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Summary Report and
MCP Phase II Completion Statement

Volume I of VI

RTN 1-0184
Indian Orchard Plant
Springfield, Massachusetts

June 2007

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Summary Report and MCP Phase II Completion Statement

RTN 1-0184
Indian Orchard Plant
Springfield, Massachusetts

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RFI/MCP Phase II Comprehensive Site Assessment Addendum Report with Human Health and Environmental Risk Characterizations, May 2007, Volumes II through VI.

1. Introduction

1.1 Summary

Plastic and resin manufacturing operations began at the Indian Orchard Plant (currently owned by Solutia Incorporated [Solutia]) (the plant) in the early 1900s. By the 1960s, the plant expanded to 180 acres of land use. Environmental investigations were initiated in 1979, upon completing a survey requested by the United States government (Eckhardt Committee Survey) to provide disposal information at for the plant.

Voluntary environmental investigation efforts carried out by Solutia and Solutia's predecessors, identified that onsite disposal of waste materials had occurred periodically throughout the ownership history. Environmental investigation results are summarized in Table 1.

TABLE 1
INDIAN ORCHARD PLANT INVESTIGATION SUMMARY

What Was Monitored?		Summary of Findings
Soil	Examined and field screened more than 9,000 feet of soil samples in more than 250 soil borings for vapors using PID/FID with GC in half of the soils screened.	- vapors were mostly observed in saturated zones below the water table, except at the northwest corner of SWDA No. 1 - no NAPL was observed in groundwater - NAPL was observed in SWDA No. 1 in one of three borings - landfill SWDAs No. 1 and No. 2, and LWDA No. 1 extent within kettle hole or at surveyed locations - top of till confining unit was delineated, as well as overlying saturated unconfined lacustrine and deltaic sands
	Analyzed 195 soil samples (44 surface and 151 subsurface soils) for VOCs, SVOCs, PCBs, pesticides, herbicides and inorganics.	- landfill SWDAs No. 1 and 2, and LWDA No. 1 extent within kettle hole or at surveyed locations - evidence of wastes observed in documented disposal area, except Burning Pits A and B - no pesticides or herbicides detected - VOCs, SVOCs and or inorganics observed above guidance values in SWDAs No. 1 and 2, and LWDA No. 2 - low levels of PCB above guidance values in SWDA No. 2 - chlorobenzene in saturated soil below water table above guidance values at Former World War II Naval Research Area (Former WWII NR Area)
	Ground-penetrating radar and magnetometer surveys	- metal objects detected in SWDAs No. 1 and 2, and LWDA No. 1

What Was Monitored?		Summary of Findings
	Test pits	- crushed empty drums in SWDAs No. 1 and 2, and LWDA No. 1 - VOCs above guidance values in soil or liquid in drums
Air	Soil vapor analysis for TO-14 list.	- vapors detected below applicable guidance values

Groundwater	685 groundwater samples collected from 119 monitoring wells and analyzed for the following parameters:
	
	- 662 samples VOCs
	- 111 samples for SVOCs
	- 110 PCBs, pesticides and herbicides
	- 128 inorganics and cyanide
	- 103 miscellaneous parameters such as acrylonitrile and allyl alcohol, MADEP VPH and EPH, and total organic carbon
		- three VOC groundwater plumes are present:
		  - chlorobenzene associated with SWDA No. 1
		  - chlorobenzene associated with Former WWII NR Area
		  - vinyl chloride associated with Former Gas Holder Area (addressed in separate reports as RTN 1-11901)
		- natural attenuation is evident in groundwater downgradient of SWDA No. 1 and at FGHA
		- natural attenuation study is recommended downgradient of Former WWII NR Area
		- no evidence of petroleum, allyl alcohol or acrylonitrile constituents

	80 passive vapor diffusion samples in Chicopee River below surface-water/ groundwater mixing zone	- incomplete migration pathway to river - chlorobenzene detected in three PVDs below guidance values downgradient of SWDA No. 1 - no detections above guidance values downgradient of the Former WWII NR Area
River Sediment and Surface Water	35 sediment and 27 surface-water samples collected for VOCs, SVOCs, PCBs and inorganic analysis from Chicopee River.	- phenol detected once at one location above benchmark - constituents do not pose a significant risk to environmental receptors because concentrations did not exceed benchmark screening levels, or were comparable or below background/ reference and local conditions
Brook Sediment and Surface Water	14 sediment and 18 surface-water samples collected for VOCs, SVOCs, PCBs and inorganic analysis from Bircham Bend Brook	- lead detected once slightly above benchmark - constituents do not pose a significant risk to environmental receptors

Notes:
PID = Photo ionization detector.
FID = Flame ionization detector.
GC = Gas chromatography.
NAPL = Nonaqueous-phase liquid.
VOC = Volatile organic compound.
SVOC = Semivolatile organic compound.
PCB = Polychlorinated biphenyl.
SWDA = Solid waste disposal area.
LWDA = Liquid waste disposal area.
MADEP = Massachusetts Department of Environmental Protection.
VPH = Volatile petroleum hydrocarbons.
EPH = Extractable petroleum hydrocarbons.
PVD = Passive vapor diffusion sampler intended for sediment below hyporheic zone.

A data Usability Assessment of the data referenced above per MCP 310 CMR 40.1056(1)(j) and 40.1056(2)(k) is provided in Volume III, Appendix B, of the attached RFI/MCP Phase II Comprehensive Site Assessment Addendum Report with Human Health and Environmental Risk Characterizations.

The environmental investigations summarized above identified four areas where further responses actions are required:

- Landfill — SWDA No. 1;
- Landfill — SWDA No. 2;
- Landfill — Liquid Waste Disposal Area LWDA No. 1; and
- Release Area — Former WWII NR Area.

In addition to these response actions, institutional controls (such as deed restrictions) are needed to maintain commercial/industrial land use and to restrict excavations on the property consistent with the assumptions used in the risk assessment for the protection of human health, public welfare and the environment. As such, a Massachusetts Contingency Plan (MCP) Phase III is necessary for the identification, evaluation and selection of a comprehensive response action to achieve a Response Action Outcome with the MADEP.

This *Summary Report of the RFI/MCP Phase II CSA Addendum Report with Human and Environmental Risk Characterization (RTN 1-0184), Indian Orchard Plant, Springfield, Massachusetts, Volume I of VI, May 2007* (report) presents the results of the more than 20 years of investigations. Details of the investigations are presented in the attached *Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI)/MCP Phase II Comprehensive Site Assessment (CSA) Addendum Report with Environmental and Human Health Risk Characterization, Volumes II through IV, RTN 1-0184, Indian Orchard Plant Springfield, Massachusetts, May 2007* (RFI/MCP Phase II CSA Addendum) (ARCADIS BBL, 2007). The attached RFI/MCP Phase II CSA Addendum (ARCADIS BBL, 2007) is a stand-alone compilation of investigative history, including the required components of an MCP Phase II CSA Report and applicable components of United States Environmental Protection Agency (USEPA) guidance documents for an RFI and risk assessments.

1.2 MCP Phase II Completion Statement and LSP Opinion

This LSP Opinion as prepared by the LSP-of-record, Ms. Caron Koll (license number 6889), presents a Completion Statement for the MCP Phase II CSA. This summary report and the attached *RFI/MCP Phase II CSA Report Volumes II through VI* (ARCADIS BBL, 2007) supplements previous investigations and conforms to the applicable MCP Phase II requirements, with the exception of meeting the deadline for Phase II completion. As such, extensions for the Tier II classification have been requested pursuant with 310 CMR

40.0560(7). The investigations discussed in this report and previous reports were conducted to evaluate the source, nature and extent of the disposal areas and potential pathways to soil, groundwater, sediment, surface water, soil vapor and air, and to meet the applicable MCP Phase II performance standards needed to evaluate risks. Although investigations reported herein resulted in the discovery of a new release area (Former WWII NR Area), the new information was consistent with previous characterizations and did not change the tier classification status.

1.2.1 MCP Phase II Performance Standards per 310 CMR 40.0830 through 40.0835

The information and assessment findings outlined in 310 CMR 40.0835(4) are provided in this MCP Phase II Report. Due to the site settings, it was necessary to provide additional information to adequately characterize the disposal site, consistent with the Response Action Performance Standard described in 310 CMR 40.0191 and 310 CMR 40.0193.

Phase II – Performance Standards	Location in Report
(a) Disposal Site Name, Location and Locus Map;	Volume II – Section 1.1, Section 2.1, Figure 1.1, 1.2
(b) Detailed Disposal Site Map(s), depicting all investigatory and sampling points relevant to the Comprehensive Site Assessment, the boundaries of the disposal site in plan view, and the vertical extent of contamination at the disposal site;	Volume II – Figures 1.1, 1.2, 2.1 - 2.3, 4.1 - 4.11, 5.1 - 5.11, 9.1 - 9.5 Volume III – Appendix D, Figure D-4 Volume IV – Appendix E, Figures E1 - E9 Volume V – Appendix F, Figures F1 - F6 Volume V – Appendix J, Figures J-1 - J17 Volume VI – Appendix Q, Figures Q1 - Q5
(c) Disposal Site History;	Volume II – Section 2, Section 3 Volume III – Appendix D-3, D-4
(d) Site Hydrogeological Characteristics, details of subsurface investigations conducted at the disposal site, together with a comprehensive description and depiction of site hydrogeologic conditions, including, without limitation: 1. a description of all relevant geologic, hydrologic, geophysical, and other subsurface investigations and assessments conducted at the disposal site; 2. documentation related to borings, well construction, and well development, including copies of well drilling logs, within or appended to the Phase II Report; and 3. a detailed characterization of geologic and hydrogeologic conditions at the disposal site, including: a. groundwater potentiometric surface(s), gradients, flow rates, and flow direction(s);	Volume I – Section 7 – Site Conceptual Model Volume II – Section 3 – Summary of Previous Investigations Volume II – Section 4 Site Physical Setting Volume II – Section 7 – Potential Migration Pathways Volume IV – Appendix E – Updated Soil Boring Monitoring Well Log Compendium Volume V – Appendix H Attachment 1

Phase II – Performance Standards	Location in Report
b. soil type(s), stratigraphy, and permeability; c. where appropriate, bedrock type and characteristics, depths and contours; and d. an evaluation and description of the potential for flooding;	
(e) Environmental Fate and Transport of Oil and/or Hazardous Material: 1. an evaluation of the environmental fate and transport characteristics of the oil and/or hazardous material identified at the disposal site, including, without limitation, mobility, stability, volatility, persistence and bioaccumulative potential of the oil and/or hazardous material; 2. identification and characterization of existing and potential migration pathways from the disposal site, including air, soil, groundwater, surface water, sediment; and 3. an evaluation of the potential for groundwater to be a source of vapors to indoor air of occupied structures as described in 310 CMR 40.0900;	Volume II – Section 6 Volume II – Section 7
(f) Nature and Extent of Contamination, characterization of the source(s), nature, and vertical and horizontal extent of contamination at the disposal site, presence and distribution of any non-aqueous phase liquids, tabulation of analytical testing results, a characterization of background concentrations;	Volume II – Section 5 and 8 Volume V – Appendix F Volume V – Appendix G
(g) Exposure Assessment, identification and characterization of all potential human and environmental receptors that could be impacted from the disposal site, and, as appropriate, the quantification of exposure to these receptors, under current and reasonably foreseeable site conditions, as describe din 310 CMR 40.0900;	Volume II – Section 9 and 10
(h) Risk Characterization, as set forth in 310 CMR 40.0900, for all appropriate human and environmental receptors identified at and near the disposal site;	Volume II – Section 9 and 10
(i) Conclusions, discussion of the reasoning and results used to support the findings, and indicate and support the outcome of the Phase II Investigation under 310 CMR 40.0840.	Volume II – Section 11 and 12

1.2.2 MCP Phase II Outcome

Upon completion of the MCP Phase II Comprehensive Site Assessment (CSA) with Method 3 human health and environmental risk characterizations for RTN 1-0184, the following outcomes will apply upon completion of an activity and use limitation (AUL) consistent with the risk characterization assumptions.

- At five of the 13 areas, further Comprehensive Remedial Actions are necessary at the site to achieve a Response Action Outcome (RAO). An MCP Phase III study for the identification, evaluation and selection of remedial alternatives will be necessary. These five areas include:

    - SWDA No.1;
    - SWDA No. 2;
    - LWDA No.1;
    - LWDA No. 2; and
    - Former WW II Naval Research Area.

- At the remaining 8 of 13 areas, the requirements of at Class B-2 RAO under 310 CMR 40.1000 have been met with the supporting documentation provided in this MCP Phase II Report (Volumes II through VI) upon completion of an AUL, for the following reasons: There were no concentrations of regulated constitutes present in soil or groundwater above Upper Concentrations Limits per 310 CME 40.0997(7) (MADEP, 2006). A "Level of No Significant Risk" is contingent on completion of an AUL. Formal RAO statements for these areas will be submitted after the AUL is completed. These eight areas include:

    - Fiberloid Landfill;
    - Building 99 Leach Fields;
    - The four burning areas - Burning Pits or Cages A, B, C and D;
    - Former Building 44 and Tank Farm D&E; and
    - Outfall Piping adjacent to Chicopee River Shoreline.

1.2.3 Public Involvement

Copies of the letters documenting the location of this Phase II report and is provided in Appendix A. Copies of the public notification per 310 CMR 40.1403(3).

1.2.4 Certification of Submittal per 310 CMR 40.0009

"I, Caron Koll, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this submittal, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the person or entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate or incomplete information."

By: _____

Signature Date

Senior Geologist, LSP of Record

Title

For: Solutia Inc.

Name of person or entity

This written declaration is provided in Appendix A in Volume III, on the appropriate BWSC form submitted electronically and with original submitted herein.

2. Compliance Summary

The Solutia Indian Orchard Plant is regulated under both the RCRA Voluntary Corrective Action Program (through Region 1 of the USEPA) and the MADEP's Bureau of Waste Site Cleanup per the MCP.

Compliance Program	Regulation	What it Covers
Chapter 21E. Massachusetts Oil and Hazardous Material Release Prevention and Response Act	310 Code of Massachusetts Regulation 40.0000 MCP	The MCP applies to any person required to notify the MADEP of a release or threat of release or response action under 21 E in Massachusetts.
RCRA	Title 40 of the Code of Federal Regulations (CFR) Parts 239 through 299 RCRA	The act primarily covers ongoing waste management at active facilities.

During the environmental investigations at the plant, Monsanto Company (currently Solutia Inc.) cooperatively and voluntarily labored to achieve the appropriate performance standards of both the USEPA and the MADEP to jointly address concerns regarding past waste management, nature and extent of constituents, fate and transport, and potential receptors. Both agencies were historically engaged in the remedial investigation process until investigation results were presented to the MADEP in 1987 through a Consent Order Agreement COA with the MADEP dated 1987. Based on this data, the MADEP categorized the plant as Tier II "low priority."

In 1989, the MADEP promulgated regulations under Chapter 21 E (MCP 310 CMR 40.000 [MADEP, 1988]) that set forth additional characterization requirements. At the same time (between 1988 and 1991), the USEPA conducted a RCRA Facility Assessment (RFA) with Monsanto in response to a RCRA Part B permit application and identified 69 solid waste management units (SWMUs) and 18 AOCs.

To address both the MCP requirements and existing RCRA guidance for an RFI, Blasland, Bouck & Lee, Inc. (BBL) prepared a scope of work (SOW) (BBL, 1994a) on Monsanto's behalf to supplement the previous 10 years of investigations conducted under the COA and to document results of the previous investigations conducted per the COA.

After the bulk of the investigations of identified in the 1994 SOW were completed and draft reports were prepared, USEPA suggested that Monsanto become regulated under the USEPA RCRA Voluntary Corrective

Action program and to achieve the broad goals and expectations outlined in the USEPA letter dated November 21, 1995.

Shortly after Monsanto entered the RCRA Voluntary Corrective Action program, the *Supplemental RFI/MCP Phase II CSA Report* (BBL, 1996a) was submitted to the MADEP and the USEPA in April 1996, followed by an MCP risk characterization in September 1996 entitled the *RFI Risk Assessment/MCP Phase II CSA Risk Characterization* (Phase II CSA Risk Characterization) (BBL, 1996b). On November 3, 1997 and March 26, 1998, the USEPA submitted to Solutia substantial draft technical comments to this the *Supplemental RFI/MCP Phase II CSA Report* (BBL, 1996a) and *Phase II CSA Risk Characterization* (BBL, 1996b). In response, Solutia submitted responses to USEPA comments clarifying the completion of and the quality and adequacy of the previous investigations prepared under the consent order.

Solutia's responses indicated that the 1994 SOW and *Supplemental RFI/MCP Phase II CSA Report* (BBL, 1996a) 1996 report were additional voluntary actions performed to comply with the MCP (Solutia, 1998a; and Solutia 1998b). On January 25, 1999, Solutia received *EPA Comments on Solutia's Technical Responses* (USEPA, 1999a), and the bulk of this report addresses those comments. Solutia became out of compliance with the MCP with respect to meeting the November 1996 the deadlines for achieving a Response Action Outcome (i.e. final remedy) for Tier II classified sites in November 1996. Therefore, Solutia has complied with the annual extension submittal requirements of the MCP. Annual Tier II extensions have been requested from the MADEP, with the required annual reports submitted in accordance with the USEPA Voluntary RCRA Corrective Action Program.

Further additional details regarding the plant's compliance history are presented in Section 1 of the *RFI/MCP Phase II CSA Addendum Report with Environmental and Human Health Risk Characterization (RTN 1-0184), Volumes II through VI* (ARCADIS BBL), attached.

3. Site Background

3.1 Land Use

Since 1904, the Indian Orchard Plant is and will continue into the foreseeable future to be used for manufacturing. The 170 acres of land at the Indian Orchard Plant owned by Solutia is zoned "Industrial" according to a city of Springfield Planning Board, Zoning Ordinance (dated March 11, 1996). Approximately 70 percent of the Indian Orchard Plant is currently used for manufacturing, power generation, temporary materials storage or administrative buildings. The remainder of the plant (approximately 50 acres) comprises parking areas, Solutia product and employee transportation corridors within the Solutia Property, ash storage, or open space (Figure 1, Site Location Plan).

The surrounding offsite land use is a primarily a mixture of commercial/industrial/municipal; the remaining property is either residential or open and forested. The Chicopee River borders the property to the north and Bircham Bend Brook borders the property in the south-southwestern corner.

3.2 Manufacturing History

Raw materials used in the eastern and western portions of the Indian Orchard Plant (East Plant and West Plant) are presented in Tables 2 and 3, Site Manufacturing History – West Plant and East Plant, respectively.

The primary constituent detected at the plant, chlorobenzene, is not in either of these tables. Chlorobenzene was never used by Monsanto or Solutia in manufacturing. The source of chlorobenzene was associated with research activities conducted by the United States Navy (Navy) during World War II at the plant. From 1942 to 1945, chlorobenzene was used by the Navy at former Building 90 (currently building 96) (see Figure 2, Site Plan with Disposal Sites) for the research and development of radar equipment antidetection coatings. The maximum timeframe for this research and development activity was from 1942 to 1945. Based on a review of 1940 aerial photographs, the area at former Building 90 was undeveloped and forested prior to 1940. From 1945 to 1952, Monsanto reportedly began research for the development of lubricating oil and discontinued use of chlorobenzene. Based on plant maps and aerial photographs, chlorobenzene was replaced with allyl alcohol by 1950 and the tanks in this area were removed for road construction beginning in 1958.

3.3 Disposal History

Historically, solid and liquid waste materials generated as part of the operations were disposed of onsite in accordance with accepted practice. Waste disposal areas were established within the present Indian Orchard Plant boundaries for the ultimate disposal of these materials. From the investigations previously reported, waste or waste residue above reportable concentrations were found in three (SWDA No. 1, SWDA No. 2 and LWDA No 1) of the 11 disposal areas (Figure 2, Site Plan with Disposal Sites).

Fiberloid Corporation began manufacturing operations and disposal activities at the East Plant as early as 1904. The Fiberloid Corporation produced mainly nitrocellulose. From approximately 1935 to 1940, the plant disposed of solid and liquid waste materials at various areas within the area now referred to as the Fiberloid Landfill.

The western portion of the plant (Shawinigan Resins Corporation) began operations and disposal activities in 1938. Shawinigan Resins Corporation produced mainly polyvinyl butyral, formalin and acetate resins. The western portion of the plant also conducted onsite waste disposal throughout its history until the mid 1970s. Types of materials disposed consisted of refuse, including coal ash, paper, cardboard, wood and off-grade resins and plastic products, construction debris, oils, sludges, inks, and solvents. The East Plant disposed of waste materials onsite via land filling at SWDA 1, SWDA 2 and the Fiberloid Landfill, land application at LWDA 1 and LWDA 2, open burning (Burning Cage/Pits A and B), and subsurface disposal via the Building 99 Leach Field.

The West Plant disposed of waste materials onsite by land application at LWDA 1 and by open burning in Burning Pits C and D. These practices were discontinued by 1971.

4. Investigations

4.1 Landfill Historical Topographic Comparisons

A Phase I Remedial Investigation (Phase I RI) conducted by Blasland and Bouck Engineers, PC included a historical topographic review of the plant. A topographic survey of the plant, at 1-foot intervals and focusing on SWDA No. 1 and LWDA No. 1, was conducted by G.E. Ainsworth and Associates in spring 1984. This elevation survey was compared to a 1935 topographic map (pre-kettle hole landfilling) of the plant area (mapped at 10-foot contour intervals) based on the same benchmark used in 1984. The 1935 topographic map and 1938, 1940 and 1952 aerial photographs clearly show two kettle hole depressions in the glacial outwash sand as significant topographic features at the plant.

Based on historical maps and aerial photographs, the bottoms of the kettle holes were once swampy areas. By 1984, the kettle holes mapped in 1935 were no longer measurable topographic features. Two known areas of filling, SWDA No. 1 and LWDA No. 1, were present within the boundaries of the previously mapped kettle holes (Blasland and Bouck Engineers, PC, 1984a). The historical topographic comparison provided a sound indication of both horizontal and vertical limits of disposal areas SWDA No. 1 and LWDA No. 1. The soil borings, test pits and geophysical survey explorations from 1985 to 1994 confirmed that the kettle holes surveyed in 1935 and observed in aerial photographs are the present SWDA No. 1 and LWDA No. 1. In addition, the vertical and horizontal limits of the waste disposal areas are defined by the base and walls of these two kettle holes.

4.1.1 Historical Aerial Photograph Review

Historical stereoscopic aerial photographs from 1938, 1940, 1952, 1970 and 1980, as well as individual aerial photographs acquired from the plant, were reviewed during the completion of the Phase I RI (Blasland and Bouck Engineers PC, 1984a). Known disposal areas were examined for content, topographic changes and horizontal limits, and included the Fiberloid Landfill; Burning Pit Cages A, B, C and D; SWDA No. 1; SWDA No. 2; LWDA No. 1; and LWDA No. 2. The aerial photograph review was used to further define the horizontal limits of these waste disposal areas. The aerial photograph and topographic comparison horizontal limits of the

landfills are presented in the soil boring and monitoring well compendium provided in Appendix E of the attached RFI/MCP Phase II CSA Addendum (ARCADIS BBL, 2007).

One kettle hole, later to become SWDA No. 1, is apparent in early plant photographs from 1935, 1939 and 1940. The kettle hole appears swampy, indicating that the bottom of the kettle hole is either at or near groundwater level or lined with glacial drift (a till-like material), as kettle holes are often without surface drainage (Bates and Jackson, 1980). Activity is first noted in a photo from 1952, in which filling had been initiated in the kettle hole. Water is visible in this 1952 photo. By 1958, there is definitive photographic evidence of landfill activities; more fill and large debris had been placed in the kettle hole. By 1970, significant amounts of fill and debris had been disposed of in the kettle hole, spreading to the edges of the depression. Photos from 1976 and 1980 show no active disposal (Blasland and Bouck Engineers, PC, 1984a).

A second kettle hole, north-northwest of the first kettle hole, was observed to be filling with debris beginning in 1958. In this photo, fill and large debris is observed in standing water in the LWDA No. 1 area. Photos from the 1960s show barrels near the top of the eastern side of the kettle hole. It is reported that contents of the barrels were emptied into LWDA No. 1. By 1972, photos show no more activity in the area (Blasland and Bouck Engineers, PC, 1984a). As discussed above, soil borings, test pits and geophysical surveys have confirmed that the vertical and horizontal limits of the landfill are defined by the base and walls of these kettle holes, established in the topographic survey.

The vertical and horizontal extent of the landfill materials and the ash cover are presented in a three-dimensional (3-D) model using the 1935 elevation survey, 1984 elevation survey and a 2001 elevation survey (Appendix F of the attached RFI/MCP Phase II CSA Addendum Report [ARCADIS BBL, 2007]). A plan view of this 3-D depiction is presented on Figure F-4 of Appendix F.

Aerial photography was used to establish when burning pits or cages were first observed and when they terminated. Burning Pit A is not observed in aerial photographs from 1939, 1940, or 1946. However, on the 1946 photograph, a road appears to have been forged through the woods to the vicinity of Burning Pit A area. A clearing and excavation are observed at the Burning Pit A area in 1946. The first observed burning activity in Burning Pit A is visible on a 1952 aerial photograph (United States Geological Survey [USGS], 1952). According to the *Draft RCRA Facility Assessment* prepared for the USEPA (Federal Programs [CDM], 1991), Burning Pit A was first used in 1952. A burning cage was used in this area from 1952 to 1954, and a burning pit was used from 1954 to 1966 (CDM, 1991). According to the *History of On-Site Waste Disposal Operations At*

Monsanto Company – Springfield and Bircham Bend Plant 1938 to 1972 (Monsanto, 1982), open burning was used to dispose of cardboard, containers, combustible trash, and some combustible process waste, as presented in Attachment 1 of the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007). The other burning area at the plant was Burning Cage B, which was used between 1966 and 1968. Soil boring and hand augers were used to confirm the location of these burning areas.

The Bircham Bend Plant had two burning areas, Burning Pit C and Burning Pits D. Based on an aerial photograph review (Blasland and Bouck Engineers, PC, 1984a), Burning Pit C was observed as a bermed burning area used between 1960 and 1966, and terminating in 1968. Burning Pits D was observed as early as 1939 and was active until 1950 (Blasland and Bouck Engineers, PC, 1984a). The types of materials observed in close-up photographs include fiber barrels, cardboard, trash and residuals of the burning such as metal hoops from fiber barrels and ash.

4.1.2 Geophysical Surveys

Phase I RI work efforts included the following geophysical surveys:

- magnetometer survey at SWDAs No. 1 and No. 2, LWDA No. 1, and Burning Pit C; and
- seismic refraction survey at SWDAs No. 1 and No. 2, LWDA No. 1 and Burning Pit A.

The magnetometer survey identified metallic anomalies within the horizontal boundaries of SWDA No. 1, LWDA No. 1, Burning Pit C and, to a limited extent, SWDA No. 2 (Blasland and Bouck Engineers, PC, 1984a).

4.1.3 Test Pits

Five test pit excavations were completed to evaluate the magnetic anomalies and characterize waste in the landfills, SWDAs No. 1 and 2, and LWDA No 1. Two test pits were excavated in SWDAs No. 1 and No. 2, and one test pit was excavated in LWDA No. l. Each test pit contained soil and scrap plastic. Twenty to thirty crushed drums containing mostly dry trash and plastic scraps were founds at each location. Four of the drums found contained less than one gallon of liquid. In no case was an intact full drum found. Analytical results for liquid contents are described in Section 4.2 below.

4.2 Previous Analytical Sampling and Analysis

Between 1984 and 1996, a substantial amount of environmental sampling was conducted at the plant. The analytical data are presented in the attached RFI/MCP Phase II CSA Addendum Report, Appendix D-2 - Analytical Data and Data Validation Reports (ARCADIS BBL, 2007). A summary of the constituents historically sampled and detected, and the number of times the constituents were detected above relevant MADEP reportable concentrations (RCs) according to 310 CMR 40.1600 criteria (including investigative data collected as of 1995) are presented in Appendix D-4. The analytical investigations conducted from 1984 to 1996 prior to the supplemental investigations presented in this report are summarized in Section 4.2.1 below.

4.2.1 Chemical Characteristics

This section summarizes the previous groundwater and soil analytical sampling and analysis conducted for the plant to determine a site-specific compound list. This analytical data is presented in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) as Appendix D-1 and D-2, as well as the Data Usability Evaluation for this data as Appendix B.

The analytical data are summarized below in the following order:

- groundwater analytical data;
- surface soil analytical data;
- subsurface soil analytical data;
- soil/waste analytical data;
- soil vapor data;
- surface-water data; and
- sediment data.

4.2.1.1 Groundwater Analytical Data

From 1983 to 2006, a total of 685 groundwater samples were collected from 119 monitoring wells or temporary wells at the plant. Of these, 662 samples were analyzed for volatile organic compounds (VOCs).

Semivolatile organic compounds (SVOCs) were analyzed in 111 groundwater samples. PCBs, pesticides and/or herbicides were analyzed in 110 groundwater samples. Appendix IX parameters were analyzed in five groundwater samples. Inorganics and cyanide were analyzed in 128 groundwater samples. Miscellaneous parameters were analyzed in 103 groundwater samples (consisting of acrylonitrile and allyl alcohol, VPH, EPH and total organic carbon).

4.2.1.2 Soil Analyses

From 1983 to 2005, a total of 195 soil samples were collected from at the plant. Of the total, 44 were surface soil and 151 were subsurface soil. Soils were analyzed for the following parameters: VOCs, SVOCs, PCBs, pesticides, herbicides and inorganics.

4.2.1.2.1 Surface Soil Analyses

VOCs were analyzed in 35 of the 44 surface soil samples, SVOCs were analyzed in 20 surface soil samples and PCBs were analyzed in 16 surface soil samples. Inorganics, including cyanide, were analyzed in 24 surface soil samples.

4.2.1.2.2 Subsurface Soil Analyses

Of the 195 soil samples collected since 1985 at the plant, 151 were subsurface soil samples. VOCs were analyzed in 129 subsurface soil samples, SVOCs were analyzed in 34 subsurface soil samples and PCBs were analyzed in six subsurface soil samples. Inorganics, including cyanide, were analyzed in 24 subsurface soil samples. Miscellaneous parameter analytical results are also available for 30 subsurface soil samples.

4.2.1.3 Soil/Waste Analyses

Since 1994, ten discrete soil/waste samples were collected at the plant from the disposal areas to evaluate the source areas and nature of the source. Limited sampling was completed in the landfills for the following reasons:

- safety considerations;
- the landfills known to contain industrial wastes are heterogeneous; and
- characterization of the landfill wastes is impractical consistent with the USEPA's presumptive remedy for landfill wastes.

The appropriate characterization performance standard for landfills is to evaluate constituents that may be leaching from the landfill. Depth intervals for each waste sample collected within the landfill or known disposal area were based on highest field screening results with the PID/FID. Analysis was conducted for VOCs, SVOCs, PCBs and inorganics.

On July 22, 1986, four samples were collected by the USEPA from liquid material found in four of the crushed drums found in the five test pits.

4.2.1.4 Surface Water and Sediment

From 1985 to 2005, surface water and sediment were collected from Chicopee River and Bircham Bend Brook. Analysis was conducted for VOCs, SVOCs, PCBs and inorganics.

At the Chicopee River in 1987, 1985, and 2005, sediment and surface-water samples were collected. A total of 35 sediment samples and 27 surface-water samples were collected from the Chicopee River for laboratory analysis. In addition, 80 passive vapor samples were collected below the hyporheic zone of the river for VOCs to delineate the extent and to evaluate the fate of chlorobenzene observed in groundwater.

At Bircham Bend Book in 1985, 1987, 1995 and 1999, sediment and surface-water samples were collected. Fourteen sediment samples and 18 surface-water samples were collected for laboratory analysis.

5. Site-Specific Compounds

Select VOCs are the most predominant class of chemical detected at the plant. VOCs detected in groundwater and the extent of VOCs are described in Section 6. Although select SVOCs, inorganics and PCBs were detected sporadically, intermittently and in localized areas, they are considered within the site-specific compound list.

Based on the historical property use, list of raw materials used at the facility, manufactured products, manufacturing processes and/or lack of detections of specific media analyzed, the following classes of parameters have been ruled out from the site- specific compound list:

- pesticides; and
- herbicides.

The following emerging constituents have also been ruled out, given records of plant operation history, raw products used in manufacturing and/or waste management practices:

- 1-4 dioxane;
- n-nitrosodimethylamine (NDMA), (also known as dimethylnitrosamine or N,N-dimethylnitrosamine);
- cyclonite (also known as cyclotrimethylene trinitramine or royal demolition explosive);
- perchlorate;
- polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzodioxins (PCDDs); and
- chloroform.

Justification for elimination is presented in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) as Appendix D-3. This appendix presents precursor information on these emerging constituents, and/or the constituent formation requirement and/or formation prerequisite conditions.

6. Source, Nature and Extent

This section describes the source; nature; extent in soil, groundwater, air, surface water and sediment; potential receptors; and potential risks for the 13 disposal areas based on the investigations and risk characterizations discussed in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007). Table 4 lists the disposal areas and presents key information about each area.

TABLE 4
DISPOSAL AREA OPERATION SUMMARY

Location Name	Years of Operation	Wastes/Raw Materials Handled	Size (acres)[1]
Solid Waste Disposal Area No. 1	1946 – 1971	Trash, construction debris, scrap plastics, and resins, colorants and stabilizers, electric transformers.	5.8
Solid Waste Disposal Area No. 2	1966 – 1971	Same as SWDA No. 1.	3
Liquid Waste Disposal Area No. 1	1954 – 1971	Waste solvents, oils, sludges.	2.7
Liquid Waste Disposal Area No. 2	1960s	Unknown, off-grade plastic.	0.2
Fiberloid Landfill	Possibly 1904 – 1940	Construction debris, coal plant ash, slag.	7
Building 99 Leach Fields	1971 – 1975	Toluene, DMF inks.	0.25 each
Burning Cages or Pits A	1950 – 1966	Plant trash, cardboard, paper	0.05
Burning Cage or Pit B	1966 – 1968	Plant trash.	0.01
Burning Pit C	1960 – 1968	Plant trash, plastic scrap.	0.01
Burning Pits D	1939 – 1961	Plant trash, fiber barrels, construction debris, scrap plastic.	0.5
Former Building 44 and Tank Farm D&E	1930s – 1987	Ethylbenzene, 2 butanone phenol.	3
World War II Naval Research Area	1942 – 1947	Chlorobenzene, mineral oil.	0.35
Outfall Piping adjacent to Chicopee River Shoreline	Unknown to present via permits	To the mid-1970s, drainage from storm drains, roof drains and floor drains. Since 1984, stormwater and once-through noncontact cooling water.	2.89

Notes:
[1]BBL, 1996a.
DMF = Dimethyl formaldehyde.

Each of these areas is summarized in this section; details are presented in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007).

6.1 Solid Waste Disposal Area No. 1 (SWDA No. 1) — SWMU 35

6.1.1 Source and Nature

SWDA No. 1 (SWMU-35) is a 5.8-acre kettle-filled landfill located on the southeast corner of the plant (Figure 2). The primary constituent associated with this area is chlorobenzene, as described in below.

Area	Primary Constituent Detected	Source Area Description	Additional Constituents Detected and Source
SWMU 35/ SWDA No. 1	Chlorobenzene, styrene and xylene	The source of chlorobenzene is disposal of soil or discarded raw materials from former WWII NR Area into SWDA No. 1. There have been no raw materials or products manufactured at the Indian Orchard Plant containing chlorobenzene that could result in a chlorobenzene byproduct. However, chlorobenzene was used for a brief period for R&D efforts by the Navy in the mid-1940s. This R&D project occurred at the Former WWII NR Area. Historical Former WWII NR Area maps and aerial photographs show three ASTs adjacent to Building 96, one of which was reportedly used to store chlorobenzene until 1950. It is likely that one or more releases of chlorobenzene occurred at the Former WWII NR Area former AST area to the soils and that these soils were then disposed into SWDA No. 1 during decommissioning or road construction around 1958.	Ethylbenzene, Bis(2-ethylhexyl)phthalate. (It is likely that these are associated with scrap plastic and resins, solution resins and syrups, and colorants and stabilizers received by the landfill during its operation.)

The limits of the landfill and the extent of chlorobenzene, ethylbenzene, xylene, styrene and bis(2-ethylhexl)phthalate in waste and/or soil in and surrounding the landfill were defined based on 31 soil borings and three test pits within and surrounding SWDA No. 1. The extent of wastes in the landfill is (shown on Figure 4-7 and in Appendix F-4) based on a 1935 elevation survey of the former kettle hole. The extent of this landfill is based on an elevation survey of the former kettle hole. The walls and floor of the kettle hole define the landfill extent. The extent of chlorobenzene in groundwater in the deep and shallow saturated zone, both of which are above the till, is shown on Figure 6-1, Figure F-5 of Appendix F, and J-2 and J-3 of Appendix J.

An electronic visualization model of the landfill relating the relationship of the water table to the landfill was created and is presented in Appendix F of the RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) attached to this Summary Report.

NAPL was observed in one soil boring, SB-37, within SWDA No. 1 above a perched water zone. The NAPL consisted of a mixture of chlorobenzene (70 percent of the mixture), ethylbenzene, xylene, toluene, bis(2-ethylhexyl)phthalate and 2-methyl naphthalene, and could be denser than water (Solutia, 1998b).

6.1.2 VOC Extent in Soil

In 1986, two test pits (TP-3 and TP-4) were excavated at locations selected based on ground-penetrating radar (GPR) and magnetometer survey test results within the former landfill. Hardened dry plastics and crushed empty drums were observed in the test pits. VOC analytical results from the test pits indicated the presence of ethylbenzene and xylene. Three soil borings (SB-37, SB-38 and SB-39) were subsequently drilled through the landfill to better characterize the waste. Six soil samples and one NAPL sample were collected from these soil borings to delineate horizontal and vertical extent, and to characterize wastes. Given the non-homogeneous nature of the landfill materials and the presence of NAPL containing 70 percent chlorobenzene (a compound denser than water), additional soil borings were not drilled into the landfill to avoid potentially exacerbating the NAPL extent. Twenty-two soil borings were advanced and continuously sampled at 2-foot intervals around the perimeter of the landfill from the early 1980s to 1999 to fully define its horizontal extent.

Seven soil samples were selected for further analysis based on FID and PID field screening of samples, along the western perimeter of SWDA No. 1, for analysis of VOCs, SVOCs, PCBs, pesticides, metals, phenols and cyanide (priority pollutants). None of these compounds were detected above method quantitation limits except metals, which were detected below RCs. The water table was located approximately 50 feet bgs.

SWDA No. 1 is identified as a hot spot based on soil sample analytical results from borings SB-37, SB-38 and SB-39; test pit results; and the NAPL sample obtained from the landfill wastes. Table 5 summarizes the concentrations meeting hot spot definition.

TABLE 5
SWDA NO. 1 HOT SPOT - RESULTS

Constituent of Concern Date Collected Depth Range (ft) Sample Type	MADEP S-2/GW-3	SB-37 6/16/1994 FS (10 - 14')	SB-37 6/16/1994 FS (26 - 28')	SB-38 6/23/1994 FS (2 - 3')	SB-39 6/21/1994 FS (10 - 14')
Chlorobenzene	100	**140U**	20U	0.38J	**140U**
Ethylbenzene	500	**2,900**	410	**760**	**6,000**
Styrene	1000	36	47	30 U	**1600**
Xylenes, Total	300	140 U	180	250	**18,000**

Constituent of Concern Date Collected Depth Range (ft) Sample Type	MADEP S-2/GW-3	SB-37 6/16/1994 FS (10 - 14')	SB-37 6/16/1994 FS (26 - 28')	SB-38 6/23/1994 FS (2 - 3')	SB-39 6/21/1994 FS (10 - 14')
bis(2-Ethylhexyl)phthalate	500	360	**1,800**	490	310
Phenol	100	76 U	**260 U**	78 U	**180**
Aroclor-1254	2	1.8 U	**13 U**	**2.3**	0.93 U
Antimony	30	12	**120**	9.4	8.2
Arsenic	20	1.4	1.8	1.3	**120**
Cadmium	30	10	3.5	**65**	9.5

Notes:
Results reported in mg/kg.
Bold qualified as meeting hot spot criteria due to exceedance of applicable Method 1 standard.
J = estimated.

In addition, the NAPL in SWDA No. 1 exceeds an Upper Concentration Limit. Therefore, the extent of the hot spot is conservatively estimated to be the entire the horizontal and vertical extent of the SWDA No. 1 landfill.

6.1.3 VOC Extent in Groundwater

Groundwater data indicate that the primary constituent detected associated with this area is chlorobenzene. Styrene detected in the landfill waste of SWDA No. 1 has not been detected in the groundwater, and ethylbenzene is limited in extent beyond the limits of SWDA No. 1. The extent of chlorobenzene in the groundwater has been delineated based on 27 monitoring wells and 55 passive vapor diffusion samplers in the Chicopee River, as well as surface water and sediment from the Chicopee River.

Based on results from groundwater samples, the source of chlorobenzene to groundwater is downgradient of SWDA No. 1. Chlorobenzene is leaching from the landfill to the groundwater from the north-northwest corner of SWDA No. 1, as described in Section 6.2.3.1 of the attached RFI/MCP Phase II CSAS Addendum Report. This plume is approximately 3,000 feet long by 600 feet wide and migrates west and then north-northwest toward the Chicopee River along a preferential pathway in the heterogeneities within the saturated deltaic outwash sand. This sand is thickest within the depression in the basal till (Figures 3-2 and 4-4 of the attached Addendum Report).

Based on an advection-dispersion equation of the plume associated with SWDA No. 1, the NAPL source is calculated to equal approximately 55 gallons (Appendix C of the Attached Addendum Report, C-4 — Review of USEPA Analytical Solution Model).

6.1.4 Natural Attenuation in Groundwater

In 1999, BBL completed an *Evaluation of Natural Attenuation Processes, Indicator Parameters, and Products* (Appendix J). The goal of this study was to evaluate groundwater-quality conditions at the site using methods adopted by the USEPA to assess the potential for NA of dissolved VOCs in groundwater.

Groundwater analytical data obtained at the site indicate that there is an NA "zone," coincident with the location of the VOC plume, in which dissolved VOCs are being metabolically degraded as a carbon source to byproducts (e.g., carbon dioxide, methane, and water) due to the presence of naturally occurring, biologically mediated redox reactions.

6.1.5 VOC Extent to Chicopee River

As discussed earlier, the chlorobenzene plume follows the path of the greatest aquifer thickness in the deltaic outwash sand. The plume is most highly concentrated in the deep aquifer oxygen-depleted zone. In the area where the chlorobenzene plume appears to intersect the Chicopee River, the aquifer is approximately 70 feet thick. It is unlikely that the plume extends beneath the Chicopee River, given that the river is the lowest-elevation water body in the area, and groundwater elevations on the other side of the river are higher than surface-water elevations, as discussed in Section 4.5.2.7 of the attached Addendum Report. It can thus be inferred that the groundwater discharges to the Chicopee River.

However, when VOC concentrations in groundwater are used to calculate the predicted surface-water concentrations using the MADEP's surface-water dilution model and 10-year, 7-day low-flow, the modeled concentrations are below the Ambient Water Quality Criteria (AWQC) (Table 6-15 of the RFI Risk Assessment/MCP Phase II CSA Report) (BBL, 1996b).

In September and October 2001, 60 PVD samplers were installed in the Chicopee River downgradient of the chlorobenzene plume. The PVDs were installed beneath the hyporheic zone of the Chicopee River to evaluate the fate of chlorobenzene from groundwater (see Sections 6.4.1 and 6.2.6 of the attached Addendum Report for additional information regarding these sampling activities). Only trace levels of chlorobenzene were detected in PVDs in the Chicopee River, ten times less than applicable groundwater criteria. These data support the conclusion that the chlorobenzene plume enters the Chicopee River. However, concentrations are significantly reduced, from approximately 1 mg/L at MW-43D to 0.05 mg/L at one of 60 PVD samples in the hyporheic zone

of the Chicopee River (see Section 6.4.1 of the attached Addendum Report — Chlorobenzene Fate Study). It is likely that, as the chlorobenzene moves from the deep oxygen-deprived aquifer up through the shallow aquifer and into the oxygen-rich surface water (DO measurements ranged from 5 mg/L to 7 mg/L in surface water in 1999) (see Table 6-5, BBL, 1996a), it readily degrades. NA may be a key degradation process, given that only trace amounts of chlorobenzene reach the hyporheic zone below the Chicopee River surface-water/groundwater interface.

6.1.6 Potential Receptors

Risks were evaluated for an outdoor onsite worker, intrusive worker, trespasser and recreator for total lifetime cancer and non-cancer hazards for media beyond the perimeter of SWDA No. 1. Excluding the hot spot associated with the wastes associated with SWDA No. 1, a Condition of No Significant Risk was identified for potential receptors, with the exception of an intrusive worker, beyond the hotspot extent. The intrusive worker is considered to be onsite for limited periods of time and engaged in ground-intrusive activities associated with building construction or the repair and/or installation of utility lines or pipe. The exposure pathway for the intrusive worker involves direct contact in the event that groundwater with concentrations of chlorobenzene greater than 0.28 mg/L is encountered beyond the perimeter of SWDA No. 1. In addition, the entire extent of SWDA No. 1 is considered a hotspot, and additional response actions are required to restrict access. This scenario also assumes an industrial land use restriction for the plant.

6.2 Solid Waste Disposal Areas No. 2 (SWDA No. 2) — SWMU 36

6.2.1 Source and Nature

SWDA No. 2 is located in the south-central portion of the site. The primary constituents associated with this area are similar to those detected in SWDA No. 1. Concentrations of one SVOC [bis(2 ethyl hexyl)phthalate], PCBs and inorganics are relatively low compared to those detected in SWDA No. 1. None of the VOCs or SVOCs exceeded a UCL or RC. Bis (2 ethyl hexyl) phthalate, PCB and lead were the only constituents that were detected above an RC, as described in the table below.

Area	Primary Constituent Detected	Source Area Description	Additional Constituents Detected and Source
SWDA No. 2 (SWMU 36)	PCBs (Aroclor 1242, 1260)	The sources of lead and bis(2 ethyl hexyl)phthalate are plant refuse landfilled at this location from 1966 to 1971. It is likely that the source of PCBs in SWDA No. 2 is linked to the former use of PCB transformers at the plant. The PCB transformers and their associated waste were removed from the site in 1991 (USEPA, 1991b) by Transformer Service Inc., Ohio, USEPA ID # NHD018902874. While the bulk of PCB-related waste was taken offsite by a permitted transporter to an approved disposal facility, it is possible that some residual waste or contaminated soils were left and deposited in SWDA No. 2.	Bis(2-ethylhexyl)phthalate, Dimethyl phthalate, styrene, xylene, arsenic cadmium, copper, lead, mercury, and selenium. It is likely that additional constituents are associated with refuse, plastic pellets, plastic sheeting, plastic fragments and adhesive-like material received by the landfill during its operation.

The limits of the landfill and the extent of waste are defined based on 28 soil borings, two test pits and eight surface soil samples within and surrounding SWMU 36/SWDA No. 2. The extent of PCBs in soil is based on 10 samples. NAPL was not observed in or around the SWDA No. 2 soils or in surrounding monitoring wells.

6.2.2 Extent in Soil

Two test pits based on GPR and magnetometer survey test results and three soil borings were installed through the landfill to characterize the waste. Waste in these borings consisted of plastic pellets, plastic sheeting, plastic fragments, semi-solid materials, adhesive-like material, brick, wood, glass, aluminum foil and cardboard. The waste materials extended approximately 10 feet into the water table. Low levels of PCBs have been detected in subsurface and surface soils. The other constituents detected in SWDA No. 2 include bis(2-ethylhexl)phthalate, dimethyl phthalate, styrene and xylene. However, none of these constituent are observed to extend beyond the extent of this landfill, as discussed below.

Using the observations and analytical data collected from subsurface soil borings, the wastes in SWMU 36/SWDA No. 2 were determined to extend vertically both above and below the water table. Furthermore, the horizontal extent of PCBs in soil is limited to the horizontal extent of SWMU 36/SWDA No. 2.

A hot spot was conservatively delineated assuming the entire horizontal and vertical extent of SWDA No. 2, as the hot spot based on topographic comparisons of the pre- and post-landfill construction elevations, landfill soil borings, test pits and landfill perimeter soil borings.

6.2.3 Extent in Groundwater

Groundwater samples were collected and analyzed from seven wells in the area of SWMU 36/SWDA No. 2 and stormwater drain culvert C-SR-11, which runs north of SWDA No. 2, westward and into the Bircham Bend Brook (Figure 2). The data suggest that groundwater in this area has been relatively unaffected by the wastes in SWDA No. 2.

Although the waste materials in SWDA No. 2 are partially below the water table, constituents are not detected in groundwater above RCs, based on groundwater and surface-water analytical data.

6.2.4 Extent in Surface Water/Sediment

PCBs have not been detected in surface water adjacent to SWDA No. 2 in Bircham Bend Brook. A culvert draining into Bircham Bend Brook was found to contain a trace of PCB Aroclor 1260 at 0.00019J mg/kg.

Sediment samples were collected in Bircham Bend Brook for analysis of SVOCs, PCBs and inorganics. Analytical data indicate that SWMU 36/SWDA No. 2 has no effect on nearby surface water or sediment (BBL, 2001b). Therefore, although risks were evaluated on a site-wide basis, a Condition of No Significant Risk currently exists around the perimeter of SWDA No. 2; however, waste within SWDA No. 2 and isolated areas of the surface soils of SWDA No. 2 are considered hot spots that require response actions to restrict access.

6.2.5 Potential Receptors

Risks were evaluated on a site-wide basis for the potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors. However, this characterization assumes that SWDA No. 2 is a hot spot and that further response actions are necessary to restrict access. An industrial land use restriction is assumed for the plant.

6.3 SWMU 34/Liquid Waste Disposal Area No. 1 (LWDA No. 1)

6.3.1 Source and Nature

LWDA No. 1 is located in the central area of the plant property northwest of SWDA No. 1.

Area	Primary Constituent Detected	Source Area Description	Additional Constituents Detected
SWMU 34/ LWDA No. 1	Styrene	The source of styrene detected in LWDA No. 1 is likely associated with disposal of off-grade products into SWMU 35/LWDA No. 1 from 1954 to 1971.	1,2-Dichloroethane, 1,1,2-Dichloropropane, Bis(2-chlorothyl)ether, N-Nitrosodiphenylamine, Benzene, Ethylbenzene, Toluene, Xylene, Arsenic and Lead. (These constituents are likely associated with waste solvents, oils, sludges and latex received by the landfill over the course of its operation.)

The limits of the landfill extent of VOCs in soils were defined based on samples from a test pit and 19 soil borings within and surrounding SWMU 34/LWDA No. 1. Styrene in the landfill has not been observed in the surrounding soil or groundwater.

6.3.2 Extent in Soil

A test pit was excavated at a location selected based on GPR and magnetometer survey test results within the former landfill. Empty, crushed drums were observed in the test pit. Two additional soil borings were drilled through the landfill to better characterize the waste. The wastes observed consisted of plastic sheeting, adhesive-like material, glass, metal fragments, wood and brick. Based on observations of samples collected from the subsurface soil borings, the vertical extent of the wastes and LWDA No. 1 were determined to be at or above the water table. Based on historical topographic maps, the deepest portion of SWDA 34/LWDA No. 1 was estimated to be 30 feet bgs. The extent of the landfill is based on an elevation survey of the former kettle hole. The walls and floor of the former kettle hole define the extent of the landfill, which has been confirmed by borings. The wastes are buried below approximately 15 to 20 feet of soil and ash cover.

Twenty-three soil borings were advanced around the perimeter of the landfill to fully define its horizontal and vertical extent. Based on a topographic survey, LWDA No. 1 is located within and is laterally confined by the boundaries of a second kettle hole mapped in 1935, approximately 100 feet northwest of SWDA No. 1.

At the suggestion of the USEPA, an additional soil boring and monitoring well were advanced at the downgradient edge of LWDA No.1. A soil sample from the boring was selected for analysis based on FID and PID soil field screening. No constituents exceeded the criteria.

Based on the concentrations of VOCs detected in the landfill, LWDA No.1 is defined as a hot spot. The extent of the hot spot is illustrated on Figure 3. Table 6 summarizes the concentrations that result in the determination of LWDA No. 1 as a hot spot.

TABLE 6
LWDA NO. 1 - HOT SPOT RESULTS

Sample ID **Date Collected** **Depth Range (ft)** **Sample Type**	**MADEP S-3/GW-3**	**SB-40 6/22/1994 FS (30 - 32')**	**SB-40 6/22/1994 FS (34 - 36')**
bis(2-Ethylhexyl)phthalate	500	**620**	**1400**
Ethylbenzene	500	180	**550**
Styrene	1000	120	**3600**
Toluene	1000	7.3 U	510
Xylenes, Total	300	55	**640**
Phenol	20	160U	**480**
Lead	30	21	**720**

Notes:
Results reported in mg/kg.
Bold qualified as meeting hot spot criteria due to exceedance above applicable Method 1 standard.

6.3.3 Extent in Groundwater

Soil/waste analytical data from LWDA No. 1 indicate that the primary constituent detected in this area is styrene. To fully characterize the horizontal and vertical extent of styrene in groundwater in this area, 13groundwater monitoring wells were installed. However, neither styrene nor any of the other constituents found in LWDA No. 1 were detected in groundwater in the vicinity or downgradient of LWDA No. 1.

The groundwater analytical data indicate that the wastes within SWMU 34/LWDA No. 1 are not migrating beyond the extent of LWDA No. 1.

6.3.4 VOC Extent in Surface Water

LWDA No. 1 is not adjacent to a surface-water body, nor are there complete pathways to a surface-water body from LWDA No. 1.

6.3.5 VOC Extent in Surface Soil

The thickness of the soil cover above the wastes in SWMU 34/LWDA No. 1, which ranges from 15 to 20 feet, precludes any impacts from SWMU 34/LWDA No. 1; therefore, surface soils were not collected in this area. The top of SWMU 34/LWDA No. 1 is considered isolated relative to MADEP MCP Soil Category Definitions (Category S-3).

6.3.6 Potential Receptors

Risks were evaluated on a site-wide basis for the potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors. However, this characterization assumes SWDA No. 2 is a hot spot and further response actions are needed to restrict access. In addition, this characterization assumes an industrial land use restriction for the plant.

6.4 SWMU 37/Liquid Waste Disposal Area No. 2 (LWDA No. 2)

6.4.1 Source and Nature

SWMU 37/LWDA No. 2 is located on the southeast corner of the property, approximately 125 feet west of SWDA No. 1.

Based on soil and groundwater analytical data, the primary constituents associated with this area are VOCs and metals, as described in the table below.

Area	Primary Constituent Detected	Source Area Description
SWMU 37/ LWDA No. 2	Bis(2-ethylhexyl)phthalate, Di-n-butylphthalate, Benzoic Acid, Tetrachloroethene, Toluene, and Lead.	This area was used in the 1960s. An aerial photo taken during the period of operation shows two tankers discharging liquids into a shallow depression. In that photo, the north edge of the area was exposed, revealing layers of hardened plastics.

The extent of VOCs in soils was defined based on eight soil boring and one surface soil sample (SS-14) within and surrounding SWMU 37/LWDA No. 2. NAPL was not observed in LWDA No. 2 or in surrounding soil boring monitoring wells.

6.4.2 Extent in Soil

Two soil borings were drilled through the landfill to characterize the waste. Waste consisted of an opaque, solid, plastic-like material at SB-44. Low levels of VOCs (ethylbenzene, xylenes and acetone) and metals (lead and cobalt) were detected in soils below the landfill; however, all detections were below criteria. Using the soil boring logs and soil analytical data collected from subsurface soil borings, the vertical extent of the wastes in SWMU 37/LWDA No. 2 was determined to be 25 to 30 feet above groundwater.

6.4.3 Extent in Surface Soil

One surface soil sample was collected above the horizontal extent of the wastes in SWMU 37/LWDA No. 2, and two samples were collected adjacent to the landfill for analysis of SVOCs, VOCs and inorganics. None of the detected concentrations exceeded the criteria.

No applicable Method 1 standards were exceeded in soil in LWDA No. 2; therefore, no hot spots were defined in this area.

6.4.4 Extent in Groundwater

Xylene, once detected downgradient of MW-5S and MW-26S, MW-28D and MW-25D, has not been detected since 1990.

Based on groundwater and soil analytical results, no constituents from LWDA No. 2, including the hardened plastic-like materials, have migrated into surrounding soil and groundwater. Concentrations of VOCs, SVOCs and metals were lower in the well downgradient of LWDA No. 2 than in the upgradient wells.

6.4.5 Extent in Surface Water

Because there are no surface-water bodies adjacent to LWDA No. 2, surface-water results are not associated with this area.

6.4.6 Potential Receptors

Risks were evaluated on a site-wide basis for potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors. However, this characterization assumes an industrial land use restriction for the plant.

6.5 Fiberloid Landfill, SWMU 33

6.5.1 Source and Nature of Area Constituents

The Fiberloid Landfill borders the Chicopee River in the area of Buildings 68 and 43A (Figure 2). Based on the analytical data, the primary constituents of concern are polycyclic aromatic hydrocarbons (PAHs) and PCBs. The following table defines the constituents, source and date of discovery:

Area	Primary Constituent Detected	Source Area Description
Fiberloid Landfill	PAHs and PCBs	From 1904 to 1964, at former Building F2 (located on the NOVA property) in the eastern portion of the site, coal was used to generate electric and steam power for the facility from 1935 to 1960. The coal ash was disposed to the west in what is now known as Fiberloid Landfill. This ash is the source of PAH detections in the Fiberloid Landfill. Approximately 5 gallons of PCB oil were found in the Fiberloid Landfill during utility improvements; remediation was completed on July 7, 1988 (BBL, 1996a).

The likely sources of PAHs and PCBs have been identified, and the extent of these constituents has been delineated (see Sections 6.2.3 and 6.3.2 of the attached Addendum Report). Two soil borings and two surface soil samples were used to delineate sources of PAHs in Fiberloid Landfill in soil. PAHs were not found in groundwater in this area. One soil boring and two surface soil samples were used to delineate PCBs in Fiberloid Landfill. No PCBs were found in groundwater. The following sections discuss these findings in detail.

6.5.1.1 Soil

There are no detections of PCBs above criteria in soil in the Fiberloid Landfill. PCBs were found at three locations. Although low-level detections of PAHs were detected in soil, these concentrations were also below criteria. Therefore, no hot spots in soils were defined in this area.

6.5.1.2 Groundwater

There were no detections of PCBs in groundwater in the Fiberloid Landfill. Concentrations of PAHs exceeding criteria were detected in groundwater in the Fiberloid Landfill. The extent of PAHs in the Fiberloid Landfill is defined by non-detects at the six sampling locations.

6.5.2 Potential Receptors

Risks were evaluated on a site-wide basis for potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors at Fiberloid Landfill, with the exception of the area where the chlorobenzene groundwater plume from the Former WWII NR Area migrates through Fiberloid Landfill. However, this characterization assumes an industrial land use restriction for the plant.

6.6 Building 99 Leach Field

6.6.1 Source and Nature

The Building 99 Leach Fields were located on the western side of Building 99 (one to the north and one to the south) as shown on Figure 2. Burning Pit B is located adjacent to the northern leach field.

Area	Primary Constituent Detected	Source Area Description
Building 99 Leach Fields	2,4,5-Trichlorophenol (only in the northern leach field)	The leach fields began operation in October 1971 and operated for 4 years. They serviced Building 99 plastic tinting operations when overflow occurred during potential equipment water flushes. In 1972, two concrete 1,200-gallon USTs (or "separation pits") were installed. These separation pits were used for holding discharge of spill cleanups and equipment water flushes from overflow and floor drains within Building 99. Solvents were recovered from the separation pit, and liquids were drained to the two leach fields. The materials used in the plastic tinting operations within Building 99 included ink solution, plasticizer, dimethyl formamide, and (possibly) methanol and 2-butanone. The materials that potentially discharged into the separation pit and through the leach field included waste ink solution, waste plasticizer, waste therminol, toluene, 2-butanone, dimethyl formamide and methanol (CDM, 1991); (Envirocomp, 1993). However, none of these constituents were detected in soil or groundwater at the leach field location. The leach field piping from each separation pit was capped in 1975. On December 3, 1993, the separation pits/accumulation tanks were formally decommissioned in place (Envirocomp, 1993).

The extent of 2,4,5-trichlorophenol in soil was defined based on two soil borings and two surface soil samples located within the leach fields. Three additional borings and five surface soil samples, located within the vicinity of the leach fields, were also used to define the extent of 2,4,5-trichlorophenol. The limits of the leach field were defined based on construction drawings and surface features surveyed to an existing building (Building 99). Because no obvious wastes or staining or PID/FID screening detections were observed, no additional soil borings were advanced.

The extent of 2,4,5-trichlorophenol in groundwater was defined based on two shallow monitoring wells that are located within the southern and northern leach fields, and on five downgradient monitoring wells.

6.6.2 Extent in Surface Soil

Two surface soil samples were collected at each of the leach field areas. These samples were analyzed for VOCs, SVOCs, inorganics and PCBs. Two VOC compounds, tetrachloroethylene (PCE) (0.001J mg/kg) and toluene (0.002J mg/kg), were detected in the southern leach field sample. No VOCs were detected in the northern leach field sample. Both of the VOCs detected in surface soil in this area were below criteria.

Four SVOCs were detected in the two surface soil samples collected in this area. However, none of these constituents, with the exception of 2,4,5-trichlorophenol, exceeded criteria at these locations. This constituent was not detected in the other nearby surface samples or in subsurface soil samples and was, therefore, limited in extent. No inorganic compounds were detected above criteria.

6.6.3 Extent in Subsurface Soil

No wastes or stained soils were observed. Both samples were analyzed for VOCs, SVOCs, inorganics, and PCBs.

No constituents were detected above criteria. No other VOC constituents were detected in either sample.

A number of SVOC constituents were detected below criteria in both soil samples within the leach fields. Comparable concentrations of these constituents were also found in nearby soil borings. Many additional SVOC constituents (e.g., di-n-octyl phthalate, dibenzofuran, and hexachloroethane) were detected at MW-73S in the northern leach field.

Inorganic compounds detected in the subsurface soil within the leach fields were similar to those detected in the surface soil, and all were below criteria. PCBs were not detected above method detection limits.

None of the applicable soil standards were exceeded in this area; therefore, no hot spots were defined.

6.6.4 Extent in Groundwater

Two groundwater samples were collected in August 1994 from the monitoring wells installed in the leach field areas. None of the VOCs or SVOCs associated with the leachfields were detected in groundwater.

6.6.5 Potential Receptors

Risks were evaluated on a site-wide basis for the potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors at Building 99 Leach Field. However, this characterization assumes an industrial land use restriction for the plant.

6.7 Burning Pits A, B, C, and D (SWMU 38, 39, 40, and 41)

6.7.1 Source and Nature of Area Constituents

Former Burning Pits A, B, C and D were located in the western or central portion of the site and were operated and managed by Fiberloid Company and Shawinigan Chemical Limited from 1938 until they were purchased by Monsanto in 1965.

Burning Pit A was located in the south-central portion of the site, on the eastern edge of SWDA No. 2. It was bordered to the north by Building 97, to the south by Worcester Street, and to the east by a railroad. Based on site and aerial photographs, it consisted of two small caged pits, approximately 15 feet by 15 feet in size.

Burning Pit B was located in west-central portion of the site, beneath the west side of Building 99 and between the Building 99 Leach Fields. It consisted of an aboveground wire cage.

Burning Pit C was located in the western portion of the site and was bordered to the north by a barrel storage area. It consisted of one pit, approximately 15 by 15 feet in size.

Burning Pits D comprised of two pits (eastern and western), each approximately 50 feet by 150 feet in size, located in the northwest corner of the site and bordered to the north by the Chicopee River and to the south by Building 115.

Area	Primary Constituent Detected	Source Area Description
Burning Pits A, B, C and D	Benzo(a)pyrene	Throughout its operation, from 1950 to 1966, Burning Pit A received solid wastes, cardboard and off-product plastics. Approximately 14,600 tons of wastes were reportedly burned. However, only traces of ash have been detected at one hand-auger location at the Burning Pit A location. Burning Pit A was owned and operated by Springfield Plant. Burning Pit B was an aboveground wire cage that operated between 1966 and 1968. The site of the burning pit is now covered by Building 99, the Saflex Building. Approximately 2,900 tons of combustible trash were reportedly burned. Burning Pit B was owned and operated by Shawinigan Resins Corporation. During the course of its operation from 1960 to 1968, Burning Pit C received fiber barrels with metal rings, plant trash, wood, paper and plastic scraps. Following its closure, the burning pit was filled in and leveled in preparation for future construction. Burning Pit C was owned and operated by Shawinigan Resins Corporation. Burning Pits D operated from 1939 to 1961. The burning pits received fiber barrels, trash and plastic scraps. Following their closure, they were filled in and leveled. Burning Pits D was owned and operated by Shawinigan Resins Corporation.

The limits of the burning areas and the extent of constituents related to the burning pits, if any, was defined based on soil borings. There were no detections above criteria for VOC, SVOC or inorganics, with the exception of 2,4,5-trichlorophenol at Burning Pit B, in the surface or subsurface soils. No wastes were encountered at Burning Pits A and B. A trace amount of plant trash was encountered in soil borings at Burning Pit C. Traces of charred materials, metal fragments, glass and plastic were found mixed in sand at Burning Pit C. Some wastes (glass, ash and plastic) were observed in Burning Pits D. None of the applicable Method 1 standards were exceeded in Burning Pits A, B, C or D; therefore, no hot spots were defined in these areas.

6.7.2 Extent in Groundwater

Burning Pit A

To fully determine the potential impact of Burning Pit A on groundwater, four groundwater monitoring wells were installed and sampled. No constituents were detected in groundwater associated with Burning Pit A.

Burning Pit B

Groundwater samples were collected from four upgradient wells near Burning Pit B. No additional parameters, with the exception of arsenic at approximately 0.05 mg/L, were detected at the downgradient wells.

No constituents were detected in groundwater associated with Burning Pit B soils.

Burning Pit C

Groundwater samples were collected from four monitoring wells near Burning Pit C. Low levels of arsenic and cadmium were detected below the criteria. No constituents were detected in groundwater associated with Burning Pit C.

Burning Pits D

Groundwater samples were collected from six monitoring wells near Burning Pits D. Benzoic acid was detected directly beneath Burning Pits D.

One well contained cadmium, nickel and lead above criteria, as well as arsenic, cadmium and chromium. None of the other wells in the vicinity of Burning Pits D contained metals in groundwater above criteria. A second sample collected this well, analyzed using low-flow techniques, confirmed that the metals detected in 1994 were the result of particulates in the sample.

6.7.3 Extent in Surface Water/Sediment

Because there are no observed releases to groundwater associated with the operation of any of the former Burning Pits, surface-water results are not associated with former Burning Pits A, B, C, or D. Sediment from the Chicopee River has been evaluated for Burning Pits D because these burning pits are adjacent to the river. Comparisons of the PAH ratios to reference standards indicate that the source of PAHs detected in the sediment is associated with former coal ash/wood ash combustion and is ubiquitous.

Additional surface water and sediment samples were collected recently (October 2006) in the Chicopee River. Constituents potentially associated with Burning Pits D (PAHs and inorganics) were evaluated. Results indicated that there were no apparent differences in concentrations of the constituents analyzed in surface water or sediment between upgradient and downgradient locations. In some cases, levels of constituents were higher in upstream samples than in samples collected next to the site. Therefore, it does not appear that constituents are entering the river adjacent the site in sufficient quantities to have a measurable impact on ambient conditions.

6.8 Former Building 44 and Tank Farm D&E, AOC 7

6.8.1 Source and Nature

Building 44 and Tank Farm D&E were located in the western portion of the Fiberloid Landfill Area, south of Building 67/67A (Figure 2). Building 44 and Tank Farm D&E were decommissioned in 1989. Based on soil and groundwater analytical data, the primary constituents of concern associated with activities in this area are ethylbenzene, phenol and 2-butanone (MEK). The following table defines the constituent, source and date of discovery:

Area	Primary Constituent Detected	Source Area Description
Former Building 44/Tank Farm D&E	Ethylbenzene, Phenol, 2-Butanone	In 1994, ethylbenzene associated with activities performed in and around Building 44 was detected above GW-3 criteria at MW-65S. Between approximately 1940 and 1987, phenolic and melamine resins were manufactured at Building 44 with raw materials containing phenol. Ethylbenzene is an impurity of the styrene monomer (Verschueren, 1983). Therefore, the most likely source of ethylbenzene is either the former tank containing styrene monomer or the filling activities associated with this tank. According to literature, styrene degrades more readily than ethylbenzene (Howard, 1989). Ethylbenzene may also be a degradation product of styrene (Warhurst and Fewson, 1994). Other materials reported to have been stored in Tank Farm E include formalin, 2-butanone, acrylonitrile, and styrene monomer. Detections of phenol and 2-butanone were also recorded in the area of concern, but none above RC criteria. Only ethylbenzene was above the RC criteria in this area, at one location. There were 15 additional detections of ethylbenzene.

Data collected in 1989, 1994, 2002 and 2003 delineated the nature and extent of ethylbenzene, phenol and 2-butanone in soil, groundwater, and pore water at the Former Building 44/Tank Farm D&E, and in soil vapor in the hyporheic zone of the Chicopee River. Each matrix, constituent and associated location is discussed below.

6.8.2 Soil

There were no exceedances in soil in the area of Former Building 44/Tank Farm D&E associated with any of the constituents of concern. None of the applicable Method 1 standards were exceeded in this area.

6.8.3 Groundwater

The extent of ethylbenzene, phenol and 2-butanone in groundwater is described below. One detection of ethylbenzene in groundwater associated with activities in the area of former Building 44/Tank Farm D&E area was above the 4 mg/L discharge to groundwater criterion. None of the detections exceeded the GW-2 criterion of 30 mg/L. Six other low-level ethylbenzene detections defined the extent of ethylbenzene. Data obtained from groundwater and soil borings in the area of Former Building 44/Tank Farm D&E suggest that the source of ethylbenzene is likely related to activities and raw materials used for styrene resins between 1940 and 1987 at the Indian Orchard Plant. Based on the above-referenced groundwater monitoring data, the extent of ethylbenzene is delineated and is limited in extent. The extent of ethylbenzene is further defined and confined within the plant; ethylbenzene does not migrate to the Chicopee River based on results below the method detection limit at surrounding monitoring wells and PVDs.

Phenol was detected at five locations in the area of Former Building 44/Tank Farm D&E at concentrations ranging from 0.001 mg/L to 2.1 mg/L, ten times less than the criteria for phenol. Therefore, the detections that define the extent of phenol in the area are limited in extent and indicate an incomplete pathway to the river. The extent of phenol in this area is localized to Former Building 44/Tank Farm D&E area and likely is associated with historical processes, but the phenol may also be a degradation product of chlorobenzene. The extent of phenol is further defined by non-detect results for the constituent at six downgradient monitoring wells.

Although phenol was detected at one sediment location, the sediment location was slightly upstream of Former Building 44/Tank Farm D&E. Phenol was detected in only two sediment samples during the 1987 and 2005 sampling events. In 1987, the detected concentration was 0.1J mg/kg (sample location CR-2-S) downgradient of

both the Former WWII NR Area and Former Building 44, as well as the chlorobenzene plume. In 2005, the concentration was 7.8 mg/kg (sampling location SE-2005-14) upstream of both the Former WWII NR Area and Former Building 44, as well as the chlorobenzene plume. Phenol was one used in the manufacturing process in Former Building 44, which is within the chlorobenzene plume. Although one of the two results for phenol exceeded the screening benchmark, it was not detected in any of the other sediment samples and is considered to be present sporadically.

The extent of 2-butanone in groundwater in former Building 44/Tank Farm D&E is defined by seven locations. 2-Butanone was detected below criteria at two of the seven locations.

6.8.4 Pore Water in the Chicopee River

PVD samples of vapor in the Chicopee River were obtained to determine the transport of VOCs from groundwater sources to the river (see Appendix G.4.1 and Appendix G.5.5 of the attached Addendum Report, respectively, for further detail regarding these sampling activities). There were no detections for ethylbenzene or 2-butanone in either of these investigations.

6.8.5 Soil Vapor

Four soil vapor points were obtained for VOC analysis in association with studies associated with the Fiberloid Landfill/Former WWII NR Area (Figure 2 — Site Plan with Disposal Sites and Sampling History). A comparison of the soil vapor results to target concentrations presented in USEPA vapor intrusion guidance (USEPA, 2001, USEPA 2002b) for air in soils with an attenuation factor of 0.01 indicates that results of the four soil vapor points are well below the guidance values, which are presented in $\mu g/m^3$. Specifically, the results are in Table 7 — Soil Vapor Results.

TABLE 7
SOIL VAPOR RESULTS

Location	USEPA EI (Table 2)/OSHA PEL	SV-1	SV-2	SV-2 (DUP)	SV-3	SV-4
Ethylbenzene (µg/m^3)	*100,000	4.0 U	6.4	4.7	5.4	4.1
Phenol (µg/m^3)	*210,000	NA	NA	NA	NA	NA
2-Butanone (µg/m^3)	**590,000	11 U	10 U	11 U	10 J	9.8

Notes:
DUP = Duplicate sample
J = Result is an estimated value
NA = Not Analyzed
U = Result below the report limit provided
* = USEPA Vapor Intrusion Guidance
** = OSHA Potential Exposure Limit (PEL) for 8-hour workers (NIOSH website, August 2004)

The nature and extent of ethylbenzene and 2-butanone are further defined by these vapor analyses, which exhibit very low concentrations relative to the guidance values provided.

6.8.6 Sediment

Phenol was detected in sediment at 7.8 mg/kg in one of 26 sampling locations adjacent to the plant in 2005 and slightly upstream of Former Building 44/Tank Farm D&E. Although the source of phenol may have been from past Building 44 manufacturing activities, or it may be a degradation byproduct of chlorobenzene, there does not appear to be an ongoing source from groundwater or soil in Former Building 44/Tank Farm D&E.

6.8.7 Potential Receptors

Risks were evaluated on a site-wide basis for potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors at this area of the site. However, this characterization assumes an industrial land use restriction.

6.9 Former World War II Naval Research Area — New AOC

6.9.1 Source and Nature

The Former WWII NR Area (a new AOC) is a 0.35-acre former aboveground storage tank (AST) area for research and development (R&D), located west of Building 96 (Figure 2). The primary constituent associated with this area is chlorobenzene.

The chlorobenzene in groundwater in this area is reportedly from a former R&D project initiated by the Navy during World War II, beginning approximately in 1942, to develop a coating to protect aircraft from radar detection. The research project involved the use of chlorobenzene as a raw product, as well as mineral oil, and was believed to be active until approximately 1947. Footprints of three ASTs believed to store these raw materials were observed on historical drawings until 1950. No or slight traces of chlorobenzene were detected in the unsaturated soil from 21 soil borings drilled at and around the former location of the ASTs, AST loading areas and AST unloading areas. An unloading pit previously existed at the location of MW-116S, and contained supply pipes for the chlorobenzene tank storage that may have leaked to soils at this location. Soils did not contain chlorobenzene above the water table, yet elevated chlorobenzene concentrations were detected in groundwater beneath these former AST locations. Therefore, it is presumed that the soils around the ASTs were removed when the ASTs were removed and the R&D project was decommissioned.

A source of chlorobenzene in soils in this area was not found; it is presumed to have been removed because of lack of detections in soil borings.

6.9.2 Soil

Chlorobenzene detections in soil were low and were located below the water table. Thus, chlorobenzene is not likely derived from a soil source, but is likely associated with groundwater because no VOCs were observed in the unsaturated soil above the water table

Detections were found in saturated soil downgradient of the AST unloading pit, where pipes supplied chlorobenzene to the AST. Therefore, the former source to groundwater was likely in the vicinity of this former unloading pit.

Hot spots in soils are defined by the MADEP (MADEP, 2006a) as a discrete area where concentrations of hazardous material exceed applicable Method 1 standards. Using the MADEP's strict definition, no hot spots were identified in the Former WWII NR Area. However, USEPA vapor intrusion guidance (USEPA, 2002b) has established that negligible concentrations of VI constituents must be documented for a distance of 100 feet — not 30 feet — both laterally and vertically from an occupied building. Because Buildings 96 and 100 are within 100 feet of the saturated soil concentrations, a hot spot was identified in this area for further consideration in the risk characterization. However, soils above the standards were obtained from below the water table and would not be as readily available to soil vapor as unsaturated soils.

The applicable Method 1 standard for these chlorobenzene detections in soil for discharge to surface water is 100 milligrams per kilogram (mg/kg) (S-2/GW-3). The average chlorobenzene concentration within the hotspot was 3.9 mg/kg, whereas the concentration in the surrounding area was 0.02 mg/kg.

6.9.3 Groundwater

The extent of chlorobenzene in groundwater was delineated based on groundwater samples from locations upgradient, downgradient and sidegradient of the potential former source area and from around the former ASTs and unloading pit in the Former WWII NR Area. The extent in groundwater coincides with the configuration of the top-of-till in this area (Figure 4-4) Appendix F Figure F-1 of the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007). The deltaic outwash sand-filled depression in the till appears to channel the chlorobenzene groundwater plume from the Former WWII NR Area to a depth of approximately 50 feet below ground surface (bgs) in shallower surrounding areas approaching the Chicopee River downgradient of the Former WWII NR Area (see Figure 6-1 and Appendix F-4). The till becomes increasingly shallow toward the river in this region of the plant. However, the chlorobenzene plume is located in a slight swale in the till surface as it approaches the Chicopee River. This channeling has resulted in an apparent narrow chlorobenzene plume (Figure 6-1 of the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007).

The maximum chlorobenzene concentrations detected in groundwater in this area occurred at MW-112D (42 milligrams per liter [mg/L]) and MW-116S (32 mg/L), above the MCP upper concentration limit (UCL) of 10 mg/L for chlorobenzene. Based on data obtained from these wells, the chlorobenzene plume is separate and distinct from SWDA No. 1.The extent of chlorobenzene in groundwater at the Former WWII NR Area coincides with the groundwater flow direction and the thickest (deepest) zone of the post-glacial outwash sand above the top of till located downgradient of Former WWII NR Area. The chlorobenzene plume appears to be confined by

the till, and the plume coincides with the swale in the till. The extent of chlorobenzene in groundwater is observed in monitoring wells adjacent to the Chicopee River (MW-105S and MW-104S). Further extent delineation of chlorobenzene in groundwater was conducted in the pore water of the Chicopee River downgradient of these wells and at the Former WWII NR Area below the groundwater/surface-water (hyporheic) zone of mixing.

6.9.4 Pore Water in the Chicopee River

PVD samplers were installed below the hyporheic zone (groundwater/surface-water interface) of the Chicopee River to evaluate the fate of chlorobenzene in groundwater near the Chicopee River. There were no detections of chlorobenzene in the PVD samples collected hydraulically downgradient of the plume and associated with the Former WWII NR Area. Chlorobenzene has not been detected historically in the Chicopee River surface water or sediment downgradient of the Former WWII NR Area. The bank of the Chicopee River was inspected and no groundwater discharges or evidence of seeps were observed along the bank of the river or from the former outfalls located near MW-105S. Therefore, an incomplete migration pathway from the Former WWII NR Area groundwater chlorobenzene plume to the Chicopee River has been established. Further studies, including natural attenuation, will be explored in the *Corrective Measure Study (CMS)/MCP Phase III – Remedy Implementation Plan*.

6.9.5 Chlorobenzene in Soil Vapor

Soil vapor samples were collected in the vadose zone near buildings occupied by 8-hour workers to evaluate potential vapor intrusion to indoor air. Buildings 96 and 100 are occupied by 8-hour workers. Buildings 60, 61, 67 and 67A are manufacturing buildings housing process equipment and are not used or intended for use by 8-hour workers, except Building 67A has an office shared by two 8-hour workers.

Soil vapor samples (SV-1 through SV-4) were obtained near Buildings 96 and 100 where shallow groundwater contained detections of chlorobenzene.

Two of the four soil vapor samples analyzed for VOCs had chlorobenzene detections of 31 micrograms per cubic meter ($\mu g/m^3$) at SV-1 and 3.9 $\mu g/m^3$ at SV-4 (for more in-depth discussion, see Sections 6.4.3 and 6.5.1). The soil vapor concentrations at these locations are significantly below Tier II generic screening criteria for soil

vapor in the *Vapor Intrusion Guidance* (USEPA, 2001 and 2002b). Therefore, according to the flow chart (Figure 2 of the *Vapor Intrusion Guidance*), there is an incomplete subsurface vapor to indoor air pathway.

6.9.6 Potential Receptors

Risks were evaluated for the potential receptors, an outdoor onsite worker, intrusive worker, trespasser and recreator, for total lifetime cancer and non-cancer hazards. A Condition of No Significant Risk was identified for these receptors, with the exception of an intrusive worker. The intrusive worker is considered to be onsite for limited periods of time, and engaged in ground-intrusive activities associated with building construction or repairing and/or laying utility lines or pipe within the chlorobenzene plume downgradient of WWII NR Area. The exposure pathway for the intrusive worker involves direct contact in the event groundwater is encountered and if chlorobenzene is detected above 0.28 mg/L. In addition, this assumes an industrial land-use restriction for the plant.

6.10 SWMU 64/Outfall Pipes adjacent to Chicopee River Shoreline

6.10.1 Source and Nature

SWMU 64/Outfall Pipes adjacent to Chicopee River Shoreline consist of former 73 outfalls along the Indian Orchard Plant boundary that discharged to surface waters at one time or another over the course of the plant's history. Of the 73 outfalls, 37 are located along the existing Solutia property. Of those 37, 36 discharge to the Chicopee River, and one discharges to Bircham Bend Brook. The remaining former outfalls are now part of NOVA Chemicals Inc. The outfalls along the Chicopee River were either permitted through NPDES, connected to the Ludlow Interceptor (LI), or decommissioned during the LI construction by the city of Springfield.

Based on soil and groundwater analytical data, the primary constituent associated with the Outfall Pipes Adjacent to Chicopee River Shoreline is the chlorobenzene associated with the Former WWII NR Area. The outfall pipes themselves may have transported a variety of materials over the course of plant operation, and it is possible that any of these substances may have leaked into the surrounding soils; however, analytical data adjacent to these outfalls and adjacent to the bank of the Chicopee River do not suggest that outfall pipes leaked into surrounding soils. The list of materials used at this facility is included in Tables 2 and 3.

Area	Possible Constituents	Source Area Description
SWMU 64/ Outfall Pipes adjacent to Chicopee River Shoreline	Raw materials used onsite, products manufactured, or their associated byproducts and waste created during the course of site operation (see Tables 6-1 and 6-2 [ARCADIS BBL, 2007])	Throughout the nearly 100-year history of the Indian Orchard Plant, a multitude of constituents were historically used or manufactured. Approximately 92% of the constituents used or manufactured historically at the plant are soluble in water and or biodegradable. The remaining 8% are insoluble and include castor oil, cellulose acetate, naphtha polyvinyl acetate, and xylene. According to plant drawings, former discharges through the outfalls were composed mostly of drainage from storm drains, roof drains and floor drains, as well as non-contact cooling water. In the mid-1970s, the floor drains and outfalls were re-routed to the municipal treatment system via the LI. Since 1984, stormwater and once-through non-contact cooling water have discharged through NPDES-permitted outfalls to the Chicopee River. The other outfall pipes are no longer actively discharging into the Chicopee River, and no seeps have been observed around the backfill of these outfalls. Chlorobenzene in groundwater in the vicinity of outfalls 62 through 64 is associated with a chlorobenzene plume moving north/northwest from the Former WWII NR Area.

The extent of constituents in soils adjacent to former outfall pipes along the Solutia property and the Chicopee River was defined based on 33 soil borings.

A sheen was observed once in soils during drilling at one location; however, NAPL was not observed anywhere in the SWMU 64/Outfall Pipes adjacent to Chicopee River Shoreline area, in a well installed at this location, MW-105S.

6.10.2 Extent in Soil

Samples from five soil borings and monitoring wells in the SWMU 64/Outfall Pipes adjacent to Chicopee River Shoreline area were submitted for laboratory analysis. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene exceeded the PRG but did not exceed MADEP criteria. These PAHs are associated with activities at Burning Pits D and the Fiberloid Landfill and are unrelated to the outfalls.

6.10.3 Extent in Surface Soil

The bank of the Chicopee River is covered by riprap underlain by a geotextile material. Thus, surface soil is not accessible for sampling.

6.10.4 Extent in Groundwater

With the exception of constituents associated with SWDA No. 1 and WWII NR Area, no constituents were detected in groundwater.

The bank of the river was inspected four times but was free of odors, staining and seeps.

6.10.5 Outfalls

There are two main categories of outfalls: decommissioned and permitted. Within the permitted outfalls, there are active and inactive outfalls. Permitted outfalls are those that are NPDES permitted and discharge to the Chicopee River. Outfalls 010, 014 and 017 are the only three active outfalls that are designated as permitted (#MA0001147). There are other utilities in the vicinity of the outfalls adjacent and parallel to the Chicopee River. These include the LI and water lines.

The LI, which was installed in 1970 by the city of Springfield, comprises a reinforced concrete 54-inch-diameter pipe buried inside a man-made underground utility trench located along the shoreline of the Chicopee River. It is covered by graded fill materials along or near the south bank of the Chicopee River. The LI accepts sewer drains that are not permitted to discharge to surface water around the Indian Orchard Plant.

In some cases during construction of the LI, existing outfalls, sewers or other utilities that were not intended to be connected to the LI did, in fact, intersect the LI. These other non-connected utilities were decommissioned or diverted over or under the LI pipe and permitted.

6.10.6 Extent in Surface Water

The effect of SWMU 64/Outfall Pipes adjacent to Chicopee River Shoreline on adjacent surface water was evaluated based on available analytical data.

In September 1995 and October 2005, sediment and or surface-water samples were collected from the Chicopee River and analyzed for VOCs, SVOCs, PCBs and inorganics using USEPA SW-846 Methods 8240, 8270, 8080,

and 6010/7000, respectively. In 1995, no VOCs, SVOCs or PCBs were detected above the method quantitation limits, and no inorganics were detected above ambient water quality criteria. In 2005, no significant differences were observed between the upgradient and downgradient surface-water and sediment samples, with the exception of one detection of phenol in sediment. In fact, upstream reference samples reported higher in PAHs and inorganic compound concentrations than samples collected adjacent to the site.

7. Site Conceptual Model

The scope of the ERA and HHRA are based on the site conceptual model depicted on Figure 4. The site conceptual model is an integration of all relevant site information. It has been updated based on information gathered during several investigations to facilitate the development of a focused risk assessment approach and to aid in selecting remedial alternatives. The site conceptual model is a tool that stakeholders can use to achieve concurrence, and it has continuously evolved as new information becomes available.

A site conceptual model is "a description of what contaminants should be present, how they entered the environment, how they were transported within the system, and routes of exposure to and identification of human and environmental receptors. It provides a framework for assessing risks from contaminants, controlling or eliminating sources, developing response action strategies, and determining whether those strategies have been effective in achieving the Response Action Outcome requirements." (ARCADIS BBL, 2007)

The 170-acre Indian Orchard Plant in Springfield, Massachusetts (Figures 1 and 2) has been in operation as a manufacturer of plastics or resins since 1904. The constituents (raw materials) used for manufacturing presented in Table 6-2 of the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) were mostly highly soluble or readily biodegradable.

7.1.1 Disposal History

Historically, solid and liquid waste materials generated as part of the operations were disposed of onsite in accordance with accepted practice. Waste disposal areas were established within the present plant boundaries for the ultimate disposal of these materials.

Fiberloid Corporation began manufacturing operations and disposal activities in the eastern portion of the plant in 1904. This portion of the Indian Orchard Plant is currently owned and operated by NOVA. Fiberloid Corporation produced mainly nitrocellulose. From approximately 1935 to 1940, the plant disposed of solid and liquid waste materials at various areas within the area now referred to as Fiberloid Landfill.

The western portion of the plant (Shawinigan Resins Corporation) began operations and disposal activities in 1938. Shawinigan Resins Corporation produced mainly polyvinyl butyral, formalin and acetate resins. The

western portion of the plant also conducted onsite waste disposal throughout its history until the mid 1970s. Materials from the East Plant were disposed of separately and independently from the West Plant. Types of materials disposed consisted of refuse (including coal ash, paper, cardboard, wood and off-grade resins) plastic products, construction debris, oils, sludges, inks and solvents. The East Plant disposed of waste materials onsite via landfilling at SWDA 1, SWDA 2 and the Fiberloid Landfill, by land application at LWDA 1 and LWDA 2, open burning (Burning Cage/Pits A and B), and subsurface disposal via the Building 99 Leach Field.

The West Plant disposed of waste materials onsite by land application at LWDA 1 and by open burning in Burning Pits C and D. These practices were discontinued in the early 1970s.

7.1.2 Geologic and Hydrogeologic Setting

The geology at the plant is characterized as glacial depositional environment. Sand deposits ranging from 25 to 200 feet overlay extensive, approximately 100-foot-thick deposits of dense glacial till. The till overlies arkosic bedrock found at approximately 200 feet below ground surface. Sands overlying the glacial till are the glacial Lake Hitchcock lacustrine (glacial lake deposits) and sediment deposits from glacier melt water deltaic/outwash sand. As a result of the retreating glacier, till was deposited in a hummocky fashion forming hills and valley sand drumlins. During the glacial retreat, melt waters carrying sand and silt were deposited in depressions (valleys) across the till surface. One such valley is observed within the plant property as revealed in boring logs, lacustrine deposits and deltaic/outwash sands that overlay the top of till surface.

The glacial till acts as a confining unit as the hydraulic conductivity in the till is low (10^{-6} centimeters per second [cm/sec]), whereas the hydraulic conductivities in the lacustrine and deltaic/outwash sand is approximately three orders of magnitude higher (at 10^{-4} to 10^{-3} cm/sec). An upward vertical gradient is measured between the till and the lacustrine and deltaic/outwash sands. Moderate upward and downward vertical gradients are measured within lacustrine and deltaic/outwash sand. Because of these vertical gradients, the direction of groundwater flow has vertical and horizontal components rather than the typical horizontal flow component. As a result of the vertical gradients, a 3-D groundwater flow model was used in 1987 to evaluate the groundwater flow direction and velocities. Based on the 3-D groundwater flow model simulation output, the direction of groundwater flow is preferential within the structural depression observed in the till. Based on a shallow groundwater piezometric contour that evaluated flow on a 2-dimensional basis, flow lines within the trough are also observed.

7.1.3 Groundwater Quality

A network of monitoring wells (54 monitoring wells in 1985, but currently 117) has been monitored nearly annually between 1985 and 2006. The groundwater VOC plume observed to begin in the vicinity of SWDA No. 1 and LWDA No. 1 has been observed since monitoring began in 1985, with consistently low concentrations of mainly chlorobenzene (1 to 2 ppm range). The groundwater VOC plume that is observed to begin at the Former WWII NR Area tanks and migrates through Fiberloid Landfill, Former Building 44 and Tank Farm D&E has been observed since monitoring wells were installed at these locations from 1988 through 2004. The VOCs (ethylbenzene and styrene) detected in groundwater in the East Plant were detected beginning in 1991, two years after annual monitoring began in this area. The network of monitoring wells is based on the results of approximately 258 soil borings, such that soils were collected continuously for a vertical profile of soil characteristics for further field screening (SB-1 through SB-141, MW-1 through MW-117S).

The major constituents detected at the plant are VOCs and mostly chlorobenzene. Two sources areas exist for chlorobenzene in the environment: SWDA No. 1 and the Former WWII NR Area. Chlorobenzene was first introduced to the plant during R&D for radar equipment during WWII. Based on investigation data, there was an apparent release at the Former WWII NR Area in the 1940s with likely subsequent removal of soils in the 1950s to an active onsite landfill (SWDA No. 1), a former kettle hole. Although the source of chlorobenzene to groundwater is no longer observed at the Former WWII NR Area, a plume of groundwater remains. The extent of chlorobenzene in groundwater at the Former WWII NR Area is defined vertically by the dense and thick glacial till underlying the site, and horizontally by glacial till and a preferential pathway of courser sand unit within a former brook channel within the deltaic outwash sand overlaying the till. At the downgradient edge of the narrow plume, chlorobenzene concentrations are above GW-3 standards. However, PVD samples installed to monitor the pore water concentrations of groundwater entering the river were nondetect for chlorobenzene.

Following the apparent disposal of chlorobenzene into the landfill, chlorobenzene leached from the landfill (SWDA No. 1) to the groundwater and residual low VOC concentrations remain in the saturated zone of the overburden unconsolidated unconfined waters. The extent of the chlorobenzene plume in groundwater is limited vertically by the dense and thick glacial till unit underlying the plant and confined horizontally by a glacial sand preferential pathway within a depression (valley) in the top of the glacial till surface. At the downgradient edge of the chlorobenzene plume is the Chicopee River. Average concentrations of 0.97 mg/L at the river edge were

below the GW-3 standard of 1.0 mg/L. In addition, PVD samples installed to monitor the pore water concentration of groundwater beneath the river entering the river were ten times below the GW-3 standard for chlorobenzene. In addition, modeled concentrations were below the GW-3 standard.

Depth to groundwater across the majority of the plant is greater than 15 feet bgs; however, there are two areas, 1) downgradient of the WWII NR Area, and 2) downgradient of SWDA No. 1, where a chlorobenzene plume is present, the groundwater is less than 15 feet, and the concentrations are above the current GW-2 standards. Figure 4-10 of the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) shows where depth to groundwater is less than 15 feet.

A limited extent of PCBs was detected in surface soils at SWDA No. 2. A potential migration pathway is present from erosion to a storm drain to the Bircham Bend Brook.

PAHs have been observed in Fiberloid Landfill and former storm drains could have acted as migration pathways to the river; however, sediment data from the Chicopee River suggest that a local condition exists for PAHs, where PAHs are generally detected at higher concentrations in upstream locations adjacent to the plant. In addition, a forensic analysis of PAHs suggests that the PAHs are from coal combustion sources and are unrelated to the plant. The PAH signatures upstream did not differ significantly from those downstream or from those in Bircham Bend Brook sediments.

The constituents xylene, ethylbenzene, and benzene have been detected around the perimeter of the landfills. However, concentrations are decreasing and biological processes appear to be degrading these to non-detection. This is, therefore, an incomplete migration pathway to the river or to other potential receptors.

7.1.4 Fate, Transport and Potential Exposure Pathways

This section addresses the fate and transport of potential constituents of concern (COCs) and the present potential exposure scenarios. Each potential exposure pathway has been characterized as complete, insignificant, or incomplete.

Known or potential migration pathways include soil migration, groundwater migration, air migration and surface-water/sediment migration. Migration pathways may result in the following potential exposure pathways:

dermal contact, incidental ingestion and inhalation. Although a migration pathway may be identified, an exposure pathway can only occur if there is a receptor (i.e., "complete pathway" to an occupational worker, the public, a trespasser, or aquatic and terrestrial ecology). Therefore, not all migration pathways result in an exposure pathway (i.e., "incomplete pathway").

In the soil migration pathways, exposure to onsite receptors could occur via incidental ingestion, dermal contact and/or inhalation via excavation activities. Plant personnel, contractors and/or other personnel who may be involved with subsurface activities (e.g., utility workers, maintenance workers and geotechnical excavation contractors) could potentially come in dermal contact with constituents in the soils. Because the plant is secured by fencing and 24-hour security, and SWMU/disposal areas are located greater than 1,000 feet from offsite residential/commercial use, dermal contact, incidental ingestion or inhalation, or exposure during excavation activities is not a viable exposure pathway to offsite residents/commercial users. Soil erosion and runoff to the Chicopee River is not currently considered a soil exposure pathway due to the extensive pavement, building coverage, constructed embankment and storm drainage.

For the groundwater migration pathway, potential exposure to onsite and offsite receptors could occur via incidental ingestion, dermal contact and/or inhalation of VOCs and phthalates. There are no known groundwater users or water-supply zones within a 1.2-mile radius of the plant. Furthermore, the nearest potential aquifer is located 1.2 miles hydraulically upgradient of the plant. Installation of new water-supply wells is controlled, new private wells are permitted through the local health department and municipal water-supply wells are permitted through the MADEP. Therefore, exposure to onsite and offsite receptors via ingestion, dermal contact and/or inhalation of VOCs from groundwater is not a viable pathway. Site personnel, contractors and/or other personnel who may be involved with subsurface activities (such as utility workers, geotechnical workers and excavation contractors) could potentially come in dermal contact with, or incidentally ingest, constituents present in the groundwater. Inhalation exposure by subsurface workers to VOCs could also occur, depending on the groundwater quality and depth to which subsurface activities are conducted.

Site personnel, contractors and/or other personnel who may be involved with working indoors could potentially be exposed to VOCs via vapor intrusion at two areas of the plant: downgradient of SWDA No. 1 at Buildings 99/100 and WWII NR Area.

Site personnel, contractors and/or other personnel who may be involved in work associated with subsurface utilities excavation could potentially come in contact with or incidentally ingest constituents present in water

within those utilities that receive groundwater infiltration and/or within the backfill of utilities beneath the groundwater table. Underground utilities may provide conduits for preferential groundwater flow in the vadose zone, and for potential migration of constituents dissolved in groundwater. As discussed in this report, although a former stream channel and Outfall #63 placed in this former stream channel could be a preferential migration pathway to the Chicopee River, the physical observations and analytical data for groundwater vapor obtained from beneath the river suggest an incomplete migration pathway to the Chicopee River.

In addition, the modeled surface-water concentrations from groundwater were below the AWQC. When VOC concentrations in groundwater are used to calculate the predicted surface-water concentrations using the MADEP's surface-water dilution model and 10-year, 7-day low-flow data, these modeled concentrations are below the AWQC (Table 6-15 of the RFI Risk Assessment/MCP Phase II CSA Report) (BBL, 1996b).

8. Human Health Risk Assessment Summary

A Method 3 Risk Characterization was conducted to evaluate potential risks to human health, public welfare, public safety and the environment for the Indian Orchard Site in Springfield, Massachusetts, including the adjacent Chicopee River and Bircham Bend Brook. The Method 3 Risk Characterization was conducted consistent with MCP Subpart I (310 CMR 40.0900) amended April 3, 2006 and the *Guidance for Disposal Site Risk Characterization – In Support of the Massachusetts Contingency Plan* (MADEP, 1995). This report summarizes the Method 3 Risk Characterization, which is presented in Section 10 of the attached RFI/MCP Phase II Comprehensive Site Assessment Addendum Report (ARCADIS BBL, 2007).

8.1 Background

A Phase II CSA Risk Characterization for the plant was previously submitted by BBL in 1996 (Phase II CSA Risk Characterization). The Phase II CSA Risk Characterization quantified risks/hazards for six of the SWMU/ disposal areas: SWDA No. 1, SWDA No. 2, LWDA No. 1, Building 99 Leach Fields, Fiberloid Landfill and Former Building 44 and Tank Farm E. Other plant areas had constituents in soil and/or groundwater at concentrations less than the MCP Method 1 and/or Method 2 Standards. Conclusions of the Phase II CSA Risk Characterization indicated that none of the SWMU/disposal areas required remediation under the MCP or RCRA programs. However, at the time, Monsanto proposed to install a cover at LWDA No. 1, SWDA No. 1 and SWDA No. 2 and to further restrict access to these SWMU/disposal areas with additional fencing and institutional controls. In addition, to achieve a permanent solution Class A-3 RAO for SWDA No. 1 and LWDA No. 1, Monsanto proposed to continue groundwater monitoring hydraulically downgradient of SWDA No. 1 and LWDA No. 1 to demonstrate that the constituents detected in SWDA No. 1 and LWDA No. 1 migrating into the groundwater are naturally attenuating.

Since the submittal of the Phase II CSA Risk Characterization, additional investigations have been conducted at the plant, and data incorporated in the current Method 3 Risk Characterization, as appropriate. While the Phase II CSA Risk Characterization was specific to each SWMU/disposal area, at the request of USEPA the current Method 3 Risk Characterization considered risks/hazards on a site-wide basis. This site-wide approach is also acceptable under MADEP guidance, as the individual SWMUs/disposal areas are not generally fenced and, as such, human receptors are able to move freely from one plant area to another. The 1996 Phase II CSA Risk Characterization noted that if risks/hazards for a particular constituent were identified, then the specific plant

area contributing to the excess risk/hazard would be targeted and further evaluated (such as including the potential need to implement area use limitations [AULs]).

A Method 3 Risk Characterization contains the following five steps:

- hazard identification;
- dose-response assessment;
- exposure assessment;
- risk characterization; and
- uncertainty analysis.

The hazard identification summarizes the analytical data and identifies constituents of potential concern (COPCs) to be evaluated during the Method 3 Risk Characterization. The dose-response assessment presents toxicological information for the COPCs. Potential human health exposure scenarios and exposure assumptions are described in the exposure assessment. The Method 3 Risk Characterization uses information from the previous three steps to describe potential non-carcinogenic hazards and carcinogenic risk, and the magnitude of such hazards and risks. The uncertainty analysis summarizes the uncertainties of the Method 3 Risk Characterization.

Sections 8.2, 8.3 and 8.4 summarize the key information presented in the Method 3 Risk Characterization, including discussions of media of potential concern and COPCs, human health receptors and exposure pathways, and Method 3 Risk Characterization results.

8.2 Media of Potential Concern and COPCs

The Method 3 Risk Characterization considers potential exposure of human receptors to constituents in soil, groundwater, indoor air, ambient air, surface water and sediment. COPCs were selected in accordance with Section 2.4 of the *Guidance for Disposal Site Risk Characterization* (MADEP, 1995), which indicates that all oil or hazardous material at a site should be considered a COPC unless one of the following conditions is true:

- Constituents are present at low frequency of detection (one or two samples, dependent on the total number of samples collected and in low concentrations);

- Constituents are present at levels that are consistent with "background" concentrations for the area and there is no evidence that their presence is related to activities at the plant (for inorganics and PAHs);
- Constituents are field or laboratory contaminants (designated as "B"); or
- Reported values for particular constituents in a particular media are qualified as "J" — the values are only estimated and below the reported sample quantitation limit (SQL).

As such, constituents were generally eliminated as COPCs based on a low frequency of detection and low concentration, and in some cases, qualified data and comparison to background.

8.2.1 Plant Site Soils

Surface soil, subsurface soils and waste soil samples have been collected from the plant. Approximately 80 percent of the plant is currently used for manufacturing, power generation, temporary materials storage or administrative buildings. The remainder of the plant (approximately 25 acres) is used for parking, Solutia product and employee transportation corridors within the Solutia property, and storage of ash or open space. The plant is secured by fencing and entrance gates are maintained 24 hours per day by security guards.

8.2.2 Surface Soil

A total of 23 surface soil samples (collected from within the 0- to 3-foot depth interval) were collected from 1994 to 2000 and these samples were considered in the Method 3 Risk Characterization. Samples were generally analyzed for VOCs, SVOCs, PCBs and inorganics, although not all samples were analyzed for all parameters. Surface soil COPCs included VOCs (ethyl acetate and tetrachloroethene), SVOCs (benzoic acid and phthalates), PCBs and inorganics (aluminum, barium, cobalt and vanadium).

8.2.3 Surface/Subsurface Soil

From 1991 to 2002, soil samples (collected from the 0- to 15-foot depth interval) were collected from 68 locations and these samples were considered in the Method 3 Risk Characterization. Data were generally analyzed for VOCs, SVOCs, PCBs and inorganics, although not all samples were analyzed for all parameters.

COPCs included VOCs (acetone, carbon disulfide, ethyl acetate, ethylbenzene, tetrachloroethene, toluene and xylene), SVOCs [bis(2-ethylhexyl)phthalate and naphthalene], PCBs and several inorganics.

8.2.4 Soil/Waste Samples

Waste samples were collected from SWDAs No.1 and No 2, LWDAs No. 1 and No. 2, and Burning Pits D. The samples were collected to characterize the waste material in the landfills. With the exception of waste sample SB-54 collected from Burning Pits D, the waste soil data were not included in the Method 3Risk Characterization as they are subsurface samples that were collected from within the disposal areas. Although constituents are expected to be present in these samples, there is no potential for exposure as digging/excavations would not be conducted in these landfills. In addition, it is already presumed that response actions are required to manage risk associated with these landfills consistent with the presumptive remedy approach (USEPA, 1993c and 1995d).

8.2.5 Hot Spots

Hotspot locations were identified at the plant (based on elevated concentrations of PCBs in surface soil and chlorobenzene in saturated subsurface soil) and, consistent with MADEP (2006), risks/hazards for these areas were quantified separately. Specifically, sample SS-13 (located in SWDA No. 2) had a PCB concentration of 5.5 mg/kg, which was 10 times greater than PCB concentrations in the surrounding samples and above MADEP S-2/GW-3 standards at SWDA No. 2. In addition, elevated chlorobenzene concentrations were reported in subsurface soil samples SB-131 (12 to 14 feet bgs at 3.9 mg/kg) and SB-124 (12 to 14 feet bgs at 3.7 mg/kg) from the Former WWII NR Area.

8.2.6 Groundwater

Groundwater is not currently used as a potable source at the plant and is not likely to be used in the future as a potable source. The Indian Orchard Plant Property is not within a zone classified as a “potentially productive aquifer” (PPA). In addition, based on review of available literature, the potential well yield from the Chicopee River drainage basin would be less than 100 gallons per minute, locally (Krejmas, 1986). Installation of new water-supply wells is controlled; new private wells are permitted through the local health department and

municipal water-supply wells are permitted through the MADEP. If this plant was within a PPA, the criteria for classification as a non-potential drinking-water source area (NPDWSA) per policy WSC-97-701 would apply because the following criteria are met:

- The plant encompasses an area greater than 100 acres; and
- This 100-plus acres is used for industry and/or electrical power.

The city of Springfield and surrounding areas obtain their water from a municipal water-supply system originating from Cobble Mountain Reservoir, Quabbin Reservoir, or Springfield Reservoir, at distances ranging from 6 to 20 miles hydraulically upgradient of the plant. Given that groundwater is supplied from offsite sources by the city of Springfield, and plant groundwater is not used for drinking water, nor has little potential for future use as drinking water due to low yield and would meet the MADEP NPDWSA designation as a non-potential drinking-water source, groundwater at the plant is not considered potable

Groundwater data has been collected for several years at the plant, with multiple rounds of data available for many wells. To evaluate potential exposure of intrusive workers to COPCs in groundwater, groundwater data were censored based on well depth and age of data. More specifically, because intrusive workers are not likely to be exposed to COPCs present at depths greater than 15 feet, groundwater data collected from wells in plant areas having groundwater at depths greater than 15 feet bgs were not considered in the dataset used to evaluate potential exposure of intrusive workers. In addition, only the most recent 2 years of data were included in this dataset (providing that the most recent data includes analytes previously evaluated and not just select constituents). Groundwater data were also not considered in the Method 3 Risk Characterization if samples were initially collected from temporary wells and more recent data are available from an adjacent well installed to verify the temporary well data. This is because sampling of the temporary wells resulted in turbid water samples that do not represent groundwater itself.

Groundwater COPCs included VOCs (1,2-dichloroethane, 1,2-dichloropropane, acetone, benzene, chlorobenzene, ethylbenzene and vinyl chloride), SVOCs [2-chlorophenol, bis (2-chloroethyl)ether and n-nitrosodiphenylamine) and several inorganics. PCBs and pesticides were not detected in groundwater.

8.2.7 Surface Water and Sediment

The water bodies adjacent to the plant include Bircham Bend Brook and the Chicopee River. Neither of these water bodies is used for drinking water. The Chicopee River and other surface waters within the drainage basin are "B" designated for fish and other wildlife, and for recreational uses. The Chicopee River is also designated as a recreational warm-water fishery (i.e., waters not of a quality to sustain year-round cold-water or seasonal cold-water fisheries). According to the Chicopee River Watershed Council (March 6, 1996), the Chicopee River does not meet Class B requirements several times during the year due to excess urban runoff and combined sewer overflow (CSO) discharge during high rainfall events. Because of these factors, the Chicopee River will not be reclassified as a drinking-water source according to the Chicopee Watershed Council. Historical and existing manufacturing facilities are located along the banks and tributaries of the Chicopee River.

Bircham Bend Brook is not listed in the Massachusetts Division of Water Pollution Control, 310 CMR 4.00 Surface Water Quality Standards. It is located in the southwestern portion of the plant, where there has been no historical manufacturing. SWDA No. 2, an inactive landfill, is located approximately 100 feet north and east of Bircham Bend Brook and contains solid and semisolid plastic remnants, brick, wood, glass and cardboard.

8.2.8 Chicopee River

Surface-water data included in the Method 3 Risk Characterization are those data collected in 1983, 1987, 1995 and 2005 (the 2005 data were collected to quantify existing conditions and to address uncertainty associated with the older data). In total, 25 surface-water samples (from 23 locations) were collected and analyzed for VOCs, SVOCs, PCBs and inorganics. COPCs included VOCs (chloroform and styrene) and three inorganics (aluminum, lead and manganese). SVOCs and PCBs were not detected in surface-water samples from the Chicopee River.

Sediment data for the Chicopee River are available for 1987 and 2005. Four samples were collected from the Chicopee River in 1987 from three locations and 22 additional sediment samples were collected in 2005 adjacent to the plant. Samples were analyzed for VOCs, SVOCs, PCBs and inorganics. COPCs included SVOCs [PAHs, bis-(2-ethylhexyl)phthalate and phenol] and PCBs.

8.2.9 Bircham Bend Brook

Eighteen surface-water samples are considered in the Method 3 Risk Characterization. Samples were collected in 1983, 1986, 1987 and 1999. Six samples were collected in 1981 (Samples 1, 1A, 1B, 2, 3 and 4). These samples were not, however, considered in the Method 3 Risk Characterization because more recent samples were available from the same general vicinity. Samples were analyzed for VOCs, SVOCs, PCBs and inorganics. COPCs included VOCs (acetone, ethylbenzene, methylene chloride, and xylenes), SVOCs [bis-(2-ethylhexyl)phthalate], and several inorganics.

Ten sediment samples collected from the Bircham Bend Brook are considered in the Method 3 Risk Characterization. Two samples were collected in 1986, four samples in 1987 and four samples in 1999. Samples were analyzed for VOCs, SVOCS, PCBs, pesticides and inorganics, although only select VOCs were analyzed for in 1999. COPCs included one VOC (2-butanone), SVOCs [generally PAHs, bis-(2-ethylhexyl)phthalate, and phenol], PCBs and several inorganics.

8.2.10 Soil Vapor

Soil vapor samples were collected in the vadose zone near buildings occupied by 8-hour workers to evaluate potential vapor intrusion to indoor air (e.g., Building 96, Building 100 and Building 67A). These buildings are closest to the groundwater wells with the highest VOC concentrations and, as such, are considered to represent a worst-case exposure scenario. In addition, these buildings are the only buildings occupied by 8-hour workers within 30 to 100 feet of the plume (associated with the Former WWII NR Area) where the water table is less than 15 feet bgs. A few other buildings are present at the plant that also involve 8-hour worker activities (i.e., Buildings 97 and 99) downgradient of the groundwater plume associated with SWDA No. 1. These buildings are downgradient of SWDA No. 1 and are within 30 to 100 feet of the plume. These data are discussed below with respect to potential migration of volatile constituents to indoor air.

8.3 Human Heath Receptors and Exposure Pathways

The Method 3 Risk Characterization considered potential exposure of human receptors to constituents in soil, groundwater, indoor air, ambient air, surface water and sediment. Pathways considered for each potentially

exposed population include ingestion, dermal and inhalation exposure to constituents in surface soil and subsurface soil, as well as ingestion, dermal and inhalation exposure to constituents in groundwater. Also included was a hypothetical recreator who is assumed to be exposed to surface water and sediment in the Chicopee River and Bircham Bend Brook. This receptor will not be present at the site, but may be exposed to constituents that may be present in surface water and sediment.

Based on the current and future use conditions, an exposure pathway conceptual model was developed to identify potential human receptors. The following five potential receptors were evaluated in the Method 3 Risk Characterization:

- Outdoor Onsite Worker: This receptor represents an onsite commercial/industrial worker involved in the day-to-day operations at the plant. He spends the majority of the onsite time outdoors. This receptor group may be exposed to surface soils via ingestion, dermal contact and inhalation pathways.

- Indoor Onsite Worker: This receptor represents an onsite commercial/industrial worker involved in day-to-day operations at the plant, who spends most of their time in plant buildings. These individuals may be exposed to volatile constituents that potentially migrate to indoor air.

- Intrusive Worker: This receptor represents individuals engaged in ground-intrusive activities associated with building construction, or repairing and/or laying utility lines or pipe. The receptor may be exposed via ingestion, dermal contact and inhalation of particulates or volatiles that could be released from soil during intrusive activities. For areas with groundwater present at shallow depths, this individual may also be exposed through dermal contact with groundwater and inhalation of volatile compounds found in water.

- Trespasser: This receptor represents youths 11-18 years of age, who may trespass at the plant. They may travel across parts of the plant, or may engage in some sort of outdoor activity. These individuals may be exposed to constituents in surface soils via incidental ingestion, dermal contact and inhalation. The plant is fenced and has 24-hour security; as such, it is assumed that this receptor is at the plant for a limited amount of time and is not expected to be engaged in ground-intrusive activities. As a result, contact with subsurface soils is not quantitatively evaluated nor is contact with groundwater.

- Recreator: This receptor is assumed to be an individual who may engage in outdoor activities adjacent to the plant, and therefore has the potential to be in contact with the sediment and surface water from Bircham Bend Brook and the Chicopee River. Because access to the river adjacent to the plant is somewhat limited and is generally not aesthetically appealing due to the industrial nature of the area, recreational use of this area is expected to be limited. Soil exposures are not quantified for this receptor, as the recreator is not expected to be at the plant. Groundwater is not potable at the plant and therefore there is no potential for exposure via ingestion. In addition, recreational users are not expected to be involved in ground-intrusive activities that would pose a groundwater exposure risk/hazard. Recreational activities are assumed to be confined to surface waters and sediment adjacent to the plant.

8.3.1 Indoor Air Evaluation

As indicated above, the Method 3 Risk Characterization evaluated the potential for exposure of indoor workers to volatile constituents that may migrate from soil and/or groundwater to indoor air. Analytical data for surface soils indicate that there are no VOCs in unsaturated soils near or within 100 feet of a building. There are two locations, however, which are occupied or could be potentially occupied by 8-hour workers where groundwater concentrations exceed the MADEP GW-2 standards (groundwater concentrations protective of indoor air). However, soil vapor samples collected at one of these locations (where VOC concentrations in groundwater are the highest) had concentrations less than the generic Tier I soil vapor screening values presented in USEPA (2001). These screening values (soil vapor concentrations protective of indoor air) are based on residential land-use assumptions and a 1×10^{-5} cancer risk level. As such, the residential exposure time and duration assumed in deriving these screening values are assumed to be more conservative than the exposure expected for commercial/industrial workers.

Three constituents had detected soil vapor concentrations that exceeded the generic screening values (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform). It is believed that chloroform is an artifact of the drinking-water treatment process supplied by the city of Springfield. The maximum detected concentration of 1,2,4-trichlorobenzene (100 $\mu g/m^3$) and 1,3,5-trichlorobenzene (190 $\mu g/m^3$) are reported in soil vapor sample SV-2, which is located between Buildings 100 and 67. While these concentrations are greater than the USEPA Tier I screening value of 60 $\mu g/m^3$, these concentrations are less than the USEPA Tier II screening value for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene of 3,000 $\mu g/m^3$ (which is based on the most conservative Tier II attenuation factor [0.002 — based on a "sand" soil type]). As such, the potential for migration of volatile

constituents to indoor is not likely to pose a concern and this pathway was not further considered in the Method 3 Risk Characterization.

8.3.2 Exposure Point Concentrations

The Method 3 Risk Characterization takes a conservative approach, in that 95 percent UCLs and maximum detected concentrations were used to estimate potential exposure to the identified receptors. For example, for surface soils, sediment and surface water the lesser of the 95 percent UCL (conservative estimate of the arithmetic mean) and maximum detected concentration was used as the exposure point concentration (EPC) (which is consistent with a reasonable maximum exposure [RME]) scenario (maximum concentrations are also used when there are insufficient data to derive an EPC). Maximum detected COPC concentrations in soil and groundwater were also used to evaluate potential exposure to construction workers. Maximum concentrations were used because intrusive workers are not likely to be exposed to average concentrations across the plant, but rather to concentrations in a smaller defined excavation trench and/or building area. As indicated above, if risks/ hazards are identified for a particular constituent in a specific plant area, the constituent and particular area would be subject to further evaluation.

Recent USEPA guidance (2006a) recommends nonparametric methods for computing 95 percent UCLs for left-censored datasets (i.e., data sets with below detection limit observations). The USEPA (2006b) ProUCL 4.0 Users Guide provides recommended 95 percent UCL computation methodologies for datasets without observations less than the detection limit and for left-censored datasets. For this Method 3 Risk Characterization, EPCs for surface soil, sediment and surface water were estimated using the 95 percent UCL of the mean based on the recommendations provided in USEPA (2006b) and ProUCL 4.0.

8.4 Risk Characterization Results

The Method 3 Risk Characterization evaluated potential risks to human health, public welfare, public safety and the environment. Results are summarized in Sections 8.4.1, below.

8.4.1 Characterization of Risk to Health

According to 310 CMR 40.0933(7), a condition of "No Significant Risk" of harm to human health exists if cumulative cancer risks and non-cancer hazards are less than MCP target limits (i.e., 1 x 10^{-5} for cancer risks and 1 for non-cancer hazards), and if no EPC is greater than an applicable or suitably analogous standard.

Characterizing the exposure to site-related constituents found in surface soil, subsurface soil, groundwater, air, sediment and surface water (including hotspot locations) by potentially exposed human receptors (onsite indoor worker, onsite outdoor worker, intrusive worker, trespasser and recreator) at the plant lead to the following conclusions regarding plant-specific risks and hazards. Conditions of "No Significant Risk of Harm to Human Health" have been achieved based on the criteria of a cumulative cancer risk threshold of 1 in 100,000 (1 x 10^{-5}), set forth in 310 CMR 40.0993(7), with the exception of non-cancer hazards for the intrusive worker exposed to groundwater. For the intrusive worker, the non-cancer hazard of greater than 1 is attributable to potential inhalation of chlorobenzene (via volatilization from groundwater) (HI = 150). The highest chlorobenzene groundwater concentrations are reported in groundwater samples collected from the Former WWII NR Area. As identified in Section 10 of this RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007), further remedial response actions and/or institutional controls are required to manage potential groundwater risks attributed to chlorobenzene in this plant area.

8.4.2 Characterization of Risks to Safety

Characterization of risk to safety was conducted in accordance with 310 CMR 40.0960. Conditions within the disposal areas were evaluated to determine if they pose or may pose a threat to safety. This evaluation considers, for example, threat of fire or explosion; rusted or corroded drums; presence of uncontainerized materials that may pose a risk due to corrosivity, reactivity, and/or infection potential; and conditions that currently or in the foreseeable future would pose a threat of physical harm or bodily injury to people.

The Indian Orchard Plant is an active manufacturing plant that is operated in accordance with applicable federal, state and local safety requirements. Solutia employs health and safety personnel to promote compliance with required safety standards. In accordance with Occupational Safety and Health Administration (OSHA) standards, Solutia has safe operating policies and procedures in effect to maintain safe conditions at the plant. No readily obvious or known conditions exist that pose or may pose a threat to safety beyond those of a typical

industrial/manufacturing environment. Therefore, the conclusion of this safety evaluation is that there is no significant risk (i.e., no threat of physical harm or bodily injury to people) related to the release or threat of release of materials at plant disposal areas.

8.4.3 Characterization of Risk to Public Welfare

Characterization of risk to public welfare was conducted for current and reasonably foreseeable conditions in accordance with MCP 310 CMR 40.0942. Factors considered in the public welfare assessment include nuisance odors attributable to the SWMU/disposal areas, loss of property value, unilateral restriction on property beyond the Solutia plant boundary and other noteworthy conditions affecting the property of others. Based on this assessment, no conditions were identified at the plant SWMU/disposal areas where significant degradation of public or private resources has or may result from COCs at the given SWMU/disposal areas.

The public welfare evaluation also compared average concentrations of observed soil and groundwater COPC concentrations to UCLs. Method 3 UCLs, promulgated by the MADEP for both soil and groundwater [310 CMR 40.0996 (5)], are used in the Method 3 Risk Characterization to evaluate the potential for significant risk of harm to public welfare and the environment under current and future conditions at hazardous waste sites. Under the MCP, a level of no significant risk exists or has been achieved for future conditions if no arithmetic mean COPC concentration in soil and groundwater exceeds its applicable UCL. If the concentration of COPCs exceeds its applicable UCL, then a level of no significant risk does not exist for future conditions.

The Method 3 Risk Characterization shows that average as well as maximum detected soil concentrations (for data collected from 0 to 15 feet and from greater than 15 feet, including hot spot samples) are less than or equal to their respective UCLs. Therefore, a level of no significant risk exists for soil at the plant. This conclusion does not, however, apply to waste soils collected from within the landfills at the plant that are being managed using “presumptive remedies” approaches (see Section 10 of this RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007)).

Average and maximum detected groundwater concentrations were also less than the UCLs, with the exception of chlorobenzene in groundwater (Table 10-20 and Table 10-21). For example, the maximum detected concentration of chlorobenzene in groundwater is 42 mg/L, which exceeds the UCL of 10 mg/L. More specifically, chlorobenzene in groundwater exceeded the UCL of 10 mg/L in only two wells from the WWII NR

Area (MM-112D at 42 mg/L; MW-116S at 34 mg/L). Groundwater concentrations averaged across the plant, however, are less than the UCL of 10 mg/L, with average chlorobenzene concentrations for the WWII NR Area approaching 10 mg/L (9.8 mg/L). While both plant-wide and area-specific average chlorobenzene concentrations are less than the UCL of 10 mg/L and satisfy the condition of no significant risk as described in Section 10 of the RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007), the WWII NR Area as well as the chlorobenzene plumes will be subject to further evaluation (e.g., remedial response actions/ implementation of AULs).

Under MCP 310 CMR 40.0996 (4), the presence of NAPLs having a thickness equal to or greater than ½ inch in any environmental medium is considered a level that exceeds UCLs. NAPL observed at SWDA No. 1 at soil boring SB-37, exceeds the MCP UCL. However, this sample was collected within the known extent of the landfill and has been identified as a hotspot that will require further response actions to restrict access.

8.5 Applicable or Suitably Analogous Standards

MCP 310 CMR 40.0993 (7)(a) specifies that in order to achieve no significant risk, constituent concentrations (EPCs) must not exceed "applicable and analogous" public health standards (in addition to not exceeding the cumulative cancer and non-cancer target limits). However, for soils there are no "applicable and analogous" public health standards and therefore soils are evaluated based on cumulative risk and hazards only.

With regard to groundwater, 310 CMR 40.0993(3)(a) identifies the Massachusetts Drinking Water Quality Standards as "applicable or suitably analogous standards" for GW-1 groundwater (potable source). However, these standards are not applicable to groundwater at the plant because it is not potable and will not be used as a potable source in the future (insufficient yield). Groundwater at the plant is identified as GW-3 (potential for migration to surface water) and the MCP GW-3 standards represent "applicable or suitably analogous" for potential migration of groundwater to surface water (based on ambient water-quality criteria for ecological receptors and a 10x dilution factor). Although these standards are not representative of the groundwater exposure pathways evaluated for the plant (i.e., exposure of construction workers via dermal and inhalation pathways), to fulfill this MCP requirement groundwater data are compared to GW-3 standards.

Results indicate that, for all VOCs, the arithmetic average concentrations as well as the maximum detected concentrations are equal to or less than the GW-3 standards. The only exception is for chlorobenzene, where the

maximum detected concentration of 42 mg/L (reported in MW-112D) is greater than the GW-3 value of 1 mg/L. For SVOCs, the maximum detected concentration of phenol (2.1 mg/L) is slightly greater than the phenol GW-3 standard of 2.0 mg/L. However, the arithmetic average groundwater phenol concentration is less than the GW-3 standard. Last, the maximum detected concentrations of a few inorganics (cadmium, cyanide, lead, nickel and silver) are greater than their respective GW-3 standards. However, arithmetic average concentrations of these constituents are lower than the GW-3 values, with the exception of cadmium (concentration of 0.00645 mg/L compared to the GW-3 value of 0.004 mg/L) and lead (concentration of 0.0176 mg/L compared to the GW-3 value of 0.01 mg/L), which are similar to the GW-3 values. No PCBs or pesticides exceeded the GW-3 values.

Overall, most of the arithmetic average groundwater concentrations are less than (or similar to) their applicable GW-3 standard. Although, in some instances, maximum detected groundwater concentrations exceed the GW-3 standards, the concentrations present in one well are not representative of actual discharges to surface water. As such, a condition of no significant risk is still achieved based on this comparison to "Suitable and Analogous Standards."

8.6 Summary

Results of the Method 3 Risk Characterization indicated that site conditions pose no significant risk to the human health receptors evaluated, with one exception. Only one exposure pathway to one receptor (groundwater exposure to the intrusive worker) resulted in conditions that could be characterized as presenting a potential hazard. This unacceptable hazard was driven by one compound, chlorobenzene. The hazards from this pathway are estimated using air modeling techniques and not with actual air data. As a result there is a degree of uncertainty inherent in any model, and there is a potential that the approach resulted in an overestimation or underestimation of true risk/hazard. Overall, the results of the Method 3 Risk Characterization reveal a facility with little if any significant health risks associated with the constituent concentrations found in the onsite and offsite soil or water, or estimated in the air. Section 10 of the RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) describes remedial response actions to address potential risks/hazards associated with potential exposure of intrusive workers to chlorobenzene in groundwater.

9. Environmental Risk Assessment Summary

9.1 Combined 2001 and 2007 Environmental Risk Characterization Conclusions

The *On-Site Ecological Risk Characterization* (BBL, 2001) and the recent *Stage I Environmental Risk Characterization*, Section 9 of the *RFI/MCP Phase II CSA Addendum Report* (ARCADIS BBL, 2007) prepared for the Solutia Inc. Indian Orchard Plant, Springfield, Massachusetts focused on assessing screening-level risks to the generalized ecological receptors at the plant proper, Bircham Bend Brook and Chicopee River adjacent to the plant. This section summarizes key features and conclusions from these investigations.

9.2 Environmental Health Investigations for Plant Proper

In response to the USEPA's comments dated July 23, 1997 to Section 9 (Environmental Risk Characterization) of the *Supplemental RFI Risk Assessment/MCP Phase II Comprehensive Site Assessment* (RA/CSA), dated September 1996 (BBL, 1996b) regarding ERC at the plant, BBL has undertaken several investigative activities to better assess and characterize risks to ecological receptors that may be present within the plant boundaries. These activities included performing a screening-level ERC of the plant property, site reconnaissance by a biologist, analysis of previous sediment and surface-water investigation, collection of new sediment and surface-water data and assessing each disposal area separately to better reflect dissimilar use history, physical characteristics, COCs and exposure considerations for each SWMU. Moreover, the SWMU-based approach allows for eliminating SWMUs that pose no risk or focusing further assessments and subsequent CMSs on areas that require additional evaluation.

Due to the involvement from both the federal (USEPA) and state (MADEP) levels, the risk assessment methodology employed in the *On-Site Environmental Risk Characterization* (BBL, 2001) is consistent with the USEPA's Ecological Risk Assessments Guidance for Superfund (USEPA, 1997) and the MADEP's MCP Method 3 ERC for the selection of appropriate response actions.

Further investigation of the exposure pathways using geophysiological data (direction of the groundwater flow) suggested that low concentrations of dissolved VOCs (primarily chlorobenzene) may be discharged to the Chicopee River along the northern plant boundary; however, groundwater vapor sampling below the river

hyporheic zone, groundwater VOC concentrations entering the river are below applicable criteria. Similarly, at the southwestern corner of the plant, groundwater may discharge into Bircham Bend Brook, but levels of VOCs at the monitoring wells nearby are below detection. Although the groundwater migration pathway was judged complete, it was unlikely to be a significant contributor to the constituent flux given the low or nondetected concentrations. Similarly, most of the disposal areas are unlikely to be significant contributors of constituents in the soil erosion pathway due to the flat topography, land cover, or low concentrations of constituents.

As a final step in analyzing the potential for exposure, habitat characterizations for the plant proper were conducted in 1984, 1996 and 1998. The characterizations included having a field biologist record observations of vegetative cover, level of human disturbance and habitat value to wildlife (e.g., the degree to which the habitats meet the requirements for food, cover, bedding areas, breeding and roosting sites). Observations of potential wildlife use (e.g., direct observations of wildlife, or the presence of tracks, scat and nesting/denning sites) were also recorded. Biologists were instructed to record evidence of signs of potential environmental effects, such as stressed or diseased vegetation. The outcomes of these efforts indicated that the disposal areas had little or no habitat potential. The lack of habitat was due to the level of human disturbance and the inadequate cover for much of the plant, as well as the relatively small areas of natural vegetative cover.

Based on these findings, *On-Site Environmental Risk Characterization* (BBL, 2001) concluded that few, if any, ecological receptors have the potential for exposure to chemical stressors in these areas and the potential impact at a community or population level is negligible. Therefore, consistent with USEPA ecological risk assessment guidelines and MADEP ERC guidelines, potentially complete exposure pathways for environmental receptors were judged incomplete or insignificant, and the need for further ecological evaluation for the terrestrial portion of the plant was unnecessary.

9.3 Environmental Health Investigations for Bircham Bend Brook

The *On-Site Environmental Risk Characterization* (BBL, 2001) contained the environmental risk assessment of the Bircham Bend Brook, which runs along the southwester corner of the plant. The brook is relatively deep in spots (1.5 to 3 feet) with mucky sediments and a large amount of detritus, leaf litter and fallen branches. In most areas, the depth ranges from 2 to 10 inches, with the bottom composed of a riffle zone and cobbles. Each type of substrate represents a suitable benthic habitat populated by plants, aquatic macro invertebrates and sediment-dwelling invertebrates. The biota found were indicative of higher quality waters.

The screening-level assessment for the Bircham Bend Brook initially considered the surface water and sediment as the two exposure media of interest. However, because historical investigations for the brook in 1981, 1983, 1986, 1994 and 1995 revealed that surface water was largely free of elevated levels of constituents of interest (i.e., above water-quality criteria), this exposure medium was judged of secondary importance and was not assessed further. In contrast, historical data for sediments revealed that some PAHs and PCBs required further assessment due to their elevated concentrations. Confirmatory sediment sampling was performed in 1999 at several locations in the brook and the resulting concentration data for metals, PCBs and SVOCs were used in the screening assessment for "current risk conditions."

The screening step included the use of a hazard quotient (HQ) approach, where the sediment concentration of a given constituent (the detected maximum) was divided by the associated sediment benchmark. This approach is consistent with the USEPA guidance for performing screening assessments (USEPA, 1997) and with the MADEP guidance for performing an MCP Stage I Screening assessment (MADEP, 1996). With the HQ approach, an HQ of less than one (unity) indicates that there is no risk of significant adverse effects.

A comparison of the detected concentrations of various constituents in the Bircham Bend Brook to the sediment benchmarks shows that only one compound (lead) was flagged as exceeding its benchmark value. The maximum lead concentration was 36 mg/kg, while the benchmark value (i.e., lowest effect level or LEL) (Persaud et al., 1993) was 31 mg/kg, resulting in an HQ of 1.2. The LEL is based on the fifth percentile of the screening level concentrations; in other words, the LEL represents a concentration that 95 percent of the species can tolerate. Therefore, the value of the calculated HQ is unlikely to be indicative of widespread adverse effects on benthic biota.

In summary, the results of the screening analysis indicate that the chemicals detected in Bircham Bend Brook do not pose a significant risk to ecological receptors. Comparison of the maximum detected concentrations to the sediment benchmarks shows that the only compound exceeding a benchmark was lead, and the HQ associated with this maximum concentration only slightly exceeded unity (i.e., 1.2). Therefore, this constituent was not considered to represent a significant ecological risk. Moreover, lead was unlikely to be site-related given its common distribution in urban environments as a result of past use of leaded gasoline. The source of lead in Bircham Bend Brook could be from leaded gasoline from Worcester Street. Lead levels in soil from urban environments, particularly in traffic areas, are known to be elevated and in some cases exceed 1,000 mg/kg. As a result, no further assessment of ecological risk is required for the Bircham Bend Brook.

9.4 Environmental Health Investigations for the Chicopee River

The Chicopee River assessments were augmented with a significant sampling program in 2005, which is presented in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007). The Chicopee River borders the plant on the north. This assessment determines whether environmental receptors are, or could potentially be, exposed to constituents at or from the disposal site. For those receptors that are exposed or potentially exposed and are associated with complete exposure pathways, an effects-based screening step was performed to determine whether any pathway poses a significant ecological risk. The procedures employed in this ERC were consistent with those prescribed by the MADEP's guidance for a Method 3 Stage I ERC (Rule 310 CMR 40.0990 to 40.0999) (MADEP, 2006a) and *Guidance for Disposal Site Risk Characterization* (MADEP, 1996), and by the guidance for performing ecological risk assessments for federally mandated Superfund sites (USEPA, 1997). The ERC builds upon results from the *On-Site Environmental Risk Characterization Report* (BBL, 2001) and addresses the risk assessment data gap for the Chicopee River.

A risk-based environmental screening (ES) of the 1983 through 2005 exposure media data was conducted for the identified constituents, in which their maximum media concentrations were compared to relevant risk-based MCP screening criteria (i.e., an HQ analysis was performed). As a result of this step, the constituents that screened through the Stage I ERC for further consideration include 2-butanone, di-n-octyl phthalate, chromium, cobalt, lead, manganese and nickel for the surface-water exposure pathway. The constituents that screened through for the sediment exposure pathway include acetone, carbon disulfide, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethylphenol, manganese, phenol and vinyl chloride. The groundwater exposure pathway was eliminated from further analysis because the EPCs of all constituents were well below any risk-based values.

When constituents were assessed further using information from older (i.e., 1987) versus the newer (2005) results, a conclusion was reached that none of the surface-water, groundwater, or sediment (except phenol, perhaps) constituents are associated with significant risk or harm to environmental receptors in the Chicopee River adjacent to the plant. Furthermore, the industrialized nature of the river in the plant vicinity has a significant influence on the estimation of facility-specific environmental risks.

The exception for phenol included one sample from 2005 where the detected concentration was 7.8 mg/kg. The MCP benchmark for this constituent was not available, but the Washington State Department of Ecology (2006) lists a Sediment Management Standards Sediment Impact Zone Maximum Level and Sediment Cleanup Screening Level/Minimum Cleanup Level at 1.2 mg/kg. Although elevated, this chemical is not a good candidate for inclusion in further assessment given its sporadic presence. Accordingly, phenol was not forwarded to the Stage II ERC.

In summary, the Stage I ERC for the Chicopee River concludes that exposure to detected constituents in surface water, groundwater, or sediment does not pose a significant harm to environmental receptors. Because recent chemical concentrations in the plant vicinity did not exceed screening levels, or were comparable or below background/reference and local conditions, no further assessment of ecological risk is required for the Chicopee River.

9.5 Conclusions

The existing environmental health/risk investigations for the plant proper, Bircham Bend Brook and the Chicopee River suggest that none of the detected constituents of interest have the potential to significantly affect the ecological receptors at these locations. Therefore, further ecological evaluations for the Indian Orchard Plant and the associated bodies of water are unnecessary.

10. Conceptual Risk Management Summary

Four of the disposal areas (SWDAs No. 1 and No. 2, LWDA No. 1 and the Former WWII NR Area) required further remedial response action and/or institutional controls to manage identified risk. A risk was identified to excavation workers for potential dermal contact to groundwater within two defined chlorobenzene plumes associated with SWDA No. 1 and the Former WWII NR Area. The three former landfills (SWDAs No. 1 and No. 2 and LWDA No. 1) were found to contain wastes above cleanup criteria; thus, "presumptive remedies" approaches will be employed as deemed appropriate to manage risks associated with the landfills. The remaining 10 areas require no further action, assuming the plant remains industrial for the foreseeable future.

To manage potential risks, it is recommended that the following be considered in the CMS/MCP Phase III Remedial Action Plan:

- incorporate institutional controls into the deed to restrict land use as commercial/industrial;
- establish restrictions in the deed for scenarios such as excavations where groundwater may be encountered downgradient of SWDA No. 1 and the Former WWII NR Area;
- demonstrate natural attenuation in groundwater;
- maintain a cover above SWDAs No. 1 and No. 2, and LWDA. No. 1 that allows for ongoing natural attenuation; and
- restrict excavations into the landfill wastes at SWDAs No. 1 and No. 2, and LWDA No. 1.

This section presents conceptual alternative risk management plans. Risk management is a distinctly different process from risk assessment. Risk assessment establishes whether a risk is present and, if so, the range or magnitude of that risk. In the risk management process, the results of the risk assessment are integrated with other considerations, such as site physical layout, or uses, to reach decisions regarding the need for and practicability of implementing various risk-reduction remedial activities. Based on the environmental and human health risk characterization, provided are alternatives to manage risks that may be considered in the Corrective Measures Study/MCP Phase III Remedial Action Plan. This Risk Management Plan will identify the risk characterization findings and the optional actions needed to manage risk to human health, public welfare and the environment so that acceptable risk levels are not exceeded under current or reasonable future land-use conditions. For each area where a risk or potential future risk was identified and or assumed under a presumptive remedy, the following will be considered.

- pathway and receptors;
- potential remedial alternatives;
- potential supplemental data to confirm or further evaluate risks; and
- applicability of institutional controls via MADEP's Activity and Use Limitation (AUL).

SWDA No.1

Risks were identified to the future non residential worker via dermal contact with groundwater from SWDA No.

1. This risk includes:

- Chlorobenzene, 1,2-dichloropropane, acetone and benzene xylene and in groundwater downgradient of SWDA No.1 via inhalation and dermal contact, for an outdoor excavation worker.

Several alternatives are available to manage this risk:

1. For future construction or utility work within the groundwater plume extent associated with SWDA No. 1, apply an institutional control to restrict excavation, or activities or uses that would involve or may result in unrestricted direct contact with groundwater and/or disturbance, movement, relocation, or removal of soil located at depths greater than water table to shallow depths, except with an approved soil management plan and health and safety plan and the Opinion of an LSP that such activities will not present a Significant Risk of harm to health, safety, public welfare, or the environment.

2. To address potential dermal contact to groundwater by an excavation worker an institution control may be used to restrict excavation with the extent of the groundwater plume associated with SWDA No. 1except with an approved soil management plan, health and safety plan and the Opinion of an LSP that such activities will not present a Significant Risk of harm to health, safety, public welfare, or the environment.

3. Reduce groundwater concentrations to levels acceptable for inhalation and dermal contact.

4. Evaluate and monitoring for NA and plume stability in groundwater.

Former WWII NA Area

Risks were identified to the future non-residential workers.

- Inhalation and dermal contact to groundwater by an excavation worker.

Several alternatives to manage these risks are presented below:

1. For future construction or utility work, apply an institutional control to restrict excavation, or activities or uses in the Former WWII NR Area that would involve or may result in unrestricted direct contact, with ground water and disturbance, movement, relocation, or removal of soil located at depths greater than 3 feet below the surface grade, except with an approved soil management plan and health and safety plan and the Opinion of an LSP that such activities will not present a Significant Risk of harm to health, safety, public welfare, or the environment.

2. If excavation were to occur, soils exhibiting chlorobenzene will be returned to the depth of origin and will not be place in shallower depths.

3. Reduce concentrations in groundwater in the vicinity of MW-116s and MW-112D.

4. Evaluate and monitor for NA and plume stability in groundwater.

SWDA No.1, LWDA No.1 and SWDA No.2

Hot spots were identified at SWDA No.1 and No.2 and LWDA No.1 from landfill wastes through a hotspot evaluation, thus risk management is required to contain wastes under presumptive remedy.

Risks were identified to the future non residential worker via dermal contact in these landfills. These included:

- The landfills contain industrial wastes. Soil wastes were found in these landfills above S-3/GW-3 or S-3/GW-3 and/or UCLs.

The following are alternatives to mitigate these potential risks:

1. Install and maintain a permeable cover to allow for ongoing NA.

2. Place an institutional control via an AUL to restrict excavation or activities or uses within the landfills that would involve or may result in unrestricted direct contact, disturbance, movement, relocation, or removal of soil located at depths greater than soil cover or 3 feet below the 1984 surface grade, except with an approved soil management plan and health and safety plan and the Opinion of an LSP that such activities will not present a Significant Risk of harm to health, safety, public welfare, or the environment.

3. Restriction of building construction without considerations in the designs for potential indoor air management and an Opinion of an LSP that such land use or designs will not present a Significant Risk of harm to health, safety, public welfare or the environment.

Site Wide

Risk might be present for land use not considered in the risk characterization. This assumption included:

- continued industrial non-residential property use and thereby did not consider residential scenarios.

The following action is required to maintain this assumption.

1. Institutional controls are necessary to limit the use of the property to those consistent with the assumptions used in the risk assessment.

2. Activities and uses would be restricted consistent with typical commercial and/or industrial uses within the area subject to the risk assessment including improvement, demolition, decommissioning, repair and build-out (e.g., construction of building[s] intended for commercial/industrial usage [including buildings intended for occupancy by commercial/industrial workers or for storage purposes]).

11. Quality Assurance

The quality program is an integral part of the plant environmental investigations. Data collected throughout these investigations have been verified and validated as part of the comprehensive quality assurance (QA) program. This QA program has been in place to provide that data are representative, reliable, defensible and are of sufficient level of precision, accuracy and completeness to meet data quality objectives as presented in the *Quality Assurance Project Plan* (QAPP) (BBL, 2005b and 1994b).

As of April 2006, data usability assessments are required in support of a Response Action Outcome per MCP 310 CMR 40.1056(2)(k). In addition, as of August 1, 2003, the requirements for achieving "presumptive certainty" per the MADEP's Compendium of Analytical Methods [CAM], established August 1, 2003 are required.

Therefore, a Data Usability Assessment is provided in Appendix B of the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) The Data Usability Assessment establishes and evaluates the quality of the data, including:

- "pre-CAM" (data compiled prior to August 1, 2003, before the MADEP's establishment of CAM requirements and requirements for completing Data Usability Assessments and Representativeness Evaluation)

- "non-CAM" (data compiled after August 1, 2003 using an analytical method not included in the CAM [e.g., less common, specialized analyses])

- "CAM non-compliant" (data compiled after August 1, 2003 using analytical methods included in the CAM, but are not consistent with CAM-specified quality control, data evaluation, or reporting requirements)

However, there are two parts to data quality: sample collection in the field and sample analysis and reporting in the laboratory.

11.1 Field Quality Assurance

As documented in the Data Usability Assessment, various field quality control procedures were established and used to maximize the quality of the data obtained. Field procedures used during site investigations (as summarized in Table B-2 of Appendix B) were appropriate at the time they were collected, and comply with currently applicable field quality control indicators.

Plant data was obtained using standard operating procedures consistent with MADEP Standard References and/or USEPA guidance as ed document in the QAPPs (BBL, 1994b and 2005b).

To verify the quality of data using field instrumentation, duplicate measurements are obtained and reported for all field measurements. A duplicate measurement involves obtaining measurements a second time at the same sampling location.

Certified-clean sample containers (I-Chem 300 Series or equivalent) are supplied by the laboratory. Trip blanks are shipped from the laboratory with the sample container and remain with the sample container through sample collection and delivery to provide data integrity, representativeness and reliability.

Field duplicates are collected from the different site materials to verify the reproducibility of sampling methods. Field duplicates are analyzed at a 5 percent frequency (every 20 samples) for the chemical constituents.

Rinse blanks are used to monitor the cleanliness of the sampling equipment and effectiveness of the cleaning procedures. Rinse blanks are prepared and submitted for analysis once per day per matrix. Rinse blanks are prepared by filling sample containers with analyte-free water (supplied by the laboratory) that has been routed through a cleaned sampling device.

11.2 Laboratory Quality Assurance

Analytical accuracy is monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes and surrogate standards are used to assess the accuracy of the analytical data.

Samples are analyzed using current SW-846 Methods for the full list of parameters for that method and reported in CLP-equivalent data packages (pre-CAM) and MADEP CAM procedures (post-CAM) to support representative and reliable risk characterization, as discussed in Appendix B – Data Usability Assessment.

Laboratory QA SOPs were presented in the QAPPs (BBL, 1994b and 2005b). Data validation reports are provided in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007) in Appendix D, as well as certification as "meeting presumption certainty" in MADEP MCP Response Action Analytical Report Certification Forms after May 2003 (Appendix B).

12. References and Acronyms

Both references and acronyms used in this report are provided in the attached RFI/MCP Phase II CSA Addendum Report (ARCADIS BBL, 2007), Volume II, in sections 13 and 14 respectively.

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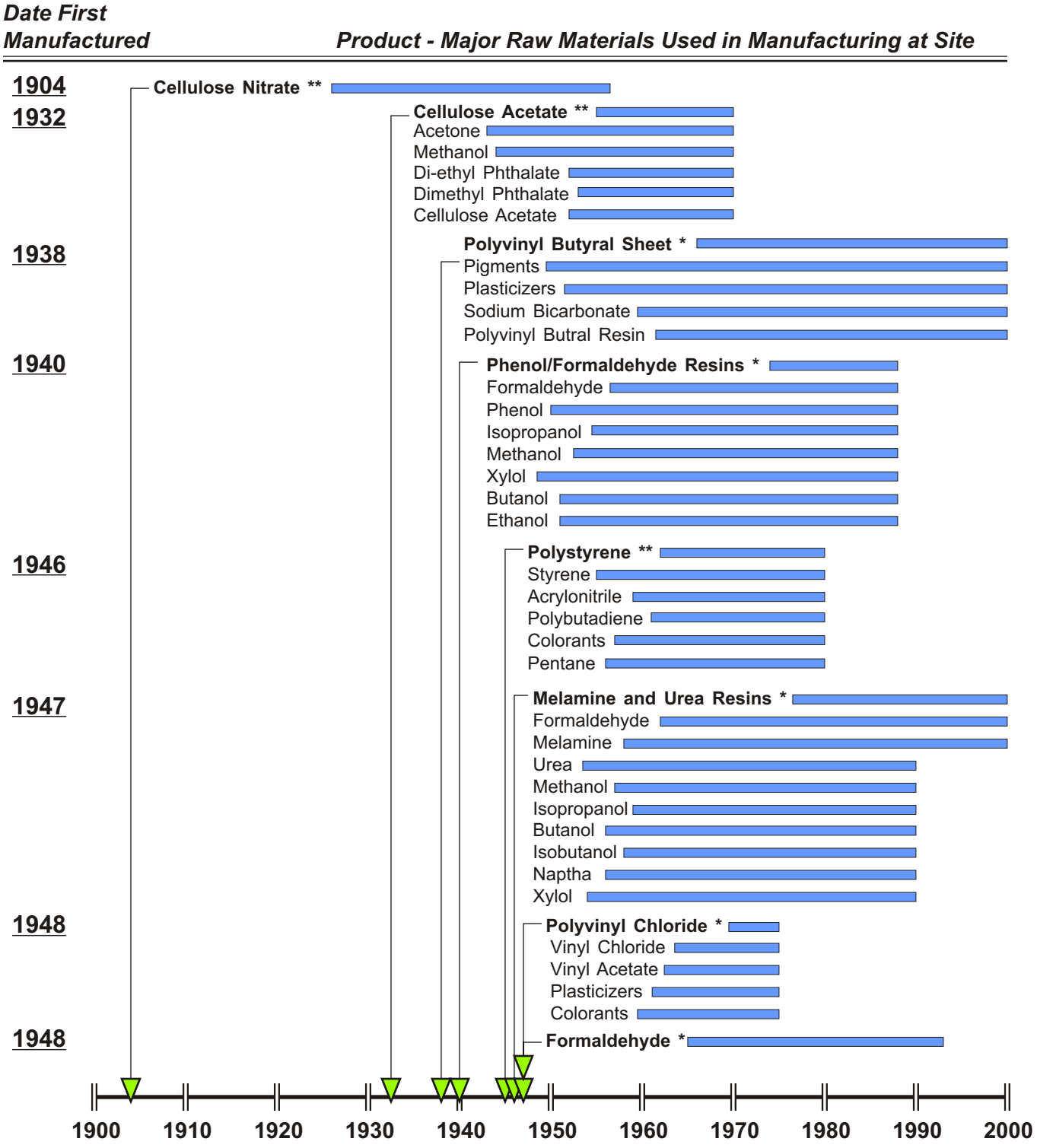
TABLE 2

RFI/MCP PHASE II CSA ADDENDUM REPORT

SITE MANUFACTURING HISTORY - EAST PLANT



Key:

* Located on eastern portion of Solutia property

** Located on NOVA Chemical Inc, property

Manufacturing duration

05/07/07 SYR-D85-DJH
10253157/10253g06.cdr

ARCADIS BBL
Infrastructure, environment, facilities

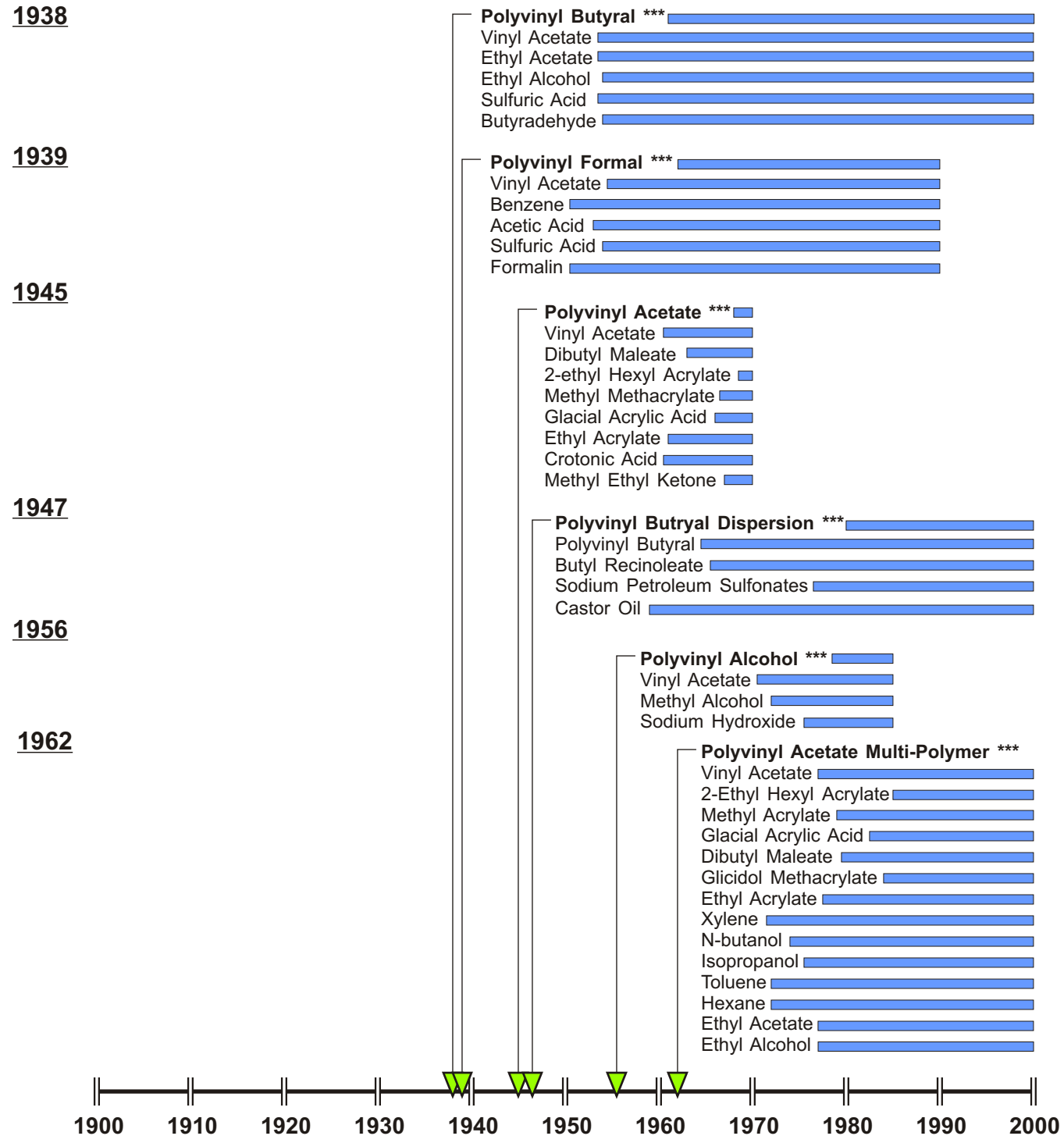
SOLUTIA INC.
INDIAN ORCHARD PLANT
SPRINGFIELD, MASSACHUSETTS

TABLE 3

RFI/MCP PHASE II CSA ADDENDUM REPORT

SITE MANUFACTURING HISTORY - WEST PLANT

Date First Manufactured — ***Product - Major Raw Materials Used in Manufacturing at Site***

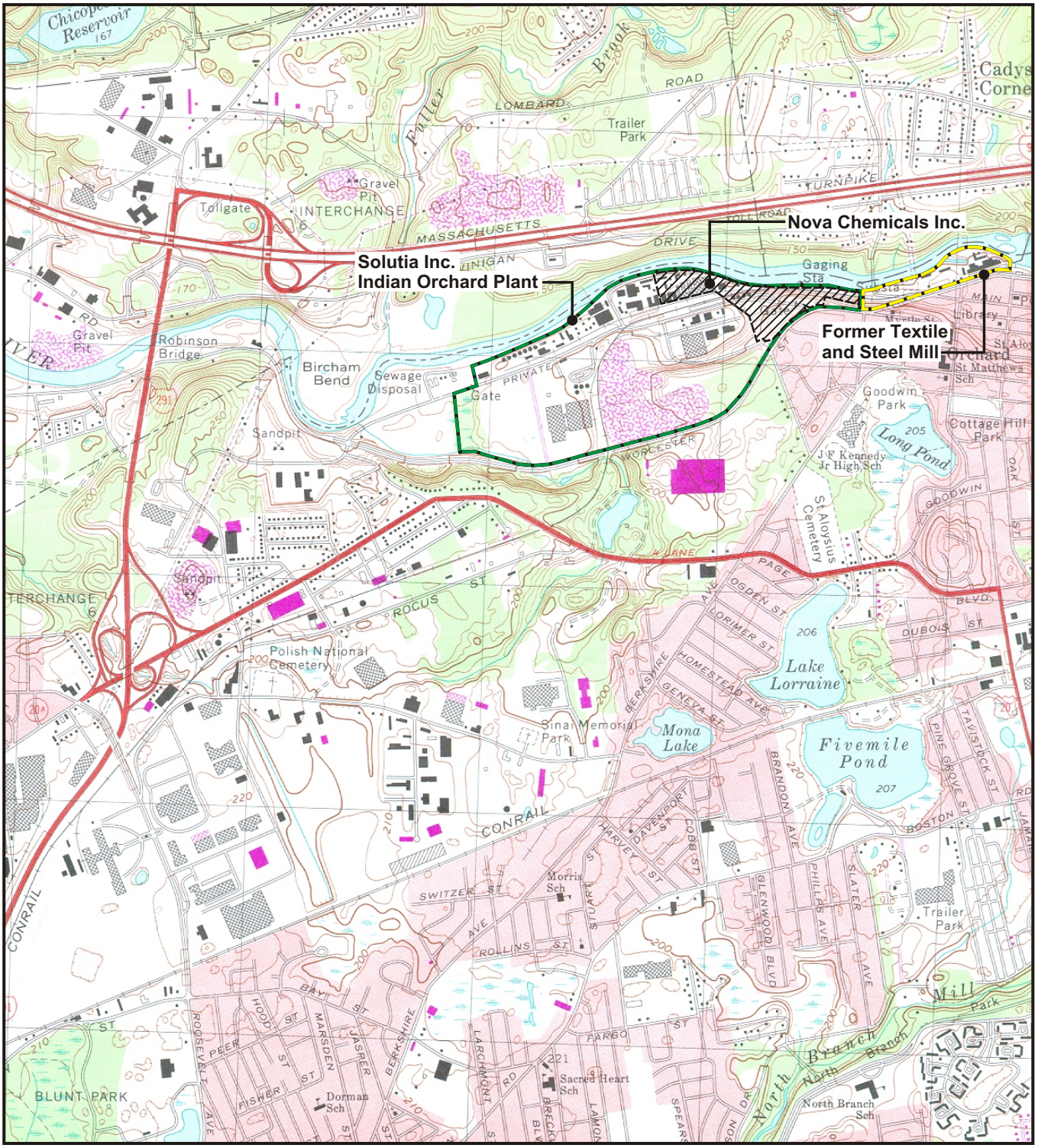


Key:

* Located on eastern portion of Solutia property
** Located on NOVA Chemical Inc, property
*** Located on western portion of Solutia property
Manufacturing duration

05/07/07 SYR-D85-DJH
10253157/10253g02.cdr

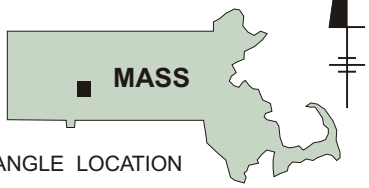
ARCADIS BBL
Infrastructure, environment, facilities



REFERENCE: Base Map USGS 7.5 Min. Series Quads., Springfield North, Mass. Photorevised 1979.

2000' 0 2000'

APPROXIMATE SCALE: 1" = 2000'



QUADRANGLE LOCATION

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ADDENDUM REPORT

SITE LOCATION PLAN

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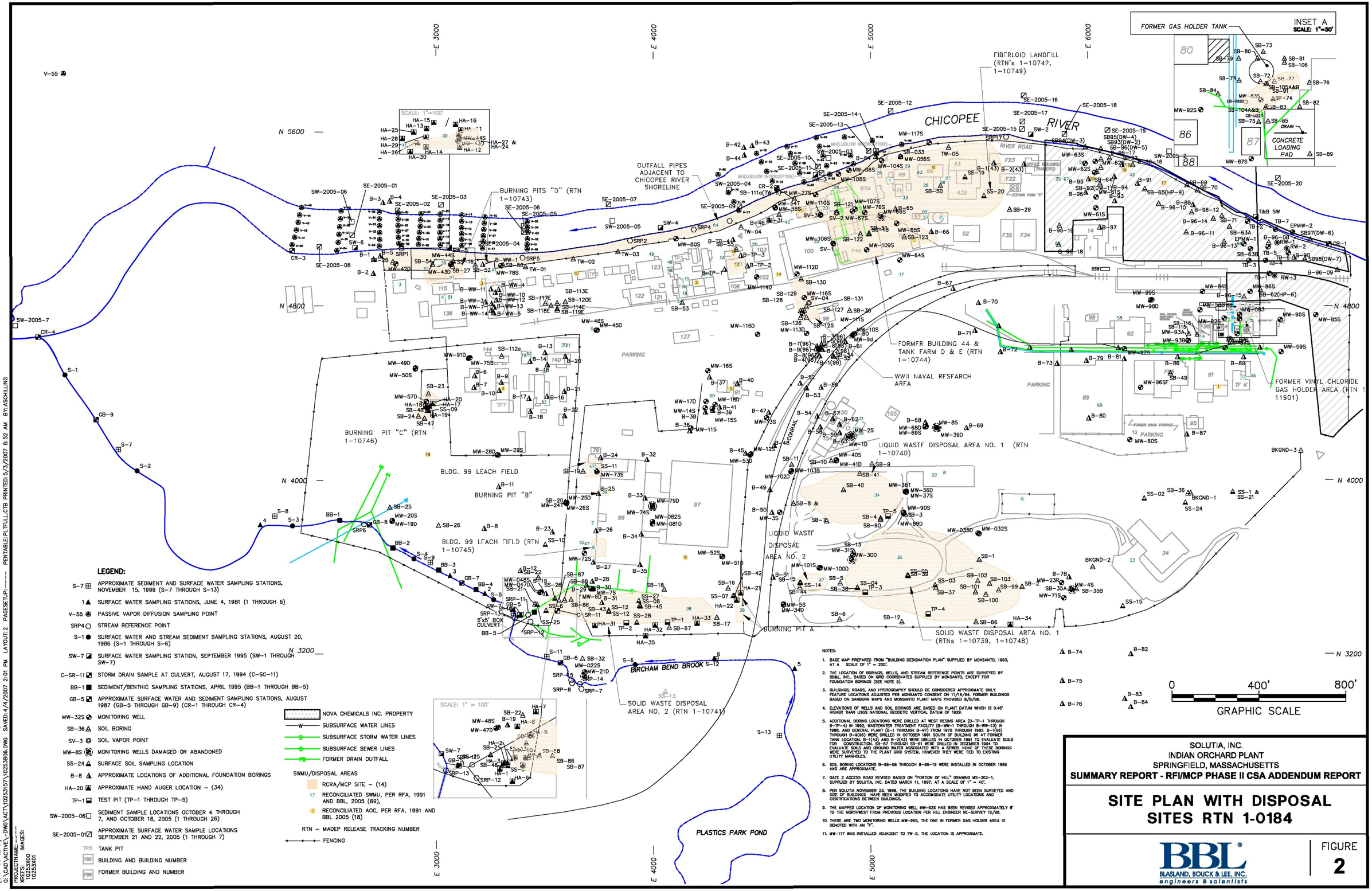
FIGURE
1

05/03/07 SYR-D85-DJH-KLS
10253157/10253n04.cdr



NOTES:

1. BASE MAP PREPARED FROM "BUILDING DESIGNATION PLAN" SUPPLIED BY MONSANTO, 1993, AT A SCALE OF 1" = 200'.
2. THE LOCATION OF BORINGS, WELLS, AND STREAM REFERENCE POINTS ARE SURVEYED BY BBML, INC., BASED ON GRID COORDINATES SUPPLIED BY MONSANTO, EXCEPT FOR FOUNDATION BORINGS (SEE NOTE 5).
3. BUILDINGS, ROADS, AND HYDROGRAPHY SHOULD BE CONSIDERED APPROXIMATE ONLY. FEATURE LOCATIONS ADJUSTED PER MONSANTO CONSENT ON 11/18/94. FORMER BUILDINGS BASED ON SANBORN MAPS AND MONSANTO PLANT MAPS PROVIDED 8/8/96.
4. ELEVATIONS OF WELLS AND SOIL BORINGS ARE BASED ON PLANT DATUM WHICH IS 0.45' HIGHER THAN USGS NATIONAL GEODETIC VERTICAL DATUM OF 1929.
5. ADDITIONAL BORING LOCATIONS WERE DRILLED AT WEST RESINS AREA (B-TP-1 THROUGH B-TP-4) IN 1992, WASTEWATER TREATMENT FACILITY (B-WW-1 THROUGH B-WW-13) IN 1988, AND GENERAL PLANT (B-1 THROUGH B-97) FROM 1979 THROUGH 1982. B-1(96) THROUGH B-9(96) WERE DRILLED IN OCTOBER 1991 SOUTH OF BUILDING 96 AT FORMER TANK LOCATION. B-1(43) AND B-2(43) WERE DRILLED IN OCTOBER 1991 TO EVALUATE SOILS FOR CONSTRUCTION. SB-57 THROUGH SB-61 WERE DRILLED IN DECEMBER 1994 TO EVALUATE SOILS AND GROUND WATER ASSOCIATED WITH A SEWER. NONE OF THESE BORINGS WERE SURVEYED TO THE PLANT GRID SYSTEM, HOWEVER THEY WERE TIED TO EXISTING UTILITY MANHOLES.
6. SOIL BORING LOCATIONS B-96-08 THROUGH B-96-19 WERE INSTALLED IN OCTOBER 1996 AND ARE APPROXIMATE.
7. GATE 2 ACCESS ROAD REVISED BASED ON "PORTION OF HILL" DRAWING WS-303-1, SUPPLIED BY SOLUTIA, INC. DATED MARCH 11, 1997, AT A SCALE OF 1" = 40'.
8. PER SOLUTIA NOVEMBER 23, 1998, THE BUILDING LOCATIONS HAVE NOT BEEN SURVEYED AND SIZE OF BUILDINGS HAVE BEEN MODIFIED TO ACCOMODATE UTILITY LOCATIONS AND IDENTIFICATIONS BETWEEN BUILDINGS.
9. THE MAPPED LOCATION OF MONITORING WELL MW-62S HAS BEEN REVISED APPROXIMATELY 8' TO THE NORTHWEST FROM PREVIOUS LOCATION PER HILL ENGINEER RE-SURVEY 12/98.
10. THERE ARE TWO MONITORING WELLS MW-96S, THE ONE IN FORMER GAS HOLDER AREA IS DENOTED WITH AN "F".
11. MW-117 WAS INSTALLED ADJACENT TO TW-5, THE LOCATION IS APPROXIMATE.

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SITE PLAN WITH DISPOSAL SITES RTN 1-0184

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FIGURE 2

[SYR-85-LEAD] SYR-85-PGL RC3 AM5 LAYER: ON=*, OFF=*REF*
G:\CAD\ACTIVE_DWG\ACT\10253157\10253806.DWG SAVED: 4/4/2007 2:01 PM LAYOUT:2 PAGESETUP:---- PENTABLE:PLTFULL.CTB PRINTED:5/3/2007 8:52 AM BY:ASCHILLING
PROJECTNAME:----
XREF'S: 10253300 10253301
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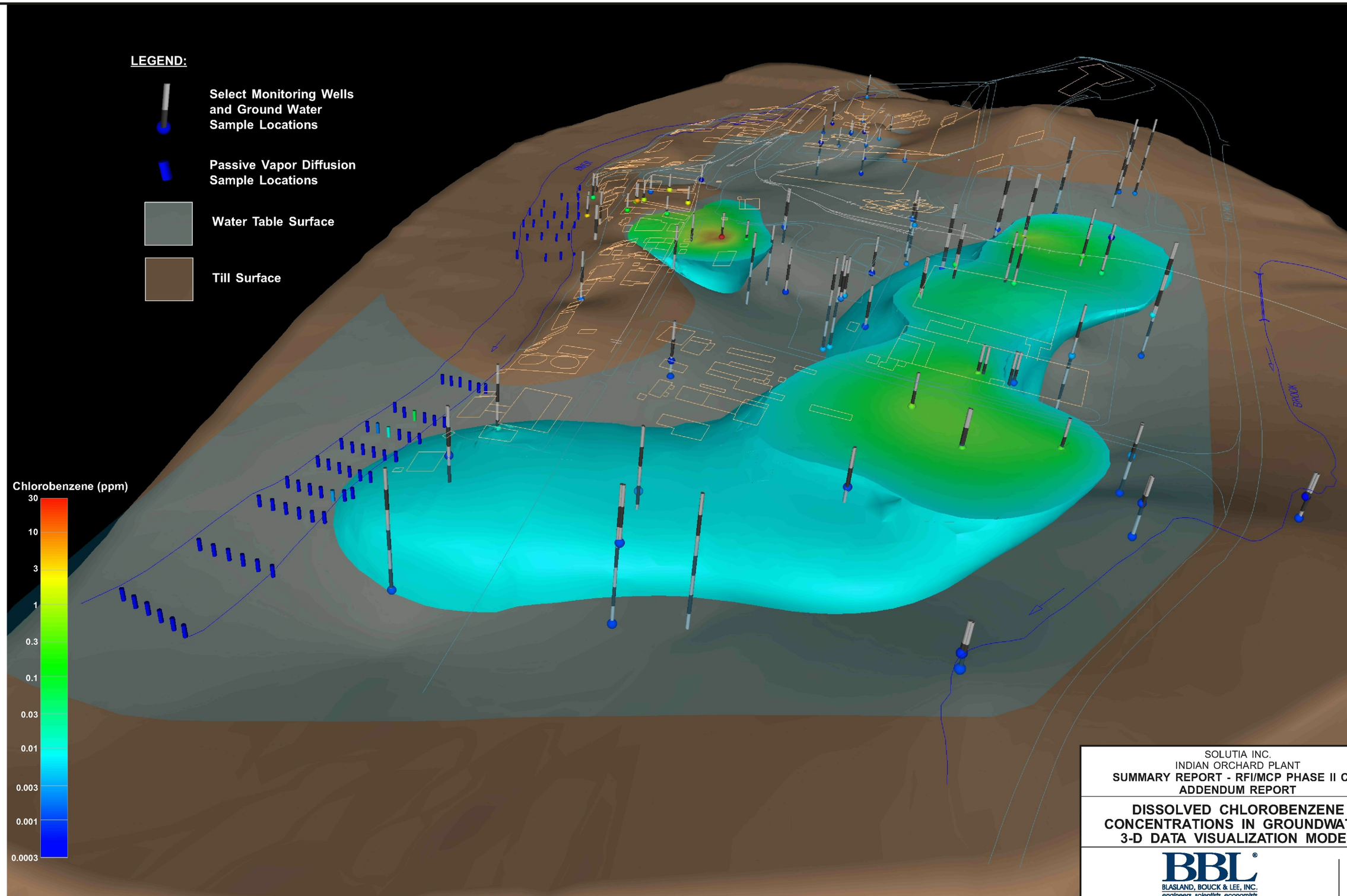

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DISSOLVED CHLOROBENZENE CONCENTRATIONS IN GROUNDWATER 3-D DATA VISUALIZATION MODEL

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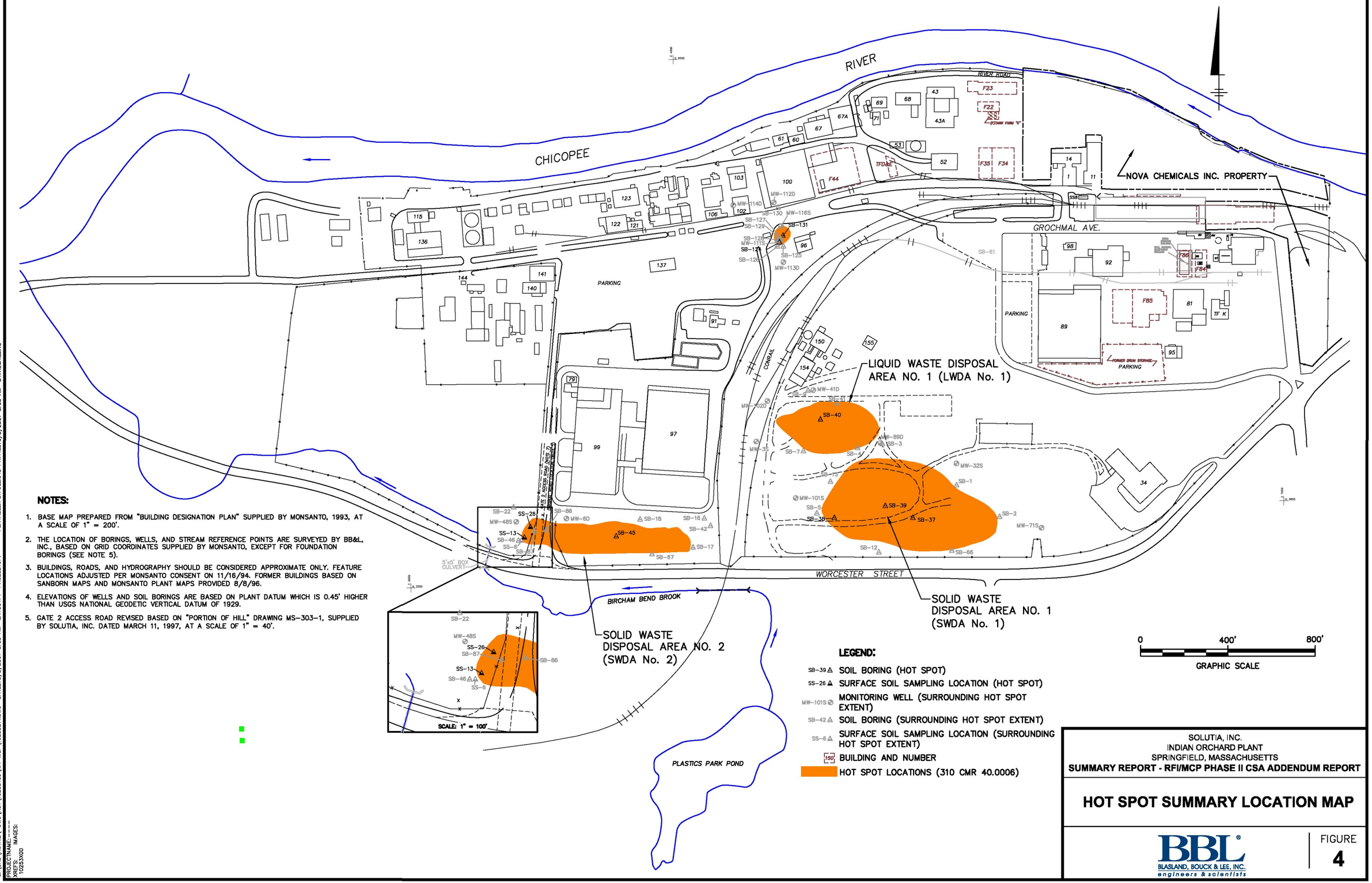
FIGURE
3

05/03/07 SYR-D85-DJH
10253157/10253g04.CDR



NOTES:

1. BASE MAP PREPARED FROM "BUILDING DESIGNATION PLAN" SUPPLIED BY MONSANTO, 1993, AT A SCALE OF 1" = 200'.
2. THE LOCATION OF BORINGS, WELLS, AND STREAM REFERENCE POINTS ARE SURVEYED BY BB&L, INC., BASED ON GRID COORDINATES SUPPLIED BY MONSANTO, EXCEPT FOR FOUNDATION BORINGS (SEE NOTE 5).
3. BUILDINGS, ROADS, AND HYDROGRAPHY SHOULD BE CONSIDERED APPROXIMATE ONLY. FEATURE LOCATIONS ADJUSTED PER MONSANTO CONSENT ON 11/16/94. FORMER BUILDINGS BASED ON SANBORN MAPS AND MONSANTO PLANT MAPS PROVIDED 8/8/96.
4. ELEVATIONS OF WELLS AND SOIL BORINGS ARE BASED ON PLANT DATUM WHICH IS 0.45' HIGHER THAN USGS NATIONAL GEODETIC VERTICAL DATUM OF 1929.
5. GATE 2 ACCESS ROAD REVISED BASED ON "PORTION OF HILL" DRAWING MS-303-1, SUPPLIED BY SOLUTIA, INC. DATED MARCH 11, 1997, AT A SCALE OF 1" = 40'.

LEGEND:

- SB-39 △ SOIL BORING (HOT SPOT)
- SS-26 ▲ SURFACE SOIL SAMPLING LOCATION (HOT SPOT)
- MW-101S ⊗ MONITORING WELL (SURROUNDING HOT SPOT EXTENT)
- SB-42 △ SOIL BORING (SURROUNDING HOT SPOT EXTENT)
- SS-6 ▲ SURFACE SOIL SAMPLING LOCATION (SURROUNDING HOT SPOT EXTENT)
- 150 BUILDING AND NUMBER
- HOT SPOT LOCATIONS (310 CMR 40.0006)

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HOT SPOT SUMMARY LOCATION MAP

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FIGURE 4

[SYR-85-LEAD] SYR-54-POL RCA RGB LAYER: ON=*, OFF=*REF*
G:\CAD\ACTIVE\-DWG\ACT\10253191\DWG SAVED: 5/3/2007 8:53 AM LAYOUT:4 PAGESETUP:---- PENTABLE:PLTFULL.CTB PRINTED:5/3/2007 8:53 AM BY:ASCHILLING
PROJECTNAME: ----
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IMAGES:
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