations even close to exceeding the developed Site-specific groundwater criteria for the protection of on-site indoor air quality. Although the historical maximum concentrations of 1,1-DCE and VC detected in groundwater are greater than the developed Site-specific groundwater criteria for protection of indoor air quality, it is not considered likely that significant concentrations of these parameters would exist in soil gas beneath the Site. Based on soil gas sampling experience, even the maximum levels of 1,1-DCE and VC historically detected in groundwater generally do not result in soil gas concentrations that would be greater than the Site-specific soil gas criteria developed for these parameters (use of the more reasonable average concentrations of 1,1-DCE and VC in groundwater on Site would result in even lower soil gas concentrations). This is because the partially saturated capillary fringe immediately above the water table can act as a significant buffer to the volatilization of VOCs from shallow groundwater to soil gas, and results in actual soil gas concentrations that are considerably less than those determined using the theoretical calculations applied in the development of the Site-specific soil gas criteria.

2.3.2.2 Comparison of CTDEP Volatilization Criteria for Soil Vapor and Site-Specific Soil Gas Criteria for Protection of On-site Indoor Air Quality

The CTDEP Volatilization Criteria for Soil Vapor and the developed Site-specific soil gas criteria for protection of indoor air quality are summarized below and are compared to the maximum concentrations detected in the most recent June 14, 2002 SVE system vapor samples, as follows:

<i>Analyte</i>	<i>CTDEP Ind./Comm. Volatilization Criteria for Soil Vapor <sup>(1)</sup> (mg/m<sup>3</sup>)</i>	<i>Site-Specific Soil Gas Criteria (mg/m<sup>3</sup>)</i>	<i>Maximum Concentrations Detected in SVE Vapor Samples <sup>(2)</sup> (mg/m<sup>3</sup>)</i>
Benzene	339	415	0.010U (SVE-1, SVE-2, SVE-3)
Toluene	10,460	11,369	0.079 (SVE-3)
Ethylbenzene	25,524	32,191	0.013 (SVE-1)
m-Xylene	7,659*	10,242	0.050 (m&p xylenes) (SVE-1)
p-Xylene	7,659*	9,454	0.050 (m&p xylenes) (SVE-1)
o-Xylene	7,659*	8,525	0.015 (SVE-1)
Heptane	NV	179,878	0.010U (SVE-1, SVE-2, SVE-3)
1,1-DCE	4.0	1.5	NA
VC	2.55	0.8	NA

Notes:

- (1) Volatilization Criteria for Soil Vapor are presented in the RSRs in units of parts per million (ppm). It is assumed herein that the units of parts per million are on a volumetric basis, and have been converted to units of mg/m<sup>3</sup> accordingly. Industrial/Commercial Volatilization Criteria for Soil Vapor as presented in the RSRs in units of "parts per million" are as follows: benzene, 113 ppm; toluene, 2,615 ppm; ethylbenzene, 5,672 ppm; total xylenes, 1,702 ppm; 1,1-DCE, 1 ppm; and VC, 1 ppm.
  - (2) Maximum concentrations detected in the most recent vapor samples collected on June 14, 2002 from SVE vapor extraction wells SVE-1, SVE-2, and SVE-3 (and the location of maximum detected concentration). Note benzene and heptane were not detected.
- mg/m<sup>3</sup> Milligrams per cubic meter of air.

- NA Not analyzed. The parameters 1,1-DCE and VC are not analyzed for in the current SVE system vapor sampling program.
- NV No value.
- U Non-detect at the associated value.
- \* Criteria are for total xylenes

As identified in the above table, toluene; ethylbenzene; and m,p & o-xylenes were detected in the soil gas samples collected from the SVE wells beneath the former manufacturing building during the June 14, 2002 SVE system monitoring event. These parameters all were detected at concentrations well below both the CTDEP Volatilization Criteria for Soil Vapor and the calculated Site-specific soil gas criteria for the protection of indoor air quality. This demonstrates that the levels of these parameters in soil gas and groundwater beneath the Site do not pose an unacceptable risk to the health of Site workers within the former manufacturing building with respect to indoor air quality.

### 2.3.3 Benzene Air Sampling Events

As identified in Section 2.4 (Surface Soil, <2 feet below grade) and Section 2.5 (Subsurface Soil, >2 feet below grade), based on historical soil sampling activities conducted by Kraft at the Site, benzene was the most prevalent Site-related parameter detected in soil. Benzene was detected in one of three initial screening air samples collected from inside the former manufacturing building at the Site in January 2002, at a concentration of 53  $\mu\text{g}/\text{m}^3$ . Benzene was not detected in either of the other two air samples collected, at a detection limit of 50  $\mu\text{g}/\text{m}^3$ . On April 15, 2002 a more comprehensive air sampling event was conducted at the Site to evaluate the indoor and outdoor concentrations of airborne benzene relative to the CTDEP Industrial/Commercial Target Indoor Air Concentration of 21.5  $\mu\text{g}/\text{m}^3$  of air. The air sampling event included the collection of three samples from inside the former manufacturing building at the Site near the locations of the initial screening air samples collected in January 2002, and seven samples from locations outside the building. Details of the more comprehensive April 2002 benzene air sampling event are presented in Appendix B.

The locations of the air samples collected from inside the former manufacturing building are shown on Figure 2.2. The results of the laboratory analyses of the indoor air samples collected on April 15, 2002 are summarized in Table 2.2. As shown in Table 2.2, benzene was not detected in any of the three indoor air samples collected. The analytical detection limit for the analyses was 15.95  $\mu\text{g}/\text{m}^3$ , which is below the CTDEP Industrial/Commercial Target Indoor Air Concentration of 21.5  $\mu\text{g}/\text{m}^3$ .

The locations of the air samples collected outside the former manufacturing building are shown on Figure 2.3. The results of the laboratory analyses of the outdoor air samples collected on April 15, 2002 are summarized in Table 2.3. As shown in Table 2.3, benzene was not detected in any of the seven outdoor air samples collected. The analytical detection limit for the analyses was 15.95  $\mu\text{g}/\text{m}^3$ , which is below the CTDEP Industrial/Commercial Target Indoor Air Concentration of 21.5  $\mu\text{g}/\text{m}^3$ .

Assuming physical conditions and operational activities occurring inside the former manufacturing building at the Site at the time of the more comprehensive April 2002 benzene air sampling event are representative of current typical conditions inside the building, and since the air samples collected were representative of the air inside the building during the sampling event, it is concluded that benzene is not present inside the building at a concentration above the CTDEP Industrial/Commercial Target Indoor Air Concentration. Furthermore, assuming outdoor physical and transient (for example, traffic frequency) conditions and operational activities of various facilities in the vicinity of the former manufacturing building at the Site on the day of sample collection are representative of current typical conditions, and since benzene was not detected in any of the outdoor air samples collected in the vicinity of the former manufacturing building at the Site, it is concluded that there are no significant sources of benzene vapors impacting the air inside the former manufacturing building.

It is noted that the benzene concentration detected in the initial screening indoor air sample is greater than the benzene concentrations most recently detected in the SVE soil vapor samples (in fact, benzene was not detected in any of the most recent SVE soil vapor samples, at a detection limit of 10 µg/m<sup>3</sup>). Based on the modeling conducted to develop Site-specific groundwater and soil gas criteria for protection of indoor air quality, as identified in Section 2.3.2, however, the single detected concentration of benzene in the air sample is also greater than what would be expected based on the concentrations of benzene in soil vapor and groundwater at the Site. Based on the above noted results of the comprehensive air sampling conducted on April 15, 2002, it is believed that the single detection of benzene during the January 2002 initial screening event is the result of a non-permanent/transient source of benzene vapors that may have been present inside the former manufacturing building at the time of sampling. Regardless, however, the American Conference of Governmental Industrial Hygienists (ACGIH) time weighed average (TWA) indoor air criterion for benzene is 1,600 µg/m<sup>3</sup>. The benzene concentration detected in the initial screening air sample is well below this occupational health and safety standard, demonstrating that there is no risk to workers within the building as a result of the detected benzene concentration.

2.4 Surface Soil (<2 feet below grade) (also addresses Subsurface Soil >2 feet below grade)

2.4.1 May 1995 Supplemental Hydrogeologic Investigation

During May through September 1995, a supplemental hydrogeologic investigation was implemented at the Site to conform to the data objectives of a Phase III site investigation, consistent with the guidance document published by the CTDEP entitled "Transfer Act Site assessment Guidance Document" (November 1991 Revision). Details of the supplemental hydrogeologic investigation completed are presented in the document entitled "Supplemental Hydrogeologic Investigation Report, Synthetic Products Company, Stratford, Connecticut", dated May 1996 and prepared by CRA. As part of the investigation completed at the Site, surficial and sub-surface soil samples were collected from 17 boreholes advanced to determine the nature and extent of Site-related chemical presence. Analytical parameters included target compound list volatile organic compounds (TCL VOCs), target compound list semi-volatile organic compounds (TCL SVOCs), total recoverable petroleum hydrocarbons (TRPH), selected target analyte list (TAL) metals (arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, silver and zinc), selected toxicity characteristic leaching procedure (TCLP) metals, and total organic carbon (TOC). Significant results of the soil sample analyses conducted as part of the supplemental hydrogeologic investigation and rationale demonstrating why soils are not reasonably suspected to be contaminated above appropriate standards are summarized as follows:

VOCs

Benzene was detected above the CTDEP GB Mobility Criterion of 0.2 milligrams per kilogram (mg/kg) at two locations (soil borings SB-3 and SB-4); toluene was detected above the CTDEP GB Mobility Criterion of 67 mg/kg at one location (SB-5A); and heptane was detected above the pollutant mobility criterion of 2.2 mg/kg developed by Kraft (there is no heptane criterion in the CTDEP RSRs) at two locations (SB-3 and SB-5A).

Contaminated soil at soil boring location SB-3 was removed by excavation. Contaminated soil at soil boring locations SB-4 and SB-5A is reasonably expected to have been remediated by operation of the SVE system operated at the Site since May 1999 as identified in Section 2.1.

### SVOCs

Two SVOCs were detected above their respective CTDEP GB Mobility Criteria for soil at soil boring location SB-1B. Benzo(a)anthracene was detected marginally above the criterion of 1.0 mg/kg, and benzo(b)fluoranthene was detected marginally above the criterion of 1.0 mg/kg.

Contaminated soil at soil boring location SB-1B is reasonably expected to have been remediated by natural biodegradation that has occurred since the soil sample was collected in May 1995, as enhanced by operation of the SVE system at the Site since May 1999 as identified in Section 2.1.

### TAL Metals and TCLP Results

Arsenic was detected above the CTDEP Industrial/Commercial Direct Exposure Criterion of 10 mg/kg in a subsurface soil sample collected at soil boring SB-3A, and at the criterion in a subsurface soil sample collected at boring SB-5.

As a result of TCLP analyses conducted on the five soil samples collected during May 1995 with the highest selected TAL metals results, cadmium was detected above the CTDEP GB Mobility Criterion by TCLP at soil boring SB-5, and lead was detected above the CTDEP GB Mobility Criterion by TCLP at boring SB-3.

Metals are prevalent throughout the Site<sup>6</sup>; however, it is likely that they are naturally occurring since most were detected within published background concentrations<sup>6</sup>. Regardless, however, the soil at boring SB-3 was removed by excavation conducted to remove VOC contaminated soil, as identified above, and the soil at boring SB-5 also was excavated and removed during RCRA closure activities.

#### 2.4.2 February 1998 Supplemental Soil Boring Program

In order to evaluate options for the remediation of VOC contaminated soil beneath the former manufacturing building at the Site, additional contaminant distribution data were required from unsaturated soil beneath the former manufacturing building. Accordingly, between February 9 and 13, 1998, soil samples were collected from ground surface to the water table at 23 additional boreholes located beneath the former manufacturing building, and the samples submitted for VOC analyses. Details of the supplemental soil boring program implemented are presented in a letter report from CRA to Kraft dated March 6, 1998<sup>9</sup>. As identified in the March 6, 1998 letter report, only benzene and toluene were detected at concentrations above any applicable regulatory criteria (CTDEP GB Pollutant Mobility Criterion<sup>5</sup>). The results of the February 1998 supplemental soil boring program<sup>9</sup> were used, in part, to design the SVE system constructed at the Site in May 1999.

Contaminated soil at soil boring locations SB-4 and SB-5A is reasonably expected to have been remediated by operation of the SVE system operated at the Site since May 1999, as identified in the Site History section in Item 2.1.

#### 2.4.3 SPC RCRA Closure Activities

The Site is currently leased by SynPro and sub-let to Hampford Research. As part of SynPro's RCRA closure activities at the Site, 14 Areas of Concern (AOC) were identified by SynPro<sup>10</sup>. Details of each AOC are described below. The 14 AOCs identified by SynPro/HRP are generally consistent with the

<sup>9</sup> Letter report from Scott Green of CRA to Romer Wilsek of Kraft, dated March 6, 1998.

<sup>10</sup> RCRA Closure Plan, Parts II & III, Synthetic Products Company, Stratford, Connecticut, dated February 2001 and prepared by HRP.

14 AOCs identified in an Environmental Indicators Review document prepared for USEPA by CTDEP<sup>11</sup>.

#### 2.4.3.1 Building 375 Front Room

The Front Room of the Synthetic Products facility, identified as Area of Concern (AOC) 1, housed approximately twenty (20) process tanks used by SynPro for storage of raw materials, process reactions and finished product storage. Spills in this area were contained by two independent floor trench systems. From 1979 until closure in circa 1998, contents of both of the two sumps were periodically pumped into the 5,000-gallon organic hazardous waste storage tank located in the Back Room (AOC-2). Prior to 1979, both sumps reportedly discharged into a leach field located between Building 375 and Building 301 (see Sec. 2.4.3.10). The soils underlying the Front Room were contaminated with VOCs, SVOCs, TPH and metals identified during RCRA closure activities.

In an effort to obtain clean closure for this area, SynPro first removed the concrete floor in the Front Room and two feet of soil below the floor. An additional volume of soil was excavated to a depth of approximately six feet below grade under the trenches. The total volume of soil removed was approximately 280 cubic yards. Confirmatory samples collected from beneath the excavation were below their respective CTDEP RSR criteria with the exception of sample FBL-1, which was collected approximately 6.5-7.0' below grade beneath the former boiler area in August 1998. Arsenic was detected at 11.3 mg/kg in this sample, which exceeded the RSR criteria for Direct Exposure (10 mg/kg). The area has also been back filled with clean fill and a new concrete floor has been poured. These remedial activities have eliminated human exposure to any significant soil contamination under current land and groundwater use.

To address VOC contamination within the front room, as indicated in Section 2.1, Kraft constructed the SVE system in this area of the Site in May 1999. Based on the results of a 48-hour SVE system shut-down test conducted in June 2001 and the results of monthly and quarterly SVE system monitoring conducted since that time, Kraft has concluded that the SVE system removal rate of VOCs in the soils beneath the former manufacturing building at the Site is at or near steady state asymptotic conditions and continued operation of the SVE system will not result in significant further reduction of VOCs in soil.

#### 2.4.3.2 Building 375 Back Room

Four (4) process tanks and two hazardous waste storage tanks were located in this room (AOC-2). The concrete floor underlying the two (2) hazardous waste storage tanks was removed. As indicated in the RCRA Closure Plan<sup>10</sup>, the contaminants beneath this area that were detected above CTDEP RSR criteria consisted of antimony, benzene, phenol, and TPH. The underlying soil was excavated to a depth of 5.0 feet below the top of the slab. Confirmatory samples collected beneath the excavation were below their respective CTDEP RSR Criteria. Therefore, the detected soil contamination has been remediated. The excavation was backfilled with structural fill and a new concrete floor was poured in the entire Back Room.

#### 2.4.3.3 Building 301 Maintenance Area

SynPro operated a small maintenance area approximately 400 square feet in size located in the Building 301 warehouse. Lubricating oils and solvents were used in this area (AOC-3). Since only minor staining was evident on the floor, it is reasonably expected this area is not a source of contamination to the underlying soil.

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<sup>11</sup> *Review of Draft Environmental Indicators from CTDEP( Marina Crawford) to USEPA, dated February 1998.*

2.4.3.4 Five (5) UST's Located West of Building 375

Five (5) fiberglass lined steel underground storage tank (USTs)<sup>12</sup> of 5,000-gallon capacity each were located immediately west of Building 375 (AOC-4). All 5 tanks were installed in May 1980 and removed in January of 1997. The tank inventory is listed below:

<i>Tank I.D.</i>	<i>Contents</i>
T-1	Ink oil solvent
T-2	Iso octanol
T-3	Mineral oil
T-4	Iso octanol
T-5	Ink oil solvent

Fourteen (14) tank grave samples were collected following the tank removals. Twelve (12) of the tank grave samples exceeded GB PMC for Total Petroleum Hydrocarbons (TPH) via EPA Method 418.1. Six (6) of the fourteen (14) samples also exceeded the Industrial/Commercial DEC for TPH. Of the fourteen (14) samples analyzed for TPH, the four (4) that were also analyzed for VOCs by EPA Method 8240 exceeded the GB PMC for toluene and xylene. The limits of excavation increased and thirteen (13) additional soil samples were collected and analyzed for TPH only. All TPH results were below the GB PMC and Industrial/Commercial DEC. The excavation was then back-filled and paved with asphalt. These remediation activities have eliminated human exposure under the current land and groundwater use conditions.

2.4.3.5 Building 375 – No. 2 Fuel Oil UST

Four (4) steel USTs were used to store fuel oil for use in various on-site boilers in use during different time periods (AOC-5). Two tanks were located north of the building while two tanks were located south of the building<sup>8</sup>. The fuel oil tank inventory is listed below:

<i>I.D</i>	<i>Volume (gallons)</i>	<i>Installation Date</i>	<i>Removal Date</i>
T-6	4,000	May 1973	1990
T-7	1,000	Unknown	1990
T-8	2,000	Unknown	May 1997
T-9	2,000	Unknown	May 1997

Since soil was excavated from each tank grave, backfilled with clean fill, and covered with asphalt pavement, it is reasonably expected that there is no significant human exposure under the current land and groundwater use conditions.

2.4.3.6 Three (3) Above Ground Storage Tanks

Two (2) 5,000 gallon above ground tanks containing dipropylene glycol methyl ethyl and high flash solvent were installed outdoors in 1980 on the south side of Building 375 (AOC-6). The two raw material tanks were removed in 1997. The area beneath the raw material tanks was excavated in 1990 as part of the leach field removal (remediation activities for the leachfield area are summarized in Section 2.4.3.10) and covered with concrete at that time. There were no records of any releases from the raw material tanks. Therefore, it is reasonably expected this area is not a source of contamination to the underlying soil.

<sup>12</sup> Phase I Site Assessment, Synthetic Products Company, Stratford, Connecticut, dated October 31, 1997 and prepared by HRP Associates, Inc..

Additionally, a No. 2 fuel oil storage tank (8,000 gallon capacity) was installed in 1990 adjacent to the raw material tanks. The fuel oil tank remains in service to provide building heat, and is equipped with secondary containment and a leak detection system. Given the spill prevention measures, and since no releases to the environment are known to have occurred from the fuel oil tank, it is reasonably expected that this area is not a source of contamination to the underlying soils.

#### 2.4.3.7 Building 375 Primary Container Storage Area

The primary container storage area (CSA) was located outdoors on the east side of Building 375 (AOC-7). The primary CSA consisted of a concrete pad equipped with a 6-inch secondary containment berm. The area was roofed, fenced and locked at all times during operation. Materials stored in the primary CSA consisted of liquid and solid wastes exhibiting, at different times, the characteristics of ignitability, corrosivity, reactivity, or toxicity (barium, cadmium, non-halogenated solvents, maleic anhydride or phenol).

During RCRA closure activities, the concrete base and soil underlying the primary CSA was excavated and disposed at an off-site licensed facility. As indicated in the RCRA Closure Plan<sup>10</sup>, the contaminants beneath this area that were detected above CTDEP RSR criteria consisted of antimony, arsenic, cadmium and phenol. The area was excavated to a depth of approximately 6.0' below surface grade. The depth of excavation was approximately 1.25' below the groundwater table measured in June 1995. Confirmatory sampling indicated that no contaminants were detected above the applicable RSR criteria, with the exception of 44 mg/kg of arsenic detected at the base of the northern sidewall and 10.3 mg/kg and 10.5 mg/kg detected in two southern sidewall samples. (The Industrial/Commercial DEC for arsenic is 10 mg/kg). Excavation proceeded to the north, and confirmatory sampling indicated that there were no further exceedences detected beneath that portion of the CSA.

As indicated in the RCRA Closure Plan, it has been requested that arsenic not be considered for the basis of clean closure because elevated concentrations of arsenic have been detected site wide in areas not affected by facility operations. The arsenic is believed to be characteristic of the fill brought on site when the initial building was built.

The excavation of the primary CSA was filled with clean soil. In addition, the arsenic detected in the northern sidewall has been removed with the additional lateral excavation. The area in which the two southern sidewall minor exceedences were detected is covered with asphalt. As such, there is no significant human exposure under the current land and ground water use conditions.

#### 2.4.3.8 Building 301 Secondary Containment Storage Area (CSA)

A small area located outdoors on the southeast side of Building 301 was designated as the secondary CSA<sup>10</sup> for hazardous waste (AOC-8). This area was intended for use when the primary container storage area reached capacity. The secondary CSA was never used for this purpose. Instead, compressed gas cylinders and miscellaneous equipment was stored in the area.

The asphalt base, containment berm, and surrounding fence for the secondary CSA were removed during closure activities. Soil samples from beneath the asphalt base confirmed that soil concentrations were below the CTDEP RSR criteria. Therefore, this area was not a source of contamination to the underlying soil.

#### 2.4.3.9 Building 375 – Five (5) Hazardous Waste Storage Tanks

Five (5) hazardous waste above ground storage tanks (AOC-9) were located in the 375 Barnum Avenue facility. The tank inventory is as follows:

- 1,200-gallon former reactor R-1
- 3,000-gallon intermediate organic hazardous waste storage tank
- 5,000-gallon organic hazardous waste storage tank
- 5,000-gallon reaction water hazardous waste storage tank
- 500-gallon reaction water storage tank (ancillary equipment associated with the 5,000 gallon reaction water tank)

SynPro utilized the 1,200-gallon reactor vessel (reactor R-1) as an intermediate hazardous waste storage tank from 1986 until 1994. In 1994, Synthetic Products converted the stainless steel "tank" back into an active reactor vessel. Former reactor R-1 was removed for use at another facility when Ferro purchased Synthetic Products.<sup>10</sup> The remaining four tanks were removed and recycled in 1997 during RCRA closure activities. The secondary containment berm and floor beneath the tanks were excavated and disposed of during front and back room excavation activities. It is reasonably expected that there is no significant human exposure under the current land and groundwater use conditions.

#### 2.4.3.10 Building 375 – Former Leach Field

From 1969 to 1979, process wastewater and floor spills collected in the Front Room trenches reportedly were discharged to a leaching field (AOC-10) located between Building 375 and Building 301.

Kraft's efforts to remediate the leach field began in 1980 and continue to the present time. Remediation activities have included the installation of groundwater recovery and an air stripping project initiated in 1983. The groundwater recovery system operated with limited success until it was shut down in July 1990. Hydrogeological studies performed by Kraft from 1982 until 1990 suggested that a preferred groundwater pathway was inadvertently created by the gravel subbase of a sanitary sewer that crosses the site. As a result, an additional recovery well was installed adjacent to the sewer line to capture free product.

In July 1990, the entire leach field between the former manufacturing building and Building 301 was excavated to groundwater, and the area backfilled with imported fill. The confirmation samples allegedly collected from the sidewalls of the excavation showed the presence of elevated aromatics or chlorinated solvents, indicating that soil contamination existed beyond the limits of the excavation. Based on the soil sampling conducted in February 1995<sup>6</sup>, however, inorganic and organic parameters were not detected above any applicable criteria in soil samples collected near the horizontal limits of excavation of the leach field. It is believed that the excavation "sidewall" samples were collected at the water table and not above the water table, and accordingly, the "sidewall" sample analytical data is likely not representative of Site soils above the water table. Regardless, any residual soil contamination that potentially remained following excavation of the leach field would be minimal and not of environmental concern. Any potentially remaining residual soil contamination from the former leach field above any applicable criteria appears to be confined to near the exterior footings of Building 301 and the steep bank leading up to Ferry Boulevard south of the Site. Any additional remaining residual soil contamination north of the former leach field is reasonably expected to have been remediated by operation of the SVE system operated at the Site since May 1999.

As the entire Site is paved, and since subsurface construction activities normally would not be conducted in close proximity to building footings (and would be of short duration if conducted), there are no complete pathways between the minimal amount, if any, of residual soil contamination remaining and human receptors such that exposures can reasonably be expected. Additionally, while

additional excavation to remove remaining residually contaminated soils, if any, is unwarranted from a human exposure perspective, additional excavation also is not feasible due to the close proximity of the on-Site buildings to the southwest and north, and Ferry Boulevard to the south of the Site.

#### 2.4.3.11 Building 375 Laboratory Satellite Accumulation Area

A small quality control laboratory was formerly located on the north side of Building 375 (AOC-11). Small quantities of hazardous waste were generated in this AOC. One 5-gallon bucket was designated as the satellite accumulation container for this area. Since no releases to the environment are known to have occurred in the laboratory, it is reasonably expected that this area is not a source of contamination to the underlying soils.

#### 2.4.3.12 Filter Blanket Shredder

The Filter Blanket Shredder was used to reduce the volume of waste filter blankets, absorbent material, and rags prior to disposal (AOC-12). A 55-gallon drum located adjacent to the shredder was used as a satellite accumulation area for the shredded filters. The waste filters, absorbent material, and rags were classified as hazardous waste (D005/D006) exhibiting the toxicity characteristic for barium and cadmium. The shredder was located indoors on the eastern side of Building 375, near the Primary Container Storage area. Since no releases to the environment are known to have occurred in the laboratory, it is reasonably expected that this area is not a source of contamination to the underlying soils. In addition, this area was included with RCRA Closure activities completed for the Back Room Area (see Section 2.4.3.2).

#### 2.4.3.13 Building 375 Storm Drain

One (1) catch basin is located on site to collect storm water runoff (AOC-13). The catch basin was equipped with a gasketed cover to be closed during finished product and raw material transfers. A spill of finished product containing 0.2% barium, 0.1% zinc complex, and epoxidized soybean oil occurred in 1993. Some of the 8,000 pounds was released into the catch basin. Asphalt and soils affected by this spill were excavated to a depth of six inches below grade and replaced with clean fill. The original catch basin was excavated and removed and replaced in 1997 during construction activities at the Raymark facility, located adjacent to the north. SynPro believes that these activities have addressed the contamination suspected to have been present in this area.

#### 2.4.3.14 Former Drum Storage Area II

A hazardous waste drum storage area (AOC-14) was formerly located between Building 375 and Building 301. Materials stored in Former Drum Storage Area II were similar to those stored in the Primary Container Storage Area. Former Drum Storage Area II was removed in 1990 during excavation of the former leach field (AOC-10). In addition, excavation to 2 feet below grade was completed adjacent to AOC-14 for RCRA Closure due to the 0.084 mg/L of antimony detected by SPLP analysis in a shallow sample. Confirmatory sampling at the base of the excavated area indicated that there were no exceedences of CTDEP RSR criteria. Therefore, the detected contaminated soil beneath this area has been remediated.

### 2.5 Subsurface Soil (>2 feet below grade)

Assessment of contamination in subsurface soil is combined with the assessment of contamination in surface soil and is included in Section 2.4.

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2.6 Air (Outdoors)

Assessment of contamination in Outdoor Air is combined with the assessment of contamination in Indoor Air, and is included in Section 2.3.

3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

<u>Contaminated Media</u>	Potential <u>Human Receptors</u> (Under Current Conditions)						Food <sup>13</sup>
	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	
Groundwater	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>			<u>No</u>
Air (indoors)	<u>--</u>	<u>--</u>	<u>--</u>				
Soil (surface e.g., <2 ft)	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>
Surface Water	<u>--</u>	<u>--</u>			<u>--</u>	<u>--</u>	<u>--</u>
Sediment	<u>--</u>	<u>--</u>			<u>--</u>	<u>--</u>	<u>--</u>
Soil (subsurface e.g., >2 ft)				<u>--</u>			<u>--</u>
Air (outdoors)	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>	<u>--</u>		

Instructions for Summary Exposure Pathway Evaluation Table:

- Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated") as identified in #2 above.
- enter "yes" or "no" for potential "completeness" under each "Contaminated" Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("\_\_"). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

     If no (pathways are not complete for any contaminated media-receptor combination) -skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).

  X   If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

     If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code.

<sup>13</sup> Indirect Pathway/Receptors (e.g., vegetables, fruits, crops, meat, and dairy products, fish, shellfish, etc.)

Rationale and Reference(s):

3.1 Potential Complete Pathways Between Contamination and Human Receptors

As detailed in Section 2.2, the Site is located within an area identified by CTDEP as a "GB" Water Classification Area. A "GB" Water Classification Area is defined as, "Groundwater within highly urbanized area of intense industrial activity and where public water is available. May not be suitable for direct human consumption due to waste discharges, spills or leaks, of chemicals and land impacts. The goal is prevent future degradation by preventing any additional discharges which could cause irreversible contamination". As identified in the RI Report, groundwater in the Site vicinity is not used as a potable source. Considering the "GB" classification and the presence of existing groundwater contamination, groundwater in the vicinity of the Site likely will not be used as such in the foreseeable future. As a result, there is no potential for the contaminated groundwater detected beneath the Site to migrate to any downgradient potable water supply well, and accordingly, there is no "complete pathway" between contaminated groundwater and human receptors such that exposures from groundwater ingestion can be reasonably expected under the current land and groundwater use conditions.

While there may potentially be a "complete pathway" between contaminants volatilizing from contaminated groundwater beneath the Site and workers in the former manufacturing building, between contaminants volatilizing from groundwater beneath the residential area and occupants of the homes and commercial properties as a result of inhalation of air, and between contaminants volatilizing from groundwater beneath or within utility excavations and construction workers, as detailed in Section 4 such exposures would not be significant.

4. *Can the exposures from any of the complete pathways identified in #3 be reasonably expected to be "significant"<sup>14</sup> (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?*

- If no (exposures can not be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination" (identified in #3) are not expected to be "significant."*
- If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant."*
- If unknown (for any complete pathway) - skip to #6 and enter "IN" status code.*

Rationale and Reference(s):

4.1 Exposures Not Significant

As detailed in Sections 2.2 and 2.3, based on air modeling conducted to evaluate the presence of BTEX, heptane, 1,1-DCE and VC (although the presence of 1,1-DCE and VC at the Site is attributable to the Raymark Superfund Site) in the air inside the former manufacturing building at the Site it is concluded

<sup>14</sup> *If there is any question on whether the identified exposures are "significant" (i.e., potentially "unacceptable") consult a human health Risk Assessment specialist with appropriate education, training, and experience.*

that the presence of these parameters in groundwater (and soil gas) beneath the Site does not pose an unacceptable risk to the health of Site workers within the former manufacturing building. This conclusion is supported by the results of a benzene air sampling event conducted inside the former manufacturing building, as detailed in Section 2.3.3. Additionally, as detailed in Section 2.3.1, based on air sampling conducted by USEPA in homes and light commercial buildings in the residential area hydraulically downgradient of the Raymark Superfund Site and the Synthetic Products Site, it has been concluded by USEPA, CTDEP, CTDPH, ATSDR, and SHD that Synthetic Products Site-related parameters do not pose unacceptable risk to occupants of these homes and buildings with respect to indoor air quality.

As identified in the RI Report, USEPA concluded that while it is possible that excavation (for construction utility maintenance, etc.) could be deep enough to come into contact with shallow groundwater, direct contact with groundwater during excavation activities was considered a minor pathway, and accordingly, was not evaluated in USEPA's baseline risk assessment.

It is possible that utility/construction workers performing on-Site or off-Site subsurface work could potentially be exposed to benzene vapors volatilizing from groundwater. Due to the typical short duration of such subsurface utility work, such potential exposure to benzene vapors would be expected to be minimal. Regardless, however, such exposures may be negated on the Site by the use of institutional controls requiring that all subsurface work be performed under appropriate health and safety protocols by appropriately trained (OSHA 1910.120) personnel.

Immediately south of the Site is a steep bank, extending an estimated 25 to 30 feet upward in elevation to Ferry Boulevard. South of Ferry Boulevard is a major expressway, Interstate Route 95, and a series of expressway access and exit ramps. The southeastern limit of Interstate Route 95 and the associated access/exit ramps is located approximately 400 feet southeast and downgradient of the Site. Within this 400-foot wide area, underground utilities will be managed by the Connecticut Department of Transportation (CTDOT). All CTDOT construction projects are subject to review by the CTDOT Environmental Division which has procedures in place to identify, assess, and manage environmental contamination and associated health and safety issues during construction projects. It can be reasonably anticipated that, given the well known nature of the Raymark Site, any construction activities within the I-95 corridor, downgradient of Raymark (and Synthetic Products) will include appropriate worker protections that will preclude any appreciable threats to worker safety due to groundwater contamination.

The benzene isopleth maps presented in the RI report indicate that levels of benzene in groundwater beyond the I-95 corridor (to the southeast) can be inferred to be at levels significantly less than a part per million. Such levels would not be expected to pose a threat to utility workers that may face inadvertent exposures for short durations.

Accordingly, based on all of the above, while there may potentially be "complete pathways" between contamination and human receptors, any potential exposures are not reasonably expected to be significant.

5. *Can the "significant" exposures (identified in #4) be shown to be within acceptable limits?*

—— *If yes (all "significant" exposures have been shown to be within acceptable limits) -continue and enter "YE" after summarizing and referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health-Risk Assessment).*

—— *If no (there are current exposures that can be reasonably expected to be "unacceptable")-continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.*

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\_\_\_\_\_ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code.

Rationale and Reference(s):

6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

X YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the Synthetic Products facility, EPA ID #CTD 000844365, located at 375 Barnum Avenue, Stratford, CT 06615 under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

\_\_\_\_\_ NO - "Current Human Exposures" are NOT "Under Control."

\_\_\_\_\_ IN - More information is needed to make a determination.

Completed by (signature) RAMUEL J. COY Date 8-25-03  
(print) RAMUEL J. COY  
(title) RFM

Supervisor (signature) Matthew R. Stogland Date 8/25/03  
(print) Matthew R. Stogland  
(title) \_\_\_\_\_  
(EPA Region or State) \_\_\_\_\_

Locations where References may be found:

References 6, 9 - Jay Churchill, Conestoga-Rovers & Associates, Chicago, Illinois (773) 380-9933.

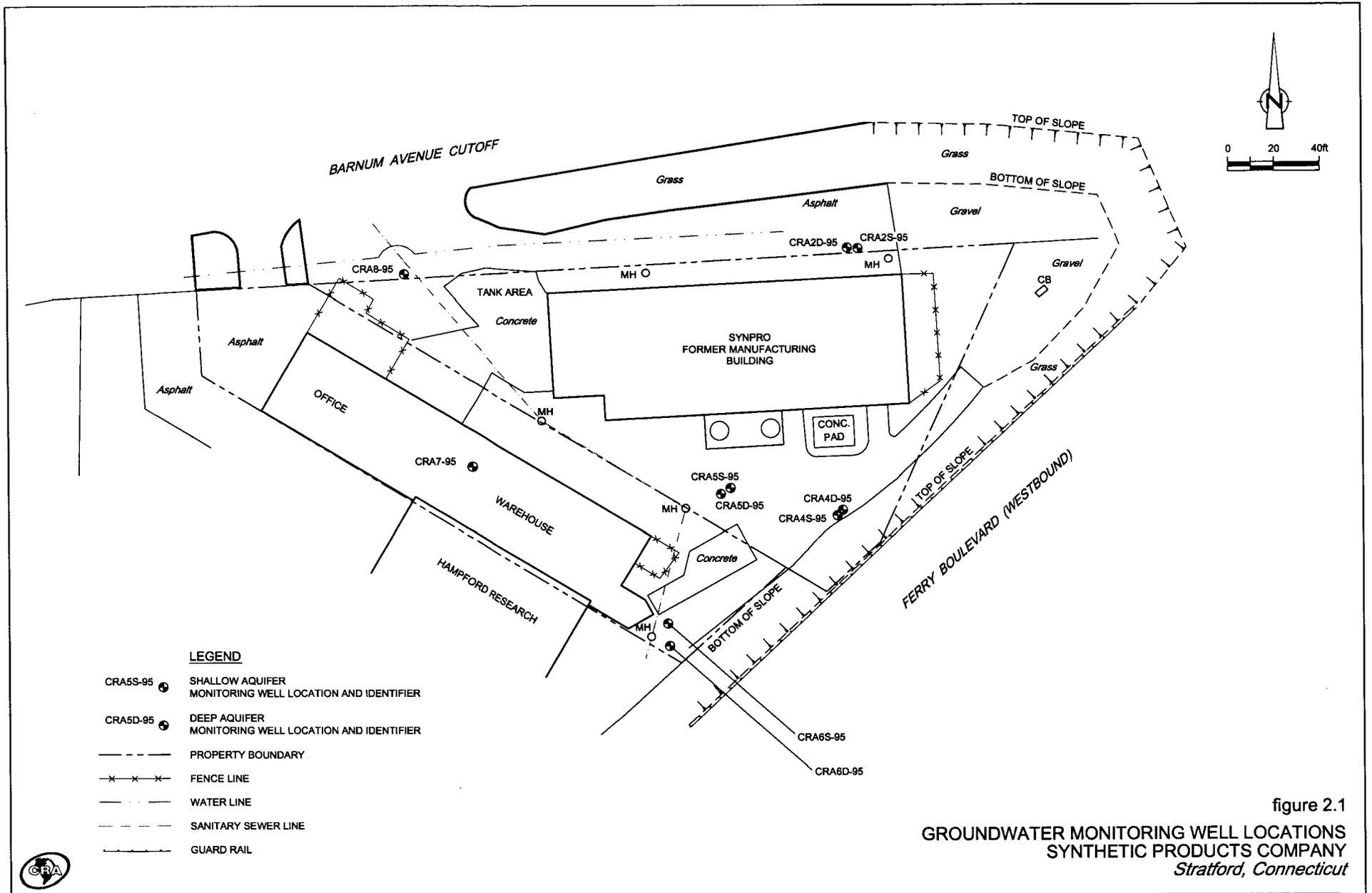
References 10, 12 - Rick McFee, HRP Associates, Inc., Plainville, Connecticut (860) 793-6899.

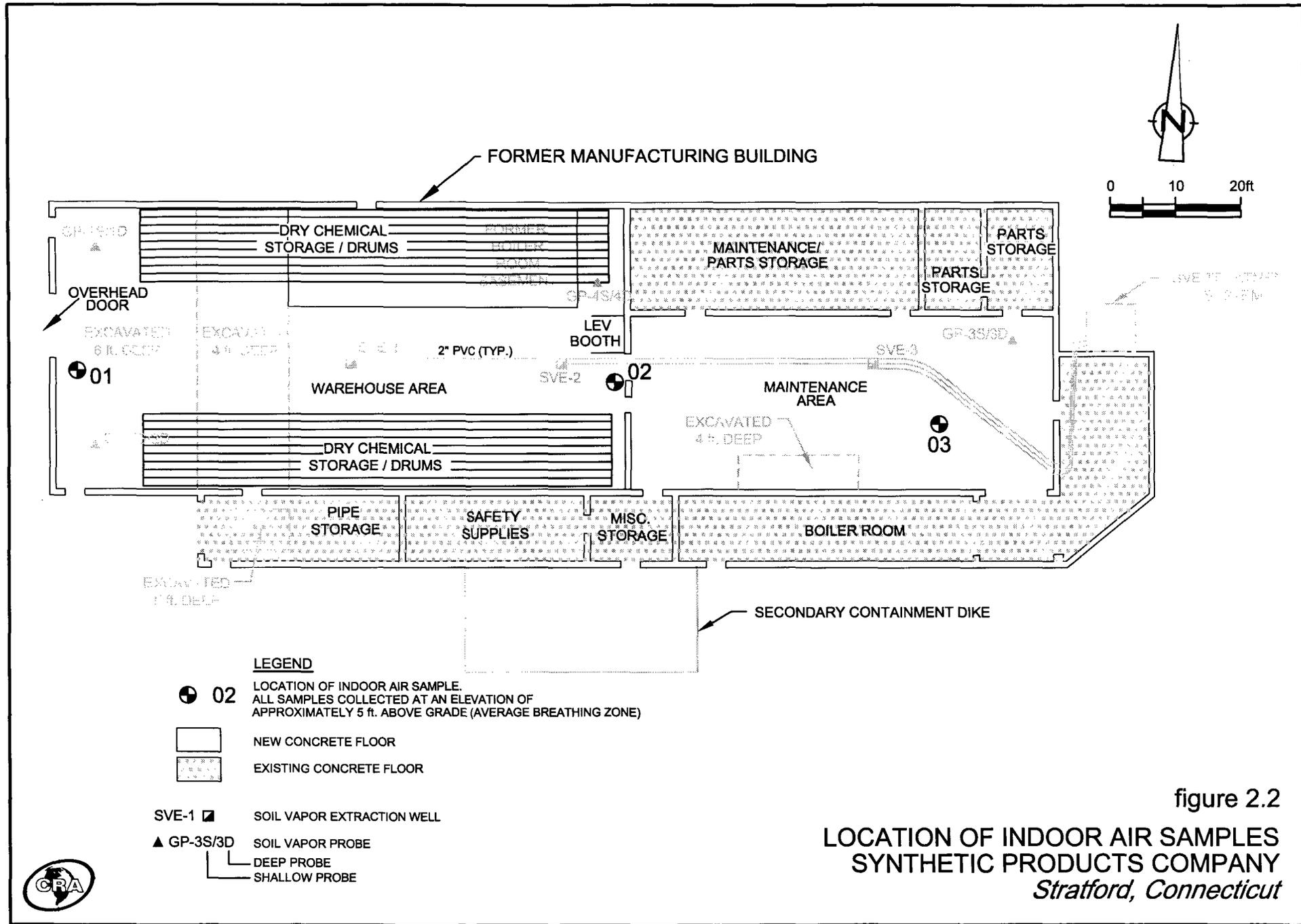
Contact telephone and e-mail numbers:

(name) Mr. Phil McAndrew, Kraft Foods North America  
(phone #) (847) 646-6801  
(e-mail) pmcandrew@Kraft.com

(name) Mr. Jamie Kalanta, Cookson Discontinued Operations Group  
(phone #) (203) 795-0554  
(e-mail) jkalanta@cookson.com

**FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (EG., SITE-SPECIFIC) ASSESSMENTS OF RISK.**





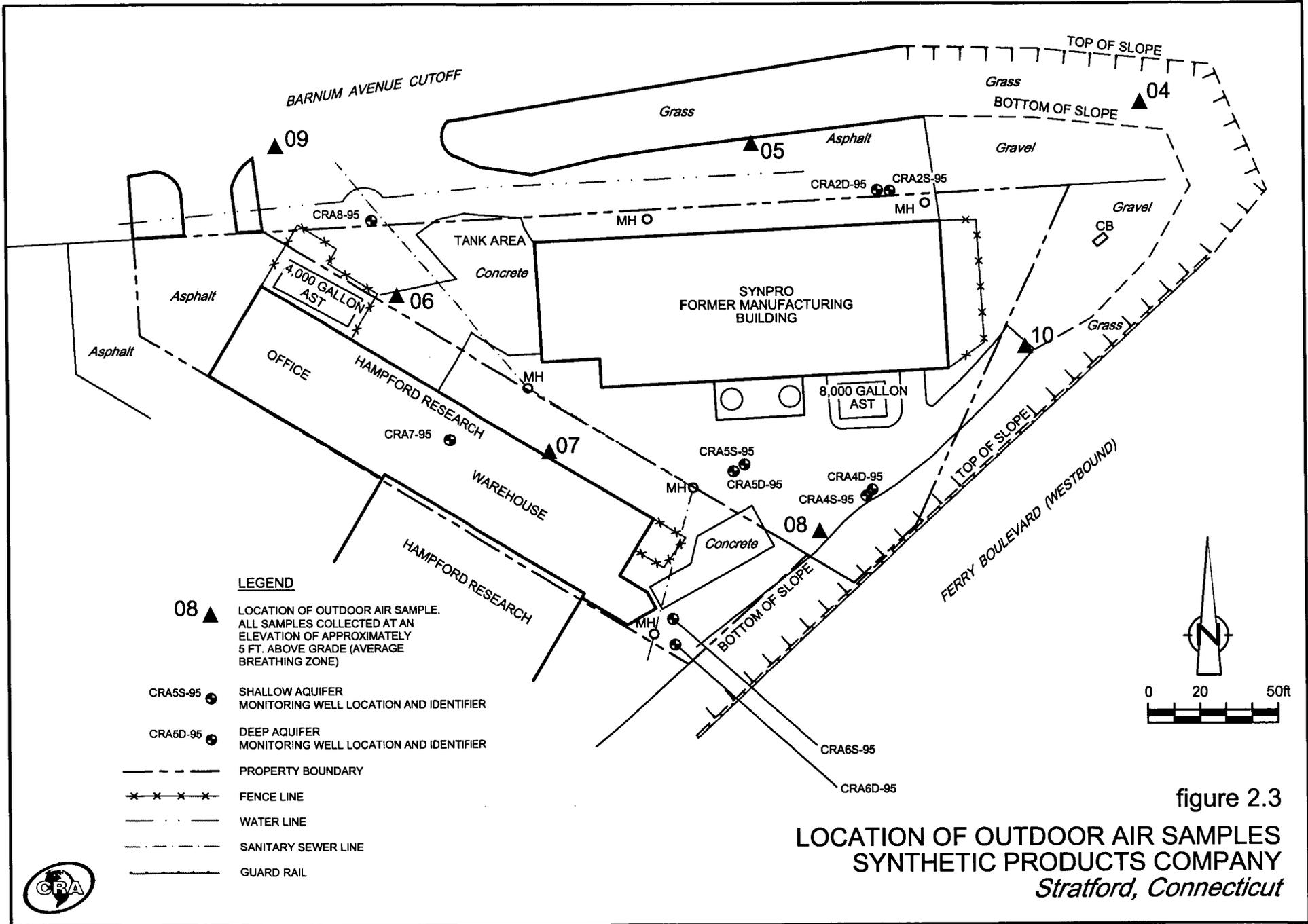


TABLE 2.1

**HISTORICAL GROUNDWATER ANALYTICAL RESULTS SUMMARY  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

Monitoring Well ID	Date Sampled	Benzene	Toluene	Ethylbenzene	Xylenes	Heptane
<b>CTDEP Industrial/Commercial</b>						
<b>Volatilization Criteria for Ground Water</b>		530	50,000	50,000	50,000	NV
CRA2S-95	6/1/95	46	ND (7.1)	ND (7.1)	ND (7.1)	NA
	9/13/95	ND (83)	ND (83)	ND (83)	ND (83)	NA
	8/17/99	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	11/16/99	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	3/16/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	6/8/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	9/12/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	12/19/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
	3/28/01	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
	6/27/01	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
	9/26/01	ND (1.0f)	ND (1.0f)	ND (1.0f)	ND (1.0f)	ND (5.0f)
	3/12/02	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	9/18/02	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	CRA2D-95	6/1/95	ND (83)	ND (83)	ND (83)	ND (83)
9/13/95		ND (83)	ND (83)	ND (83)	ND (83)	NA
8/17/99		ND (20)	ND (20)	ND (20)	ND (20)	ND (100)
11/16/99		ND (20)	ND (20)	ND (20)	ND (20)	ND (100)
3/16/00		ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
6/8/00		ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/12/00		ND (1.0f)	ND (1.0f)	ND (1.0f)	ND (1.0f)	ND (5.0f)
12/19/00		ND (5.0)	ND (5.0)	ND (5.0)	ND (25)	ND (25)
3/28/01		ND (10)	ND (10)	ND (10)	ND (50)	ND (50)
6/27/01		ND (20)	ND (20)	ND (20)	ND (100)	ND (100)
9/26/01		0.88f	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/12/02		ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/18/02		ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (25)
CRA4S-95		6/14/95	620	2,900	ND (120)	ND (120)
	9/13/95	1,000	3,200	ND (100)	ND (100)	NA
	8/17/99	628	ND (10)	ND (10)	ND (10)	ND (50)
	11/16/99	464	7.4	ND (5.0)	ND (5.0)	ND (25)
	3/16/00	220	2.6	ND (1.0)	ND (1.0)	ND (1.0)
	6/8/00	904	10.0	ND (5.0)	ND (5.0)	ND (25)
	9/12/00	738	7.4	ND (5.0)	ND (5.0)	ND (25)
	12/19/00	770	ND (2.5)	ND (2.5)	ND (12)	ND (12)
	3/28/01	331	30.6	1.0	ND (5.0)	ND (5.0)
	6/27/01	127	5.9	ND (5.0)	ND (25)	ND (25)
	9/26/01	445	35.3	1.3	1.6	ND (5.0)
	3/12/02	758	7.1	ND (5.0)	ND (5.0)	ND (250)
	9/18/02	753	105	1.9	2.7	ND (5.0)
	CRA4D-95	6/14/95	47/63	140/190	ND (33)/ND (25)	ND (33)/ND (25)
9/13/95		ND (120)	ND (120)	ND (120)	ND (120)	NA
8/17/99		20.0	ND (10)	ND (10)	ND (10)	ND (50)
11/16/99		ND (10)	ND (10)	ND (10)	ND (10)	ND (50)
3/16/00		ND (10)	ND (10)	ND (10)	ND (10)	ND (50)
6/8/00		19.9	ND (5.0)	ND (5.0)	ND (5.0)	ND (25)
9/12/00		15.5f	ND (1.0f)	ND (1.0f)	ND (1.0f)	ND (5.0f)
12/19/00		5.1	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
3/28/01		ND (5.0)	ND (5.0)	ND (5.0)	ND (25)	ND (25)
6/27/01		ND (10)	ND (10)	ND (10)	ND (50)	ND (50)
9/26/01		164	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/12/02		2.2	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/18/02		0.74f	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)

TABLE 2.1

**HISTORICAL GROUNDWATER ANALYTICAL RESULTS SUMMARY  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

Monitoring Well ID	Date Sampled	Benzene	Toluene	Ethylbenzene	Xylenes	Heptane
<b>CTDEP Industrial/Commercial Volatilization Criteria for Ground Water</b>						
		530	50,000	50,000	50,000	NV
CRA5S-95	6/14/95	9,900	6,200	ND (500)	ND (500)	NA
	9/14/95	16,000/14,000	11,000/9,400	ND (500)/ND (500)	ND (500)/ND (500)	NA
	8/17/99	16,000	ND (50)	ND (50)	ND (50)	ND (250)
	11/16/99	10,500	ND (50)	ND (50)	ND (50)	ND (250)
	3/16/00	3,230	ND (20)	ND (20)	ND (20)	ND (100)
	6/8/00	2,310J	ND (10)	ND (10)	ND (10)	ND (50)
	9/12/00	7,580	ND (20)	ND (20)	ND (20)	ND (100)
	12/19/00	9,460	ND (50)	ND (50)	ND (250)	ND (250)
	3/28/01	6,290	ND (50)	ND (50)	ND (250)	ND (250)
	6/27/01	7,240	ND (50)	ND (50)	ND (250)	ND (250)
	9/26/01	5,680	ND (50)	ND (50)	ND (50)	ND (250)
	3/12/02	4,350J	ND (5.0)	3.0J	ND (5.0)	ND (25)
	9/18/02	2,950	ND (25)	ND (25)	ND (25)	ND (130)
	CRA5D-95	6/14/95	1,200	480	ND (42)	ND (42)
9/15/95		320	ND (12)	ND (12)	ND (12)	NA
8/17/99		152	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
11/16/99		70.2	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/16/00		8.5	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
6/8/00		155	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/12/00		166	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
12/19/00		8.6	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
3/28/01		177	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
6/27/01		223	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
9/26/01		132	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/12/02		40.1	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/18/02		5.4	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
CRA6S-95		6/14/95	15,000	ND(830)	ND (830)	ND (830)
	9/14/95	16,000/17,000	ND (620)/ND (620)	ND (620)/ND (620)	ND (620)/ND (620)	NA
	8/17/99	19,400/15,500	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)
	11/16/99	12,400/22,600	ND (50)/17.6	ND (50)/13.2	ND (50)/11.3	ND (250)/ND (5.0)
	3/16/00	2,520/2,510	14.4/12.7	ND (10)/ND (10)	ND (10)/ND (10)	ND (50)/ND (50)
	6/8/00	13,330/12,500	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)
	9/12/00	12,100/12,200	ND (50)/ND (50)	ND (50)/ND (50)	ND (50)/ND (50)	ND (250)/ND (250)
	12/19/00	10,400/11,400	ND (50)/ND (50)	ND (50)/ND (50)	ND (250)/ND (250)	ND (250)/ND (250)
	3/28/01	8,800/8,210	ND (50)/ND (25)	ND (50)/ND (25)	ND (250)/ND (120)	ND (250)/ND (120)
	6/27/01	10,600/8,860	ND (100)/ND (50)	ND (100)/ND (50)	ND (500)/ND (250)	ND (500)/ND (250)
	9/26/01	4,390/5,790	ND (25)/ND (25)	8.1J/9.6J	ND (25)/ND (25)	ND (120)/ND (120)
	3/12/02	4,750/4,530	ND (20)/ND (20)	ND (20)/ND (20)	ND (20)/ND (20)	ND (100)/ND (100)
	9/18/02	3,460/3,670	1.5/ND (20)	11.8/ND (20)	1.1/ND (20)	ND (5.0)/ND (100)
	CRA6D-95	6/14/95	3,600/3,800	990/1,100	ND (100)/ND (120)	ND (100)/ND (120)
9/14/95		7,100	ND (250)	ND (250)	ND (250)	NA
8/17/99		3,680	ND (10)	ND (10)	ND (10)	ND (250)
11/16/99		7,860	ND (50)	ND (50)	ND (50)	ND (50)
3/16/00		1,770	ND (10)	ND (10)	ND (10)	ND (250)
6/8/00		8,830	ND (50)	ND (50)	ND (50)	ND (50)
9/12/00		9,530	ND (25)	ND (25)	ND (25)	ND (120)
12/19/00		1,220J	ND (5.0)	ND (5.0)	ND (25)	ND (25)
3/28/01		775	ND (5.0)	5.7	ND (25)	ND (25)
6/27/01		2,570	ND (20)	ND (20)	ND (100)	ND (100)
9/26/01		6,990	ND (50)	ND (50)	ND (50)	ND (250)
3/12/02		1,670	ND (10)	ND (10)	ND (10)	ND (50)
9/18/02		4,660	ND (20)	ND (20)	ND (20)	ND (100)

## Notes:

Concentrations in micrograms per liter (µg/L)

ND ( ) Not detected at reporting limit stated in parentheses.

NA Not Analyzed.

J Indicates an estimated value.

4,390/5,790 Sample result/duplicate sample result.

NV No Volatilization Criteria for Groundwater reported.

	Detected concentration exceeds Industrial/Commercial Volatilization Criteria for Groundwater.
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TABLE 2.2

**SUMMARY OF INDOOR AIR SAMPLE ANALYTICAL RESULTS  
APRIL 15, 2002 BENZENE AIR SAMPLING EVENT  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

<i>Sample Location</i>	<i>CTDEP Ind./Com.</i>	<i>01</i>	<i>02</i>	<i>03</i>
<i>Sample Identification</i>	<i>Target Indoor Air Concentration</i>	<i>3627-41502-GP-01</i>	<i>3627-41502-GP-02</i>	<i>3627-41502-GP-03</i>
<u><b>Volatile Organic Compounds (<math>\mu\text{g}/\text{m}^3</math>)</b></u>				
Benzene	21.5	ND (15.95)	ND (15.95)	ND (15.95)

## Notes:

Analytical results in this table are presented in units of micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ), as converted from laboratory analytical data which is reported in units of parts per billion on a volumetric basis (ppbv).

ND ( ) - not detected at detection limit shown in parenthesis.

TABLE 2.3

SUMMARY OF OUTDOOR AIR SAMPLE ANALYTICAL RESULTS  
 APRIL 15, 2002 BENZENE AIR SAMPLING EVENT  
 SYNTHETIC PRODUCTS COMPANY  
 STRATFORD, CONNECTICUT

<i>Sample Location</i>	<i>04</i>	<i>05</i>	<i>06</i>	<i>07</i>	<i>08</i>	<i>09</i>	<i>10</i>
<i>Sample Identification</i>	3627-41502-04	3627-41502-05	3627-41502-06	3627-41502-07	3627-41502-08	3627-41502-09	3627-41502-10
<u>Volatile Organic Compounds (<math>\mu\text{g}/\text{m}^3</math>)</u>							
Benzene	ND (15.95)						

## Notes:

Analytical results in this table are presented in units of micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ), as converted from laboratory analytical data which is reported in units of parts per billion on a volumetric basis (ppbv).

ND ( ) - not detected at detection limit shown in parenthesis.

APPENDIX A

DEVELOPMENT OF SITE-SPECIFIC GROUNDWATER  
AND SOIL GAS CRITERIA  
FOR PROTECTION OF INDOOR AIR QUALITY

## APPENDIX A

### DEVELOPMENT OF SITE-SPECIFIC GROUNDWATER AND SOIL GAS CRITERIA FOR THE PROTECTION OF INDOOR AIR QUALITY SYNTHETIC PRODUCTS COMPANY SITE STRATFORD, CONNECTICUT

#### 1.0 INTRODUCTION

Site-specific groundwater and soil gas criteria for protection of indoor air quality were developed for the compounds benzene, toluene, ethylbenzene, xylenes, and heptane which historically have been detected in soil gas samples collected from the soil vapor extraction (SVE) wells beneath the former manufacturing building at the Site and which also are currently being analyzed for during groundwater monitoring events. The attached Table A.1 presents the concentrations of these parameters detected in soil vapor samples collected since start-up of the SVE system. The attached Table A.2 presents the concentrations of these same parameters detected in groundwater samples collected during the groundwater quality monitoring program being implemented at the Site. Of these parameters, only benzene currently is detected in groundwater above the Connecticut Department of Environmental Protection (CTDEP) Volatilization Criteria for groundwater at monitoring wells CRA4S-95, CRA5S-95, CRA6S-95, and CRA6D-95 as indicated in Table A.2. The Site-specific groundwater and soil gas criteria are compared to detected contaminant concentrations in groundwater and soil gas to assess whether the potential exists for an unacceptable risk to the health of workers within the former manufacturing building due to exposure to indoor air.

Site-specific groundwater and soil gas criteria also were developed for the volatile organic compounds (VOCs) 1,1-dichloroethene (1,1-DCE) and vinyl chloride (VC) which historically were detected in groundwater at concentrations above the CTDEP Volatilization Criteria for groundwater (CRA, 1996<sup>1</sup>). A comparison of the Site-specific groundwater criteria to the historically detected concentrations of these parameters also was conducted.

The development of Site-specific groundwater and soil gas criteria for the protection of indoor air quality is presented herein for the VOCs listed above. The Site-specific criteria were developed based on the characteristics of the existing building, the characteristics of the vadose zone soils observed beneath the Site, and allowable risk-based target indoor air concentrations based on an industrial indoor air exposure scenario. The development of the Site-specific criteria follows the indoor air migration modeling approach applied by the United States Environmental Protection Agency (USEPA) (2000<sup>2</sup>). A brief description of the modeling approach is presented in Section 2.0. A description of the applied risk-based target indoor air concentrations is presented Section 3.0. A description of the Site-specific input parameters applied to develop the Site-specific criteria is presented in Section 4.0. The calculation of the Site-specific criteria is presented in Section 5.0.

#### 2.0 MODELING APPROACH

The Site-specific groundwater and soil gas criteria are applicable in situations where the only potential for human exposure to contamination in the subsurface is through the migration of contaminant vapors to the indoor air of the overlying Site building. The modeling approach is based on the

- 
- 1 CRA, 1996. Supplemental Hydrogeologic Investigation Report, Synthetic Products Company, Stratford, Connecticut, May.
  - 2 USEPA, 2000. User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Intrusion into Buildings (Revised), Office of Emergency and Remedial Response, Washington, DC, December.

selection of an allowable risk-based target indoor air concentration that is protective of human health for an industrial exposure scenario. This allowable indoor air concentration is used to determine an allowable soil gas concentration beneath a building that would not cause an exceedance of the allowable indoor air concentration. The allowable soil gas concentration is converted to a groundwater concentration at the water table based on Henry's law.

The allowable soil gas concentration is determined by estimating the degree of attenuation occurring as contaminant vapors migrate upward through the vadose zone, enter the building, and mix with the air volume within the building. The degree of attenuation is determined using the modelling approach presented by Johnson and Ettinger (1991<sup>3</sup>). Johnson and Ettinger (1991<sup>3</sup>) present a screening-level model which represents the advective-dispersive migration of contaminants in soil gas through the vadose zone soil and building foundation, followed by the mixing of the intruding contaminant vapors with the indoor air volume of the building. The contaminant vapors in soil gas are assumed to be sourced from the presence of soil contamination in the vadose zone and/or groundwater contamination at the water table. The USEPA's implementation of the Johnson and Ettinger (1991) model is applied herein (USEPA, 2000).

The Site-specific groundwater criteria for protection of indoor air quality are calculated from the allowable risk-based target indoor air concentrations using the following:

$$C_{gw} = \frac{C_{air}}{\alpha \times d \times H \times C}$$

where:

- $C_{air}$  - The allowable risk-based target indoor air concentration [micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ )];
- $C_{gw}$  - The calculated groundwater concentration which would not result in an indoor air concentration greater than  $C_{air}$  [micrograms per liter ( $\mu\text{g}/\text{L}$ )];
- $\alpha$  - A calculated soil gas attenuation factor which relates the indoor air concentration to the concentration in soil gas directly above a groundwater or soil source based on the heuristic model developed by Johnson and Ettinger (1991; Equation 21);
- $d$  - A modification factor to convert the theoretical groundwater to soil gas equilibrium concentrations (as determined by Henry's Law) to realistic environmental concentrations (in which equilibrium conditions are unlikely). A value of 0.1 is applied for  $d$ , which corresponds to increasing by a factor of 10 the groundwater concentration predicted by Henry's Law to result from a soil gas concentration immediately above the water table. Conversely, the application of a value of 0.1 for  $d$  corresponds to decreasing by a factor of 10 the soil gas concentration immediately above the water table predicted by Henry's Law to result from a groundwater concentration. The application of this modification factor is related to the recognition that equilibrium conditions, as represented by Henry's Law, between groundwater concentrations and soil concentrations immediately above the water table are unlikely to exist in the actual physical setting due to the presence of a partially saturated zone immediately above the water table, referred to as the capillary fringe. The capillary fringe forms a barrier to contaminant volatilization from groundwater to the vadose zone. A value of 0.1 is selected for  $d$  as a conservative approximation and is

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<sup>3</sup> Johnson, P.C. and R.A. Ettinger, 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings, *Environmental Science and Technology*, 25(8), pp. 1445-1452.

consistent with that applied by Massachusetts Department of Environmental Protection (MDEP) (MDEP, 1994<sup>4</sup>);

- $H$  - Compound-specific dimensionless Henry's Law Constant; and
- $C$  - Units conversion factor of  $10^3$  liters per cubic meter ( $L/m^3$ ).

Equation (1) above can be separated into the following two components:

$$C_{sg} = \frac{C_{air}}{\alpha} \quad (2a)$$

$$C_{gw} = \frac{C_{sg}}{d \times H \times C} \quad (2b)$$

where:

- $C_{sg}$  - the allowable soil gas concentration which would not result in an indoor air concentration greater than  $C_{air}$  ( $\mu g/m^3$ ).

Equation (2a) above is applied herein to determine the Site-specific soil gas criteria. Equation (2b) represents the application of Henry's Law to convert  $C_{sg}$  immediately above the water table to a groundwater concentration to determine the Site-specific groundwater criteria. The application of Henry's Law in the development of the Site-specific groundwater criteria assumes the presence of equilibrium conditions between the water table and soil gas immediately above the water table. As described above, equilibrium conditions are unlikely in the actual physical setting. The presence of the capillary fringe attenuates the volatilization of VOCs from groundwater to soil gas and prevents equilibrium conditions from being established. The application of a value of 0.1 for the modification factor  $d$  in Equations (1) and (2b) is consistent with that applied by MDEP (1994).

The Johnson and Ettinger (1991) soil gas attenuation factor is based on an analytical solution of the advective-dispersive contaminant transport equation for the vadose zone which incorporates intrusion of soil gas vapors through a building foundation and the mixing of these vapors within the air shed of the building. To evaluate the Site-specific criteria, soil gas attenuation factor values are calculated consistent with compound, vadose zone soil, and building properties specific to the Site. The calculation of the Site-specific soil gas attenuation factor is conducted through the application of the Johnson and Ettinger (1991) solution incorporated into a Microsoft Excel spreadsheet model developed by the United States Environmental Protection Agency (USEPA) (USEPA, 2000). The USEPA implementation of the Johnson and Ettinger (1991) model has undergone extensive peer review and is widely accepted by regulatory agencies throughout the United States and Canada. The Site-specific compound, vadose zone soil, and building properties applied to calculate the Site-specific attenuation factor values used in the development of the Site-specific soil gas and groundwater criteria are presented in Section 4.0.

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<sup>4</sup> MDEP, 1994. Background Documentation for the Development of the MCP Numerical Standards, Bureau of Waste Site Cleanup and Office of Research and Standards, April.

### 3.0 RISK-BASED TARGET INDOOR AIR CONCENTRATIONS

The allowable risk-based target indoor air concentrations applied in this analysis correspond to CTDEP's Industrial/Commercial Target Indoor Air Concentration reported in the State of Connecticut Remediation Standard 22a-133k-3 (c)(4). The applied allowable indoor air concentrations are presented in the attached Table A.3.

A CTDEP Industrial/Commercial Target Indoor Air Concentration is not reported for heptane. An allowable indoor air concentration for heptane was calculated from the following:

$$C_{air} = \frac{THQ \times RfD \times BW \times AT \times CF}{InR \times EF \times ED}$$

where:

- $C_{air}$  - allowable indoor air concentration based on inhalation exposure ( $\mu\text{g}/\text{m}^3$ );
- $THQ$  - target hazard quotient. A value of 1.0 is applied;
- $RfD$  - chemical-specific reference dose factor for inhalation exposure [milligrams per kilogram-day ( $\text{mg}/\text{kg}\text{-day}$ )]. A value of 2  $\text{mg}/\text{kg}\text{-day}$  is applied for heptane, as reported by Edwards et al. (1997<sup>5</sup>);
- $BW$  - adult body weight. A value of 70 kilograms is applied;
- $AT$  - averaging time for non-carcinogen (days). A value of 30 years, or 10,950 days is applied;
- $CF$  - conversion factor (1,000  $\mu\text{g}/\text{mg}$ );
- $InR$  - inhalation rate [cubic meters per day ( $\text{m}^3/\text{d}$ )]. A value of 20  $\text{m}^3/\text{d}$  is applied based on an adult inhalation rate;
- $EF$  - exposure frequency [days per year ( $\text{d}/\text{yr}$ )]. A value of 350  $\text{d}/\text{y}$  is applied; and
- $ED$  - exposure duration (years). A value of 30 years is applied.

Applying the input parameters described above provides an allowable risk-based target indoor concentration of 7,300  $\mu\text{g}/\text{m}^3$  for heptane.

### 4.0 SITE-SPECIFIC INPUT PARAMETERS

The modeling approach applied to develop Site-specific soil gas and groundwater criteria consists of evaluating a Site-specific value for the Johnson and Ettinger (1991) soil gas attenuation factor  $\alpha$ . The Site-specific calculation of  $\alpha$  is based on compound, vadose zone soil, and building property data specific to the Site. For the analysis presented herein, the applied vadose zone soil properties are considered consistent with measured data for the sand and gravel deposit beneath the Site that

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<sup>5</sup> Edwards, D.A., Andriot, M.D., Amoruso, M.A., Tummey, A.C., Bevan, C.J., Tveit, A., Hayes, L.A., Youngren, S.H., and Nakles, D.V., 1997. Total Petroleum Hydrocarbon Working Group Series Volume 4: Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH), Amherst Scientific Publishers, Amherst, Massachusetts.

comprises both the vadose and saturated zones. The applied building properties correspond to that of the existing Site building.

### Compound Properties

Site-specific compound properties applied in the calculation of the Johnson and Ettinger (1991) soil gas attenuation factor consist of a Henry's Law constant, a water diffusion coefficient, an air diffusion coefficient, and organic carbon partitioning coefficient. Values for these compound properties, specific to each compound under consideration, are applied as incorporated into the chemical property database implemented in USEPA (2000). For heptane, compound properties are not contained in USEPA (2000) and the applied compound properties for heptane correspond to those reported by Gustafson et al. (1997<sup>6</sup>; Table 3). The compound properties applied to develop the Site-specific soil and groundwater criteria for each compound under consideration are presented in the attached Table A.3. The compound properties of Henry's Law constant and air diffusion coefficient were corrected to a vadose zone temperature of 20 degrees Celsius corresponding to the average groundwater temperature measured during monitoring well purging for the September 18, 2002 groundwater sampling event. The groundwater temperatures measured during the most recent groundwater monitoring event conducted in September 2002 are warmer than groundwater temperatures measured during the three previous monitoring events on March 12, 2002, September 26, 2001, and June 27, 2001, leading to greater volatilization potential, and are therefore considered conservative.

### Vadose Zone Soil Properties:

The vadose zone beneath the Site consists of a sand and gravel deposit. The Site-specific vadose zone soil physical properties applied in the development of the Site-specific soil gas and groundwater criteria consist of the following:

- soil moisture content,  $\theta_m$  :  
Moisture content value of 8 percent is applied to reflect conservative moisture content levels expected within the sand and gravel deposit comprising the vadose zone;
- porosity,  $\epsilon_T$  :  
A porosity value of 30 percent is applied and is considered representative of the sand and gravel comprising the vadose zone. Fetter (1994<sup>7</sup>) indicates that a porosity value of between 20 and 35 percent is appropriate for soils described as mixed sand and gravel;
- dry bulk soil density,  $\delta_{ab}$  :  
A dry bulk soil density value of 1.852 grams per cubic centimeter ( $\text{g}/\text{cm}^3$ ) is applied and is calculated using the relationship  $\delta_{ab} = (1 - \epsilon_T) \times G_s \times \rho_w$ , where a specific gravity  $G_s$  of 2.65 was assumed and a water density  $\rho_w$  of  $998.2 \text{ kg}/\text{m}^3$  at  $20^\circ\text{C}$  was applied; and
- hydraulic conductivity which is converted to a vadose zone effective vapor permeability to vapor flow,  $k_v$  :  
A hydraulic conductivity value of  $1.52 \times 10^{-2}$  centimeters per second ( $\text{cm}/\text{s}$ ) is applied based on the geometric mean of the hydraulic conductivity values determined from single-well response

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<sup>6</sup> Gustafson, J.B, J.G. Tell, and D. Orem, 1997. Total Petroleum Hydrocarbon Working Group Series Volume 3: Selection of Representative TPH Fractions Based on Fate and Transport Considerations, Amherst Scientific Publishers, Amherst, Massachusetts, July.

<sup>7</sup> Fetter, C.W., 1994. Applied Hydrogeology, Third Edition. Upper Saddle River, N.J., Prentice Hall.

tests conducted at Site monitoring wells completed within the sand and gravel deposit (CRA, 1996). The hydraulic conductivity is converted to an intrinsic permeability  $k_i$  (as indicated in the attached Table A.3). A relative vapor permeability  $k_r$  is determined after Parker et al. (1987<sup>8</sup>) for a sand soil type as implemented in USEPA (2000) (as indicated in the attached Table A.3). The effective vapor permeability is equal to the product of  $k_i$  and  $k_r$  (as indicated in the attached Table A.3).

Building Properties:

The following building properties are applied and are considered consistent with the former manufacturing building that exists at the Site:

- below grade building surface area,  $A_B$  :  
A 794 square meter (8,550 square feet) total area is applied. This area is based on the equivalent length and width of the existing Site building of 162 feet and 51 feet, respectively, with slab-on-grade construction and a floor slab thickness of 8 inches. The Site building is irregular in shape and the building area must be input using the dimensions of a rectangular area. The equivalent length and width were selected to closely match the overall rectangular building shape and to provide an area equivalent to the total building area calculated based on the actual building footprint;
- building volume,  $V_B$  :  
A 5,147 cubic meter volume is applied based on the approximate equivalent length and width of the existing Site building of 162 feet and 51 feet, respectively, and an average ceiling height of 22 feet;
- building indoor air exchange rate,  $T_{air}$  :  
An indoor air exchange rate of 0.83 building volumes per hour was applied consistent with the industrial enclosed-space air exchange rate stipulated in the American Society for Testing and Materials (ASTM) Standard Guide in Risk-Based Corrective Action at Petroleum Release Sites (ASTM, 1995<sup>9</sup>);
- distance from the building floor to the groundwater impact,  $L_T$  :  
A distance of 2.04 meters is applied based on the average depth to groundwater of approximately 6.7 feet measured at shallow Site monitoring wells during the June 27, 2001 groundwater sampling event (CRA correspondence to CTDEP dated January 2, 2002). The average depth to groundwater measured in June 2001 is less (higher water table) than the average depth measured during the three most recent groundwater monitoring events conducted on September 26, 2001, March 12, 2002, and September 18, 2002 and therefore results in a more conservative calculation; and
- ratio of building crack area to building below-grade area,  $\eta$  :  
A value of 0.1 percent is applied which is consistent with the assumption that 1 millimeter wide cracks with a spacing 1 meter exist along the floor of the Site building.

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<sup>8</sup> Parker, J.C., R.J. Lenhard, and T. Kuppusamy, 1987. A Parametric Model for Constitutive Properties Governing Multiphase Flow in Porous Media, Water Resources Research, Vol. 23, No. 4, pp. 618-624.

<sup>9</sup> ASTM, 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, ASTM Designation: E1739-95, West Conshohocken, PA.

5.0 **CALCULATION OF SITE-SPECIFIC CRITERIA FOR PROTECTION OF INDOOR AIR QUALITY**

The calculations of the Site-specific soil gas and groundwater criteria for protection of indoor air quality are presented in the attached Table A.3. All applied input parameters and the basis for these parameters are presented in Table A.3.

The Site-specific soil gas criteria for protection of indoor air quality are summarized below and are compared to the maximum concentrations detected in the most recent June 14, 2002 SVE system vapor samples, as follows:

<i>Analyte</i>	<i>Site-Specific Soil Gas Criteria (mg/m<sup>3</sup>)</i>	<i>Maximum Concentrations Detected in SVE Vapor Samples <sup>(1)</sup> (mg/m<sup>3</sup>)</i>
Benzene	415	0.010U (SVE-1, SVE-2, SVE-3)
Toluene	11,369	0.079 (SVE-3)
Ethylbenzene	32,191	0.013 (SVE-1)
m-Xylene	10,242	0.050 (m&p Xylenes) (SVE-1)
p-Xylene	9,454	0.050 (m&p Xylenes) (SVE-1)
o-Xylene	8,525	0.015 (SVE-1)
Heptane	179,878	0.010U (SVE-1, SVE-2, SVE-3)
1,1-DCE	1.5	NA
VC	0.8	NA

Notes:

mg/m<sup>3</sup> Milligrams per cubic meter of air.

NA Not analyzed. The parameters 1,1-DCE and VC are not analyzed for in the current SVE vapor sampling program.

U Non-detect at the associated value.

(1) Maximum concentrations detected in the most recent vapor samples collected on June 14, 2002 from SVE vapor extraction wells SVE-1, SVE-2, and SVE-3 (and the location of maximum detected concentration). Note benzene and heptane were not detected.

The Site-specific groundwater criteria for protection of indoor air quality are summarized below and are compared to the maximum concentrations detected in the most recent shallow groundwater samples collected on September 18, 2002 (September 1995 for 1,1-DCE and VC), as follows:

<i>Analyte</i>	<i>Site-Specific Groundwater Criteria (µg/L)</i>	<i>Maximum Concentrations Detected in Groundwater<sup>(1)</sup> (µg/L)</i>
Benzene	22,582	4,660 (CRA6D-95: September 18, 2002)
Toluene	534,918	105 (CRA4S-95: September 18, 2002)
Ethylbenzene	1,311,383	11.8/ND(20) (CRA6S-95: September 18, 2002)
m-Xylene	449,196	2.7 (total xylenes) (CRA4S-95: September 18, 2002)
o-Xylene	530,080	2.7 (total xylenes) (CRA4S-95: September 18, 2002)
p-Xylene	420,612	2.7 (total xylenes) (CRA4S-95: September 18, 2002)
Heptane	20,995	ND(130) (CRA5S-95: September 18, 2002)
1,1-DCE	17	570 (CRA4S-95: September 1995)
VC	8.2	150 (CRA4S-95: September 1995)

Notes:

µg/L Micrograms per liter.

ND Not detected at the reporting limit indicated in parentheses.

(1) Maximum concentrations detected in the most recent groundwater samples collected from shallow monitoring wells and the location of the maximum detected concentration.

## 6.0 CONCLUSIONS

The concentrations of benzene, toluene, ethylbenzene, xylenes, and heptane detected in the SVE system vapor samples and in groundwater are all below the respective Site-specific criteria for protection of indoor air quality. This demonstrates that the levels of these parameters in soil gas and groundwater beneath the Site do not pose an unacceptable risk to the health of Site workers within the former manufacturing building.

Although the historical concentrations of 1,1-DCE and VC detected in groundwater are greater than the developed Site-specific groundwater criteria for protection of indoor air quality, it is not considered likely that significant concentrations of these parameters would exist in soil gas beneath the Site. Based on CRA's soil gas sampling experience, the levels of 1,1-DCE and VC historically detected in groundwater generally do not result in soil gas concentrations that would be greater than the Site-specific soil gas criteria developed for these parameters. This is because the partially saturated capillary fringe immediately above the water table can act as a significant buffer to the volatilization of VOCs from shallow groundwater to soil gas, and results in actual soil gas concentrations that are considerably less than those determined using the theoretical calculations applied in the development of the Site-specific soil gas criteria.

TABLE A.1

**HISTORICAL ANALYTICAL RESULTS SUMMARY  
SVE SYSTEM VAPOR SAMPLES  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

Sample Location	Date Sampled	Benzene	Toluene	Ethylbenzene	M&P Xylene	O-Xylene	Heptane
SVE-1	5/20/99	16	2.7	0.83U	0.83U	0.83U	0.83U
	12/7/99	0.05U	0.39	0.063	0.15	0.028J	1.3
	3/7/00	0.05U	1.3B	0.1	0.128	0.023J	0.58
	6/7/00	0.032B	0.069	0.002J	0.005J	0.001J	0.005U
	9/12/00	0.079B	0.058	0.0077	0.033	0.010	0.62E
	12/20/00	0.034B	0.018	0.002J	0.0066	0.0022	0.02
	3/29/01	0.0084U	0.027	0.0011J	0.006	0.0017J	0.014
	6/25/01	0.01U	0.035	0.005U	0.0064	0.0017J	0.013
	6/27/01	0.01U	0.04	0.005U	0.0045J	0.005U	0.047
	9/11/01	0.028U	0.14	0.0012J	0.0052	0.005U	0.032
	12/27/01	0.007J	0.046	0.004J	0.010J	0.003J	0.010U
	3/4/02	0.010U	0.020	0.010U	0.010U	0.010U	0.055
	6/14/02	0.010U	0.069	0.013	0.050	0.015	0.010U
SVE-2	5/20/99	10	1.1	0.5U	0.5U	0.5U	0.5U
	12/7/99	0.051	0.47	0.016J	0.045J	0.05U	1.1
	3/7/00	0.058B	1B	0.2	0.41	0.084	0.1
	6/7/00	0.009U	0.1	0.002J	0.006	0.001J	0.015
	9/12/00	0.0069B	0.031	0.0053	0.017	0.0061	0.039
	12/20/00	0.0065B	0.027	0.001J	0.0029	0.0010	0.024
	3/29/01	0.0085U	0.012	0.001J	0.002J	0.001J	0.010
	6/25/01	0.0064U	0.021	0.005U	0.005U	0.005U	0.005U
	6/27/01	0.0054U	0.031	0.005U	0.0035J	0.005U	0.024
	9/11/01	0.034U	0.13	0.005U	0.0056	0.005U	0.005U
	12/27/01	0.006J	0.014	0.010U	0.010U	0.010U	0.010U
	3/4/02	0.010U	0.015	0.010U	0.010U	0.010U	0.021
	6/14/02	0.010U	0.058	0.005J	0.017	0.004J	0.010U
SVE-3	5/20/99	28	240	10U	10U	10U	820
	12/7/99	10U	88	10U	10U	10U	520
	3/7/00	22B	290B	5U	5U	5U	240
	6/7/00	0.1U	3.2	0.1U	0.1U	0.1U	5.2
	9/12/00	0.445B	3.7	0.25U	0.25U	0.25U	28E
	12/20/00	0.168JB	0.96	0.2U	0.2U	0.2U	13
	3/29/01	0.042U	0.065	0.05U	0.05U	0.05U	0.05U
	6/25/01	0.0068U	0.0278	0.0056U	0.0056U	0.0056U	0.2778
	6/27/01	0.0047UJ	0.023	0.005U	0.0032J	0.005U	0.095
	9/11/01	0.005UR	1.2J	0.005UR	0.005UR	0.005UR	0.005UR
	12/27/01	0.020U	0.056	0.020U	0.020U	0.020U	4.800
	3/4/02	0.020U	0.058J	0.020U	0.020U	0.020U	0.640J
	6/14/02	0.010U	0.079	0.006J	0.022	0.006J	0.010U

## Notes:

All results presented in milligrams per cubic meter (mg/m<sup>3</sup>).

U - Non-detect at associated value.

B - Compound also detected in method blank.

J - The associated value is an estimated quantity.

E - Result is estimated due to concentration exceeding the range of instrument linearity.

R - Data unusable based on data quality assessment and validation.

June 27, 2001 results are at completion of 48-hour SVE system shut-down test.

TABLE A.2

**HISTORICAL GROUNDWATER ANALYTICAL RESULTS SUMMARY  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

<i>Monitoring Well ID</i>	<i>Date Sampled</i>	<i>Benzene</i>	<i>Toluene</i>	<i>Ethylbenzene</i>	<i>Xylenes</i>	<i>Heptane</i>
<b>CTDEP Industrial/Commercial</b>						
<b>Volatilization Criteria for Ground Water</b>		<b>530</b>	<b>50,000</b>	<b>50,000</b>	<b>50,000</b>	<b>NV</b>
CRA2S-95	6/1/95	46	ND (7.1)	ND (7.1)	ND (7.1)	NA
	9/13/95	ND (83)	ND (83)	ND (83)	ND (83)	NA
	8/17/99	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	11/16/99	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	3/16/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	6/8/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	9/12/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	12/19/00	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
	3/28/01	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
	6/27/01	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
	9/26/01	ND (1.0J)	ND (1.0J)	ND (1.0J)	ND (1.0J)	ND (5.0J)
	3/12/02	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	9/18/02	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
	CRA2D-95	6/1/95	ND (83)	ND (83)	ND (83)	ND (83)
9/13/95		ND (83)	ND (83)	ND (83)	ND (83)	NA
8/17/99		ND (20)	ND (20)	ND (20)	ND (20)	ND (100)
11/16/99		ND (20)	ND (20)	ND (20)	ND (20)	ND (100)
3/16/00		ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
6/8/00		ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/12/00		ND (1.0J)	ND (1.0J)	ND (1.0J)	ND (1.0J)	ND (5.0J)
12/19/00		ND (5.0)	ND (5.0)	ND (5.0)	ND (25)	ND (25)
3/28/01		ND (10)	ND (10)	ND (10)	ND (50)	ND (50)
6/27/01		ND (20)	ND (20)	ND (20)	ND (100)	ND (100)
9/26/01		0.88J	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/12/02		ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/18/02		ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (25)
CRA4S-95		6/14/95	620	2,900	ND (120)	ND (120)
	9/13/95	1,000	3,200	ND (100)	ND (100)	NA
	8/17/99	628	ND (10)	ND (10)	ND (10)	ND (50)
	11/16/99	464	7.4	ND (5.0)	ND (5.0)	ND (25)
	3/16/00	220	2.6	ND (1.0)	ND (1.0)	ND (1.0)
	6/8/00	904	10.0	ND (5.0)	ND (5.0)	ND (25)
	9/12/00	738	7.4	ND (5.0)	ND (5.0)	ND (25)
	12/19/00	770	ND (2.5)	ND (2.5)	ND (12)	ND (12)
	3/28/01	331	30.6	1.0	ND (5.0)	ND (5.0)
	6/27/01	127	5.9	ND (5.0)	ND (25)	ND (25)
	9/26/01	445	35.3	1.3	1.6	ND (5.0)
	3/12/02	758	7.1	ND (5.0)	ND (5.0)	ND (250)
	9/18/02	753	105	1.9	2.7	ND (5.0)
	CRA4D-95	6/14/95	47/63	140/190	ND (33)/ND (25)	ND (33)/ND (25)
9/13/95		ND (120)	ND (120)	ND (120)	ND (120)	NA
8/17/99		20.0	ND (10)	ND (10)	ND (10)	ND (50)
11/16/99		ND (10)	ND (10)	ND (10)	ND (10)	ND (50)
3/16/00		ND (10)	ND (10)	ND (10)	ND (10)	ND (50)
6/8/00		19.9	ND (5.0)	ND (5.0)	ND (5.0)	ND (25)
9/12/00		15.5J	ND (1.0J)	ND (1.0J)	ND (1.0J)	ND (5.0J)
12/19/00		5.1	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
3/28/01		ND (5.0)	ND (5.0)	ND (5.0)	ND (25)	ND (25)
6/27/01		ND (10)	ND (10)	ND (10)	ND (50)	ND (50)
9/26/01		164	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/12/02		2.2	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/18/02		0.74J	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)

TABLE A.2

**HISTORICAL GROUNDWATER ANALYTICAL RESULTS SUMMARY  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

Monitoring Well ID	Date Sampled	Benzene	Toluene	Ethylbenzene	Xylenes	Heptane
<b>CTDEP Industrial/Commercial</b>						
<b>Volatilization Criteria for Ground Water</b>		530	50,000	50,000	50,000	NV
CRA5S-95	6/14/95	9,900	6,200	ND (500)	ND (500)	NA
	9/14/95	16,000/14,000	11,000/9,400	ND (500)/ND (500)	ND (500)/ND (500)	NA
	8/17/99	16,000	ND (50)	ND (50)	ND (50)	ND (250)
	11/16/99	10,500	ND (50)	ND (50)	ND (50)	ND (250)
	3/16/00	3,230	ND (20)	ND (20)	ND (20)	ND (100)
	6/8/00	2,310J	ND (10)	ND (10)	ND (10)	ND (50)
	9/12/00	7,580	ND (20)	ND (20)	ND (20)	ND (100)
	12/19/00	9,460	ND (50)	ND (50)	ND (250)	ND (250)
	3/28/01	6,290	ND (50)	ND (50)	ND (250)	ND (250)
	6/27/01	7,240	ND (50)	ND (50)	ND (250)	ND (250)
	9/26/01	5,680	ND (50)	ND (50)	ND (50)	ND (250)
	3/12/02	4,350J	ND (5.0)	3.0J	ND (5.0)	ND (25)
	9/18/02	2,950	ND (25)	ND (25)	ND (25)	ND (130)
	CRA5D-95	6/14/95	1,200	480	ND (42)	ND (42)
9/15/95		320	ND (12)	ND (12)	ND (12)	NA
8/17/99		152	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
11/16/99		70.2	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/16/00		8.5	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
6/8/00		155	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/12/00		166	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
12/19/00		8.6	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
3/28/01		177	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
6/27/01		223	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)
9/26/01		132	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
3/12/02		40.1	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
9/18/02		5.4	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)
CRA6S-95		6/14/95	15,000	ND(830)	ND (830)	ND (830)
	9/14/95	16,000/17,000	ND (620)/ND (620)	ND (620)/ND (620)	ND (620)/ND (620)	NA
	8/17/99	19,400/15,500	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)
	11/16/99	12,400/22,600	ND (50)/17.6	ND (50)/13.2	ND (50)/11.3	ND (250)/ND (5.0)
	3/16/00	2,520/2,510	14.4/12.7	ND (10)/ND (10)	ND (10)/ND (10)	ND (50)/ND (50)
	6/8/00	13,330/12,500	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)	ND (100)/ND (100)
	9/12/00	12,100/12,200	ND (50)/ND (50)	ND (50)/ND (50)	ND (50)/ND (50)	ND (250)/ND (250)
	12/19/00	10,400/11,400	ND (50)/ND (50)	ND (50)/ND (50)	ND (250)/ND (250)	ND (250)/ND (250)
	3/28/01	8,800/8,210	ND (50)/ND (25)	ND (50)/ND (25)	ND (250)/ND (120)	ND (250)/ND (120)
	6/27/01	10,600/8,860	ND (100)/ND (50)	ND (100)/ND (50)	ND (500)/ND (250)	ND (500)/ND (250)
	9/26/01	4,390/5,790	ND (25)/ND (25)	8.1J/9.6J	ND (25)/ND (25)	ND (120)/ND (120)
	3/12/02	4,750/4,530	ND (20)/ND (20)	ND (20)/ND (20)	ND (20)/ND (20)	ND (100)/ND (100)
	9/18/02	3,460/3,670	1.5/ND (20)	11.8/ND (20)	1.1/ND (20)	ND (5.0)/ND (100)
	CRA6D-95	6/14/95	3,600/3,800	990/1,100	ND (100)/ND (120)	ND (100)/ND (120)
9/14/95		7,100	ND (250)	ND (250)	ND (250)	NA
8/17/99		3,680	ND (10)	ND (10)	ND (10)	ND (250)
11/16/99		7,860	ND (50)	ND (50)	ND (50)	ND (50)
3/16/00		1,770	ND (10)	ND (10)	ND (10)	ND (250)
6/8/00		8,830	ND (50)	ND (50)	ND (50)	ND (50)
9/12/00		9,530	ND (25)	ND (25)	ND (25)	ND (120)
12/19/00		1,220J	ND (5.0)	ND (5.0)	ND (25)	ND (25)
3/28/01		775	ND (5.0)	5.7	ND (25)	ND (25)
6/27/01		2,570	ND (20)	ND (20)	ND (100)	ND (100)
9/26/01		6,990	ND (50)	ND (50)	ND (50)	ND (250)
3/12/02		1,670	ND (10)	ND (10)	ND (10)	ND (50)
9/18/02		4,660	ND (20)	ND (20)	ND (20)	ND (100)

## Notes:

Concentrations in micrograms per liter (µg/L).

ND ( ) Not detected at reporting limit stated in parentheses.

NA Not Analyzed.

J Indicates an estimated value.

4,390/5,790 Sample result/duplicate sample result.

NV No Volatilization Criteria for Groundwater reported.

--

Detected concentration exceeds Industrial/Commercial Volatilization Criteria for Groundwater.

**SITE-SPECIFIC SOIL GAS AND GROUNDWATER CRITERIA BASED ON PROTECTION OF INDOOR AIR QUALITY  
SYNTHETIC PRODUCTS COMPANY  
STRATFORD, CONNECTICUT**

Compound of Concern (COC)	Chemical Properties (1)			Johnson & Ettinger Attenuation Factor, $\alpha$ (2)	CTDEP Industrial/Commercial Target Indoor Air Concentration, $C_{air}$ (3) ( $\mu\text{g}/\text{m}^3$ )	Calculated Site-Specific Soil Gas Criteria, $C_{sg}$ (4) ( $\mu\text{g}/\text{m}^3$ )	Theoretical Groundwater Concentration, $C'_{gw}$ Based on Henry's Law (5) ( $\mu\text{g}/\text{L}$ )	Calculated Site-Specific Groundwater Criteria, $C_{gw}$ (Adjusted for Actual Non-Equilibrium Conditions) (6) ( $\mu\text{g}/\text{L}$ )
	Henry's Law Constant, $H_L$ ( $\text{atm m}^3/\text{mol}$ )	Water Diffusion Coefficient, $D^{H_2O}$ ( $\text{cm}^2/\text{s}$ )	Air Diffusion Coefficient, $D^{air}$ ( $\text{cm}^2/\text{s}$ )					
<b>Compounds Detected in SVE System</b>								
Benzene	0.0044 (20° C)	9.80E-06 (25° C)	0.0858 (20° C)	5.186E-05	21.5	414,555	2,258.2	22,582
Toluene	0.0051 (20° C)	8.60E-06 (25° C)	0.0848 (20° C)	5.137E-05	584	11,368,768	53,491.8	534,918
Ethylbenzene	0.0059 (20° C)	7.80E-06 (25° C)	0.0731 (20° C)	4.535E-05	1,460	32,190,762	131,138.3	1,311,383
m-Xylene	0.0055 (20° C)	7.80E-06 (25° C)	0.0682 (25° C)	4.276E-05	438	10,242,055	44,919.6	449,196
o-Xylene	0.0039 (20° C)	1.00E-05 (25° C)	0.0848 (25° C)	5.138E-05	438	8,524,892	53,008.0	530,080
p-Xylene	0.0054 (20° C)	8.44E-06 (25° C)	0.0750 (25° C)	4.633E-05	438	9,454,253	42,061.2	420,612
Heptane	2.0600 (20° C)	7.59E-06 (25° C)	0.0642 (20° C)	4.058E-05	7,300	179,877,547	2,099.5	20,995
<b>Compounds Historically Detected Above CTDEP Volatilization Criteria for Groundwater</b>								
1,1-Dichloroethene	0.0218 (20° C)	1.04E-05 (25° C)	0.0877 (20° C)	5.281E-05	0.0818	1,549	1.7	17
Vinyl Chloride	0.0235 (20° C)	1.23E-05 (25° C)	0.1033 (20° C)	6.031E-05	0.0487	807	0.8	8.2

Notes:

- The applied chemical properties are obtained from the chemical properties database implemented in USEPA (2000), with the exception of heptane where the applied chemical properties were obtained from Gustafson et al. (1997). The Henry's Law constant and air diffusion coefficient were corrected for an average vadose zone temperature of 20°C. The reference temperature for the water diffusion coefficient is 25°C and, considering its low value, a correction to 20°C was considered negligible.
- The soil gas attenuation factor  $\alpha$  is based on the solution for soil gas migration to building indoor air presented in Johnson and Ettinger [1991; Equation (21)], the vadose zone and building properties listed below, and a 4 Pa pressure difference between the vadose zone and the building ( $\Delta P$ ) as applied by USEPA (2000). The calculation of the soil gas attenuation factor was conducted using the Excel spreadsheet "GW-ADV.xls" developed by USEPA (2000) and the following Site-specific vadose zone and building properties.

**Vadose Zone Soil Properties:**

Moisture Content, $\theta_m$ (%)	8.00	Applied to reflect conservative moisture content levels expected within the sand and gravel deposit comprising the vadose zone.
Total Porosity, $\epsilon_T$ (%)	0.3	Conservatively assumed porosity value considered representative of the sand and gravel deposit comprising the vadose zone.
Dry Bulk Soil Density, $\rho_{db}$ ( $\text{g}/\text{cm}^3$ )	1.852	Calculated based on $\rho_{db} = (1 - \epsilon_T) \rho_s + \epsilon_T \rho_w$ , where a specific gravity $C_s$ value of 2.65 is assumed and a water density $\rho_w$ of $998.2 \text{ kg}/\text{m}^3$ at 20°C is applied
Hydraulic Conductivity, $K$ ( $\text{cm}/\text{s}$ )	1.52E-02	Geometric mean of hydraulic conductivity values determined from single-well response tests conducted with the sand and gravel deposit.
Intrinsic Permeability, $k_i$ ( $\text{cm}^2$ )	1.56E-07	Intrinsic permeability, $k = K \mu_w / \rho_w g$ , where water density $\rho_w = 998.2 \text{ kg}/\text{m}^3$ at 20°C, gravitational acceleration $g = 9.81 \text{ m}/\text{s}^2$ , and the dynamic viscosity of water $\mu_w = 1.002 \times 10^{-3} \text{ kg}/\text{ms}$ at 20°C (Freeze and Cherry, 1979).
Relative Vapor Permeability, $k_r$ ( $\text{cm}^2$ )	0.53	Estimated after Parker et al. (1987) for a sand soil type as implemented in USEPA (2000) to account for the reduction in permeability due to the degree of vadose zone water saturation.
Effective Vapor Permeability, $k_v$ ( $\text{cm}^2$ )	8.22E-08	Determined from $k_v = k_r \cdot k_i$ .
Vadose Zone Temperature (°C)	20	Average groundwater temperature measured during monitoring well purging for the September 18, 2002 groundwater sampling event.
Distance from Source to Building, $L_T$ (m)	2.04	Based on the average depth to groundwater of 6.7 feet measured at shallow Site monitoring wells during the June 27, 2001 groundwater sampling event.
Vapor Viscosity of Air, $\mu_a$ at 10°C ( $\text{g}/\text{cm s}$ )	1.78E-04	Vadose zone temperature corrected vapor viscosity as implemented in USEPA (2000).

**Building Properties:**

Below-Grade Area of Building Surfaces, $A_B$ ( $\text{m}^2$ )	794	Based on the area of the existing Site building of approximately 162 feet by 51 feet with a slab-on-grade thickness of 8 inches.
Building Volume, $V_B$ ( $\text{m}^3$ )	5,324	Based on the area of the existing Site building of approximately 162 feet by 51 feet with an approximate ceiling height of 22 feet.
Building Air Exchange Rate, $T_{air}$ (1/hr)	0.83	Industrial indoor air exchange rate after ASTM (1995).
Ratio of Crack Area to Below-Grade Area, $\eta$ (%)	0.1	Assumed based on 1 mm wide cracks at a spacing 1 m along the building floor and walls as applied in the example by Johnson and Ettinger (1991).
Foundation Thickness, $L_{crack}$ (cm)	20	Assumed based on a 20 cm (8 inch) floor slab thickness.

- CTDEP Industrial/Commercial Target Indoor Air Concentration reported in the State of Connecticut Regulation of Department of Environmental Protection concerning Remediation Standard; 22a-133c-3: Ground-Water Remediation Standards, with the exception of heptane. The target indoor air concentration for heptane is determined as presented in Section 2.3. The target indoor air concentration for m-, o-, and p-xylenes is based on total xylenes.
- The Site-specific soil gas criteria beneath the existing Site building is calculated from  $C_{sg} = C_{air} / \alpha$ .
- The theoretical groundwater concentration determined from the soil gas concentration assuming equilibrium conditions and Henry's Law;  $C'_{gw} = C_{sg} \cdot (T^*R)/H$  where T is the vadose temperature in degrees Kelvin and the universal gas constant R is  $8.206 \times 10^{-5} \text{ atm m}^3/\text{mol K}$ .
- The Site-specific groundwater criteria is determined from  $C_{gw}/d$  where the source dilution factor  $d=0.1$  relating the theoretical groundwater concentration calculated from Henry's Law to the actual groundwater concentration that would exist under more realistic non-equilibrium conditions as applied by MDEP [1994].

APPENDIX B

APRIL 15, 2002 BENZENE AIR SAMPLING EVENT

## APPENDIX B

### RESULTS OF BENZENE AIR SAMPLING EVENT SYNTHETIC PRODUCTS COMPANY SITE STRATFORD, CONNECTICUT

#### 1.0 INTRODUCTION

On April 15, 2002, an air sampling event was conducted at the Synthetic Products Company site (Site), located in Stratford, Connecticut to evaluate the indoor and outdoor concentrations of airborne benzene relative to the Connecticut Department of Environmental Protection (CTDEP) Industrial/Commercial Target Indoor Air Concentration of 21.5 micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ). The air sampling event included the collection of three samples from inside the former manufacturing building at the Site near the locations of initial screening air samples collected in January 2002, and seven samples from locations outside the building.

This report identifies the air sample locations, sampling procedures, Site conditions at the time of sample collection, air sample analytical data, and the conclusions drawn therefrom.

#### 2.0 AIR SAMPLE COLLECTION AND ANALYSES

In order to achieve the low analytical detection limits necessary for documenting concentrations of benzene in air in comparison with the CTDEP Industrial/Commercial Target Indoor Air Concentration of  $21.5 \mu\text{g}/\text{m}^3$ , the air samples were collected in accordance with United States Environmental Protection Agency (USEPA) Compendium Method TO-15 for the Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared stainless steel canisters. Samples were collected in accordance with EPA TO-15 utilizing the subatmospheric pressure sampling mode, and analyzed for benzene by gas chromatography/mass spectrometry.

The air samples were collected over a 4-hour period by introduction of air into the specially-prepared initially evacuated stainless steel canisters. Galson Laboratories, located in East Syracuse, New York provided sampling canisters pre-cleaned and certified in accordance with EPA TO-15. The canisters were adjusted by the laboratory to provide constant flow sampling over a period of 4 hours for a total sample volume of 0.440 liter. Air samples were drawn into the pre-evacuated and passivated canisters through a sampling train comprised of components that regulate the rate and duration of sampling.

Following sample collection and labeling, samples were logged on a Chain of Custody Record sheet and properly packaged to prevent breakage during shipment to the analytical laboratory. Samples were delivered by commercial courier to Galson Laboratories for benzene analyses by EPA Method TO-15. Galson Laboratories is accredited by the American Industrial Hygiene Association (AIHA), and has comprehensive experience in conducting analysis utilizing EPA TO-15. Based on a data quality assessment and validation conducted on the laboratory analytical data received, the data are suitable for their intended use without qualification.

### 3.0 INDOOR AIR SAMPLES

#### 3.1 GENERAL

The locations of the air samples collected from inside the former manufacturing building are shown on Figure B.1. The field determination of the indoor sampling locations was based upon the following general criteria:

1. Collection of samples would approximate (to the extent feasible) the locations of the initial screening samples collected in January 2002;
2. Adjustments to sample locations or the need for additional indoor sample locations would be based upon the presence of stored materials, products, machinery, and equipment inside the former manufacturing building that could potentially release benzene vapors; and
3. The sample locations would provide a representative assessment of benzene concentrations in the former manufacturing building air on the day of the sampling event.

Three sampling locations were selected within the former manufacturing building based upon the above criteria. The locations were generally near the locations of the initial screening air samples collected on January 30 and 31, 2002. No additional samples were necessary to obtain a representative sample of benzene concentrations within the air of the former manufacturing building. The locations of the indoor air samples were tied in by measurements made relative to known reference points within the former manufacturing building.

The indoor air samples were collected at a height of approximately 5 feet above grade (average breathing zone level). Sampling commenced concurrently at the selected locations at approximately 8:10 a.m. Ambient temperature in the former manufacturing building at the beginning of the sampling event was 66 degrees Fahrenheit (°F). The temperature 4 hours later at the completion of sample collection was 76°F. A slight air movement from west to east throughout the building was detectable once the overhead door on the west side of the building was opened at approximately 10:00 a.m. The overhead door, which is apparently used to supplement the passive ventilation in the building, remained opened for the remainder of the sampling event. A propane-powered forklift, which operated in the building for several minutes at a time periodically during the sampling period, used the open overhead door as an access/egress point.

Hampford Research currently uses the former manufacturing building for two purposes. The west portion of the building is used for general warehousing of dry chemicals, empty cardboard drums, and empty 55-gallon steel drums. The dry chemicals (powders) identified in this area included benzil (99%), ammonium acetate, ammonium sulphate, and bisphenol A. Pallets (two rows) of the various dry chemicals and empty drums were located against both the north and south walls. A local exhaust ventilation (LEV) booth is also located in the west portion of the building. The booth is used by employees for the loading, by manual shoveling, of dry chemical powder into cardboard drums. The booth is approximately 8 feet high, 8 feet wide, and 6 feet deep, and is situated adjacent to the east wall of the west portion of the building, as shown on Figure B.1. The LEV system from the booth also includes a bank of bag filters located just to the north of the booth.

Hampford Research currently uses the east portion of the former manufacturing building as a general maintenance shop. Materials and equipment in this area were generally consistent with typical industrial maintenance shops. Storage of machinery parts, lubricating oils, welding equipment, and hand tools was observed. Solvent degreasers were not observed and facility management personnel indicated that they were not aware of any in use in this area. A drum of a compound labeled "Foamtrol WT-2" was observed in the maintenance area; the label indicated the compound contains synthetic hydrocarbons. The use of the drummed compound was not determined.

Smaller rooms of the former manufacturing building are used for storage of various miscellaneous items such as piping and safety supplies. There is also a locker room on a platform area located on the north side of the maintenance area.

No obvious sources of potential benzene vapors were observed within the former manufacturing building.

### 3.2 INDOOR AIR SAMPLE ANALYTICAL RESULTS

The results of the laboratory analyses of the indoor air samples collected on April 15, 2002 are summarized in Table B.1. As shown in Table B.1, benzene was not detected in any of the three indoor air samples collected. The analytical detection limit for the analyses was  $15.95 \mu\text{g}/\text{m}^3$ , which is below the CTDEP Industrial/Commercial Target Indoor Air Concentration of  $21.5 \mu\text{g}/\text{m}^3$ .

## 4.0 OUTDOOR AIR SAMPLES

### 4.1 GENERAL

The locations of the air samples collected outside the former manufacturing building are shown on Figure B.2. The field determination of the outdoor sample locations was based upon the following general criteria:

1. Samples would be collected from appropriate locations to identify any potential sources of benzene vapors in the air;
2. Sample locations outdoors would be based upon the presence of stored materials, products, machinery, equipment, and adjacent facility activities that could potentially release benzene vapors, in conjunction with weather and wind conditions on the day of the sampling event; and
3. The sample locations would provide a representative assessment of outdoor air benzene concentrations in the vicinity of the former manufacturing building on the day of the sampling event.

Outdoor air samples were collected from seven locations based upon the above criteria. Sample location 9 was selected specifically to detect potential benzene vapors generated from automobiles traveling along Barnum Avenue Cutoff that may be directed towards the former manufacturing building by the wind. Location 9 was also not shielded from the wind by the adjacent Hampford Research facility buildings. Sample location 10 was selected specifically to detect potential benzene vapors from an 8,000-gallon aboveground storage tank (AST) located approximately 40 feet west of sample location 10. The 8,000-gallon AST contains No. 2 fuel oil used to power a 60 horsepower Cleveland-Brooks boiler located in the former manufacturing building. Location 10 was also not directly shielded by the Hampford Research facility buildings. The locations of the outdoor air samples collected were tied in by measurements made relative to known reference points outside the former manufacturing building.

Outdoor air samples were collected over a duration of 4 hours at a height of approximately 5 feet above grade (average breathing zone level). Sampling commenced concurrently at the selected outdoor locations at approximately 8:45 a.m. Wind conditions on the day of the sampling event were from the west - southwest, at an estimated wind speed of 10 to 20 miles per hour (mph). The wind also appeared to swirl between the former manufacturing building and the adjacent Hampford

Research facility to the southwest. The outdoor air temperature at the beginning of the sampling event was 65°F, and 80°F at the completion of sampling. Weather conditions were cloudy and misty at the beginning of sampling, and changed to sun and variable clouds by 10:00 am.

As part of the assessment of potential benzene vapor sources, personnel from the Hampford Research facility located southwest of the former manufacturing building were interviewed regarding its manufacturing process. Hampford Research manufactures photo-developing initiators. Hampford Research personnel identified that activities conducted at their facility do not involve the use of benzene and they are not aware of any by-products that would generate benzene vapors. Hampford Research personnel indicated that the two largest stack emissions are methylene chloride and isopropyl alcohol. The largest volumes of chemicals utilized by Hampford Research are glacial acetic acid; orthochlorobenzaldehyde; sodium hydroxide (50%); hydrogen peroxide (35%); sodium hypochlorite; ammonium acetate; isopropyl alcohol; and methylene chloride. Accordingly, it does not appear that activities conducted within the Hampford Research facility would be a contributing source of benzene vapors.

Outside of the former manufacturing building and the Hampford Research facility two large ASTs containing No. 2 fuel oil were observed. As previously identified, the AST located outside the south wall of the former manufacturing building has a volume of 8,000 gallons and is used to provide fuel for the boiler located within the building. An additional AST is located outside the northeast wall of the Hampford Research facility. This AST has a volume of 4,000 gallons and is used to fuel processes within the Hampford facility. The 4,000-gallon AST had visible venting, and is located directly west of the overhead door located on the west side of the former manufacturing building. The 4,000-gallon AST is enclosed by chain link fencing and was locked on the day of the sample event. Sample location 6 was adjacent to this AST.

Also as previously indicated, the former manufacturing facility property is in close proximity to streets on the north, east, and south sides. Interstate-95 (I-95) also runs parallel to the south side of the property within one tenth of a mile. Three intersections are also within a tenth of a mile of the property. All the surrounding streets have high volumes of traffic throughout the day.

Based on observations on the day of the sampling event, potential emission sources for benzene in the vicinity of the former manufacturing building include the two identified ASTs, and automobile exhaust from surrounding streets.

#### 4.2 OUTDOOR AIR SAMPLE ANALYTICAL RESULTS

The results of the laboratory analyses of the outdoor air samples collected on April 15, 2002 are summarized in Table B.2. As shown in Table B.2, benzene was not detected in any of the seven outdoor air samples collected. The analytical detection limit for the analyses was 15.95 µg/m<sup>3</sup>, which is below the CTDEP Industrial/Commercial Target Indoor Air Concentration of 21.5 µg/m<sup>3</sup>.

### 5.0 SUMMARY AND CONCLUSIONS

As identified in Section 1.0, the purpose of the air sampling event conducted on April 15, 2002 was to evaluate the indoor and outdoor concentrations of airborne benzene at the Site relative to the CTDEP Industrial/Commercial Target Indoor Air Concentration of 21.5 µg/m<sup>3</sup>. As identified in Sections 3.2 and 4.2, benzene was not detected in any of the three indoor and seven outdoor air samples collected. The analytical detection limit for the benzene analyses was 15.95 µg/m<sup>3</sup>, which is below the CTDEP Industrial/Commercial Target Indoor Air Concentration of 21.5 µg/m<sup>3</sup>.

Assuming physical conditions and operational activities occurring inside the former manufacturing building at the Site at the time of the April 2002 sample collection are representative of current typical conditions inside the building, and since the air samples collected were representative of the air inside the building during the sampling event, it is concluded that benzene is not present inside the building at a concentration above the CTDEP Industrial/Commercial Target Indoor Air Concentration. Furthermore, assuming outdoor physical and transient (for example, traffic frequency) conditions and operational activities of various facilities in the vicinity of the former manufacturing building at the Site on the day of sample collection are representative of current typical conditions, and since benzene was not detected in any of the outdoor air samples collected in the vicinity of the former manufacturing building at the Site, it is concluded that there are no significant sources of benzene vapors impacting the air inside the former manufacturing building.

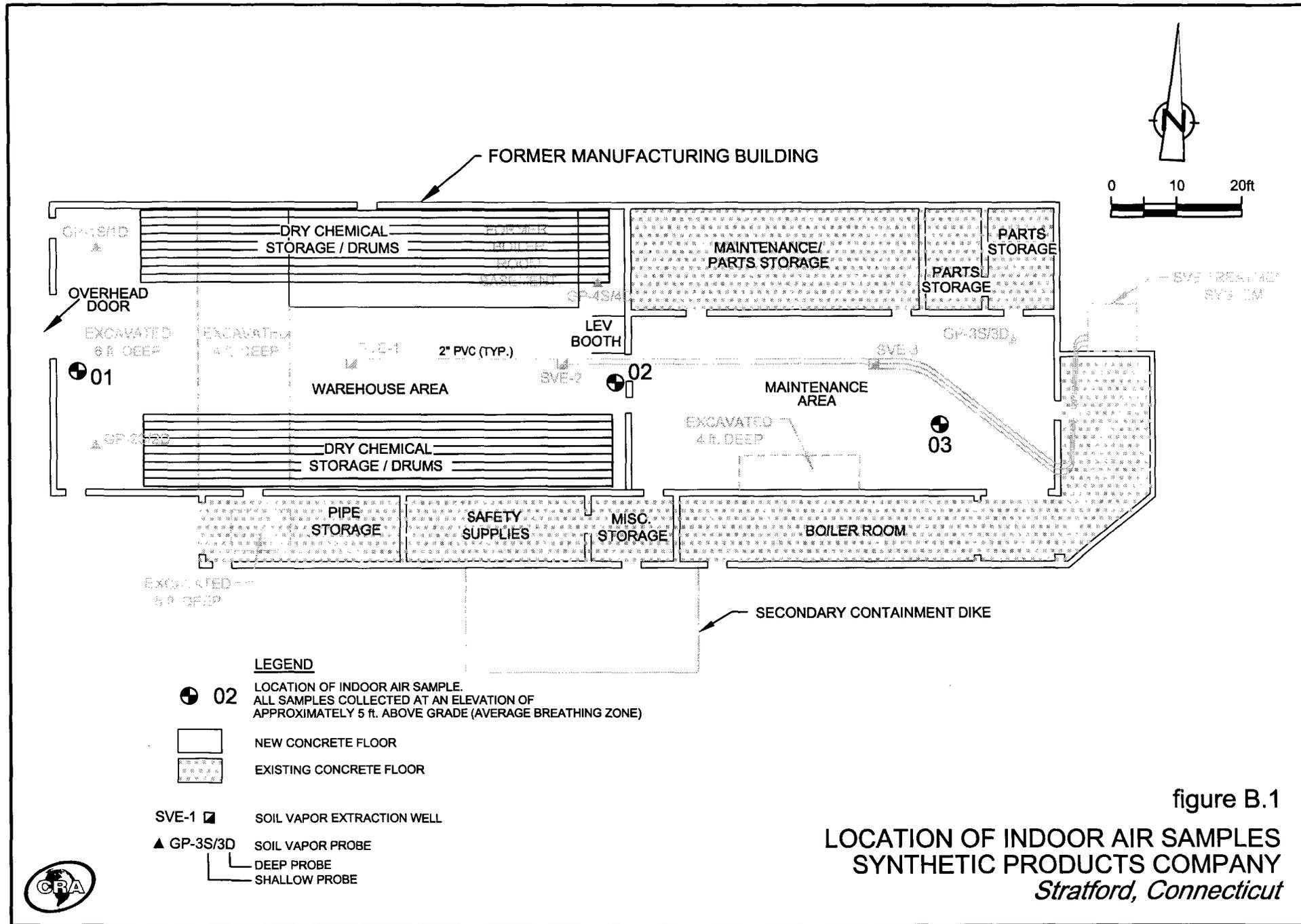


figure B.1  
**LOCATION OF INDOOR AIR SAMPLES**  
**SYNTHETIC PRODUCTS COMPANY**  
*Stratford, Connecticut*

TABLE B.1

**SUMMARY OF INDOOR AIR SAMPLE ANALYTICAL RESULTS  
 APRIL 15, 2002 BENZENE AIR SAMPLING EVENT  
 SYNTHETIC PRODUCTS COMPANY  
 STRATFORD, CONNECTICUT**

<i>Sample Location</i>	<i>CTDEP Ind./Com.</i>	<i>01</i>	<i>02</i>	<i>03</i>
<i>Sample Identification</i>	<i>Target Indoor Air Concentration</i>	<i>3627-41502-GP-01</i>	<i>3627-41502-GP-02</i>	<i>3627-41502-GP-03</i>
<b><u>Volatile Organic Compounds (<math>\mu\text{g}/\text{m}^3</math>)</u></b>				
Benzene	21.5	ND (15.95)	ND (15.95)	ND (15.95)

## Notes:

Analytical results in this table are presented in units of micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ), as converted from laboratory analytical data which are reported in units of parts per billion on a volumetric basis (ppbv).

ND ( ) - not detected at detection limit shown in parenthesis



TABLE B.2

SUMMARY OF OUTDOOR AIR SAMPLE ANALYTICAL RESULTS  
 APRIL 15, 2002 BENZENE AIR SAMPLING EVENT  
 SYNTHETIC PRODUCTS COMPANY  
 STRATFORD, CONNECTICUT

<i>Sample Location</i>	<i>04</i>	<i>05</i>	<i>06</i>	<i>07</i>	<i>08</i>	<i>09</i>	<i>10</i>
<i>Sample Identification</i>	3627-41502-04	3627-41502-05	3627-41502-06	3627-41502-07	3627-41502-08	3627-41502-09	3627-41502-10
<u>Volatile Organic Compounds (<math>\mu\text{g}/\text{m}^3</math>)</u>							
Benzene	ND (15.95)						

## Notes:

Analytical results in this table are presented in units of micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ), as converted from laboratory analytical data which are reported in units of parts per billion on a volumetric basis (ppbv).

ND ( ) - not detected at detection limit shown in parenthesis