

EPA WORK ASSIGNMENT NUMBER: 157-RICO-02GZ
EPA CONTRACT NUMBER: 68-W-98-214
TETRA TECH EC, INC.
RAC II PROGRAM

PRELIMINARY
CONCEPTUAL SITE MODEL FOR OPERABLE UNIT 4
OF THE
CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE
SOUTH PLAINFIELD
MIDDLESEX COUNTY, NEW JERSEY

MAY 2006

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LIST OF ACRONYMS

AOC	Area of Concern	NWI	National Wetland Inventory
ARAR	Applicable or Relevant and Appropriate Requirement	OU	Operable Unit
AST	Aboveground Storage Tank	PAH	polycyclic aromatic hydrocarbon
BBL	Blasland, Bouck & Lee	Pc	Parsippany Variant
BCF	Bioconcentration Factor	PCB	polychlorinated biphenyl
BEE	Baseline Ecological Evaluation	PCE	tetrachloroethene
bgs	below ground surface	PCSM	Preliminary Conceptual Site Model
BTEX	benzene, toluene, ethylbenzene, xylene	pg/g	picograms per gram
CEA	Classification Exception Area	ppm	part per million
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PQO	Project Quality Objective
CSM	Conceptual Site Model	PRG	Preliminary Remedial Goal
DCE	dichloroethene	PRP	Potentially Responsible Party
DUA	Dunellon-Urban Land Complex	RAO	Remedial Action Objectives
DVA	Dunellon-Variant Sandy Loan	RAWP	Remedial Action Work Plan
DWA	Dunellon Variant-Urban Land Complex	RFA	Reaville-Urban Land Complex
EMSA	Environmental Measurements and Site Assessment	RI	Remedial Investigation
ENR	Enhanced Natural Recovery	Ro	Rowland Silt Loam
EPA	United States Environmental Protection Agency	ROD	Record of Decision
ESA	Ellington Variant-Urban Land Complex	SOW	Statement of Work
FS	Feasibility Study	SVOC	semi-volatile organic compound
FWENC	Foster Wheeler Environmental Corporation	TAL	Target Analyte List
HHCSM	Human Health Conceptual Site Model	TBC	To Be Considered
HRS	Hazard Ranking System	TCA	trichloroethane
mg/kg	milligram per kilogram	TCE	trichloroethene
MNR	Monitored Natural Recovery	TPH	Total petroleum hydrocarbon
msl	mean sea level	TtEC	Tetra Tech EC, Inc.
MTBE	Methyl-tert butyl ether	ug/L	micrograms per liter
NAPL	Non-Aqueous Phase Liquid	USGS	U.S. Geological Survey
NJDEP	New Jersey Department of Environmental Protection	UST	Underground Storage Tank
NJGWQS	New Jersey Ground Water Quality Standards	VOC	volatile organic compound
NJSCC	New Jersey Soil Cleanup Criteria	WA	Work Assignment
		WAF	Work Assignment Form
		WESTON	Roy F. Weston, Inc.
		WPA	Works Progress Administration

1.0 INTRODUCTION

Remedial Investigation (RI) and Feasibility Study (FS) activities will be undertaken for Operable Unit 4 (OU4) at the Cornell-Dubilier Electronics Superfund Site (the Site), located in South Plainfield, New Jersey. OU4 consists of the sediments, floodplain, soils, and surface water of the Bound Brook in the vicinity of the Site, identified as the Bound Brook Corridor. The RI/FS for OU4 will be performed following the Triad Approach, which focuses on the management of decision uncertainty by incorporating: (1) systematic project planning; (2) dynamic work plan strategies; and (3) the use of real-time measurement technologies to accelerate and improve the cleanup process.

This Preliminary Conceptual Site Model (PCSM) has been prepared by Tetra Tech EC, Inc. (TtEC): in response to Work Assignment (WA) 157-RICO-02GZ; in accordance with the Statement of Work (SOW) included as an attachment to the Work Assignment Form (WAF), dated 14 September 2005; and as directed in WAF Amendment 1, dated 29 March 2006. This WA was issued by the U.S. Environmental Protection Agency (EPA) under EPA RAC II Contract Number 68-W-98-214. Historical reports and data were acquired from the EPA, New Jersey Department of Environmental Protection (NJDEP), and other regulatory agencies and information databases to document the basis for developing this PCSM.

1.1 Purpose of Conceptual Site Model

A Conceptual Site Model (CSM) is a basic description of how contaminants enter a system, how they are transported and distributed within the environment, and where routes of exposure to organisms and humans occur. It provides an essential framework for assessing risks from contaminants, addressing uncertainties, determining source control requirements, and developing remedial strategies. Some of the key elements required to develop a CSM are the location and form of contaminant sources (e.g., direct releases, spills, contaminated filling, etc.), hydrodynamics and transport/migration factors (such as the possibility for contaminant sinks), contaminant fate/behavior (such as degradation rates), exposure mechanisms/pathways, and potential human and ecological receptors.

Because of the complex interplay between the biological and physico-chemical compartments of an ecosystem, CSM models, which attempt to address every nuance and answer every scientific question, can become quite complex (NOAA, 2006). By relying on reasonable assumptions, more simplified models may be generated. Regardless, CSMs are a tool to support management decisions, and the issues, constraints, and requirements associated with the management decision ultimately determine the appropriate depth and breadth of the CSM (NOAA, 2006).

As stated in EPA's "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (EPA, 2005), the "development of an accurate conceptual site model" is "[e]specially important at sediment sites." The CSM is also one of the primary tools used during the systematic project planning phase for the Triad Approach, and this PCSM has been prepared to present information about the Bound Brook Corridor that is pertinent to decision-making requirements. This synthesized information will assist the project team in identifying data needs, and as further information is obtained, the PCSM for OU4 will be revised and project decision goals refined, if necessary.

1.2 Site Background and Location

The Site consists of the Hamilton Industrial Park, contaminated portions of the Bound Brook adjacent to and downstream of the industrial park (Bound Brook Corridor), and contaminated residential, municipal, and commercial properties present in the vicinity of the former Cornell-Dubilier Electronics Corporation, Inc. (Cornell-Dubilier Electronics) facility. The former Cornell-Dubilier Electronics facility (the facility), also presently known as the Hamilton Industrial Park, is located at 333 Hamilton Boulevard in South Plainfield, Middlesex County, New Jersey.

The facility consists of approximately 26 acres, containing numerous subdivided buildings that are used by several commercial and industrial operations. The facility is bordered on the northeast by Bound Brook and the former Lehigh Valley Railroad, Perth Amboy Branch (presently Conrail); to the southeast by the South Plainfield Department of Public Works property, which includes an unnamed tributary to Bound Brook; to the southwest, across Spicer Avenue, by single-family residential properties; and to the northwest, across Hamilton Boulevard, by mixed residential and commercial properties.

The RI/FS for the Site is comprised of four operable units (OUs): residential, commercial, and municipal properties in the vicinity of the former Cornell-Dubilier Electronics facility (OU1); the facility soils and buildings (OU2); groundwater and vapor intrusion (OU3); and the Bound Brook Corridor (OU4).

Remedial activities to date for OU1, OU2 and OU3 include:

- The results of the residential, commercial, and municipal properties investigation (OU1) were addressed in the OU1 Remedial Investigation Report and OU1 Feasibility Study Report (FWENC, 2001a; 2001b). The Record of Decision (ROD) for OU1 was issued in September 2003.
- The results of the facility soils and buildings investigation (OU2) were addressed in the OU2 Remedial Investigation Report and OU2 Feasibility Study Report (FWENC, 2002; 2004). The ROD for OU2 was issued in September 2004.
- An Administrative Order on Consent (Consent Order) was entered into between EPA and the Dana Corporation, a Potentially Responsible Party (PRP), on 1 August 2005. This Consent Order requires the PRP to perform the RI/FS activities for OU3 with oversight by EPA.

The focus of the OU4 RI/FS and this PCSM is the sediments, floodplains soils and surface waters of the Bound Brook in the vicinity of the former Cornell-Dubilier facility property. The area that will be investigated extends from approximately 2 channel miles of the Bound Brook upstream of the facility to approximately 4 channel miles downstream of the facility and the associated tributaries and impoundments (discussed further in Section 2.1). The Bound Brook Corridor extends through (from east to west) the municipalities of Edison, South Plainfield, New Market, Dunellen, and Middlesex. The 100-year floodplain of the Bound Brook delineates the approximate lateral extent of the investigation. Figure 1-1 presents the extent of the Bound Brook Corridor.

This PCSM presents information on the details of the Bound Brook Corridor. Discussion on the former Cornell-Dubilier facility property is also presented throughout the PCSM as this represents the major known source of contamination in the Bound Brook Corridor, and physical characteristics of the property presented typify subsurface conditions and industrial developed properties in the Bound Brook Corridor.

1.3 Site History

1.3.1 Development History

The Spicer Manufacturing Company established operations at the facility in 1912 (South Plainfield Bicentennial Committee, 1976). Most of the major structures on-site were erected by 1918. Table 1-1 presents construction dates and Cornell-Dubilier Electronic's usage of the structures on the property, as shown on a Factory Insurance Association Map (FIA, 1956). Figure 1-2 shows the locations of the buildings on the facility. The Spicer Manufacturing Company ceased its operations at the facility in the mid to late 1920s. When the Spicer Manufacturing Company ceased operations at the facility, the property consisted of approximately 210,000 square feet of buildings.

1.3.2 Manufacturing History

The Spicer Manufacturing Company operated a manufacturing plant on the property from 1912 through the mid- to late 1920s. The plant manufactured universal joints and drive shafts, clutches, drop forgings, sheet metal stampings, screw products, and coil springs for the automobile industry. The plant included a machine shop, box shop, lumber shop, scrap shop, heat treating building, transformer platform, forge shop, shear shed, boiler room, acid pickle building, and die sinking shop. A chemical laboratory for the analysis of steel was added in 1917. The Spicer Manufacturing Company is Dana Corporation's predecessor (EPA, 2001).

Cornell-Dubilier Electronics operated at what is now the Hamilton Industrial Park from 1936 to 1962, manufacturing electronic components including capacitors. It has been reported that the company also tested transformer oils for an unknown period of time. Polychlorinated biphenyls (PCBs) and chlorinated organic degreasing solvents were used in the manufacturing process, and it has been alleged that during Cornell-Dubilier Electronics' period of operation, the company disposed of PCB-contaminated materials and other hazardous substances at the facility. A former employee has claimed the rear of the property was saturated with transformer oils and capacitors were also buried behind the facility during the same time period (EPA, 1996a).

Following Cornell-Dubilier Electronic's departure from the property, the facility was operated as a rental property consisting of warehouses and light industries. Since the early 1960s, numerous tenants have occupied the complex.

1.3.3 Remedial History

Numerous sampling and analytical programs have been conducted on, or in the vicinity of, the Cornell-Dubilier Electronics facility to date.

Detailed discussions of the programs associated with groundwater and residential soil sampling are provided in the following documents:

- Cornell-Dubilier Electronics Inc. Site Inspection Prioritization Evaluation. Report No. 8003-306. Malcolm Pirnie, Inc. for U.S. Environmental Protection Agency. 23 January 1995.
- Letter, “Actions Taken to Respond to the Violation.” Prepared by Mr. Lester Pae, DSC of Newark Enterprises, Inc. to Mr. Edward J. Faille, Central Bureau of Field Operations, New Jersey Department of Environmental Protection. 26 July 1990.
- Letter, “Cellar Pit and Outside Ground Water Cleanup” with attached figure. Prepared by Mr. Lester Pae, DSC of Newark Enterprises, Inc. to Mr. Edward J. Faille, Central Bureau of Field Operations, New Jersey Department of Environmental Protection. 6 November 1990.
- Sampling Trip Report. START-02-F-01157. Prepared by Superfund Technical Assessment and Response Team, Federal Programs Division, Roy F. Weston, Inc. to Removal Action Branch, Region II, U.S. Environmental Protection Agency. 7 July 1997.
- Tier I Residential Sampling and Analysis Summary Report, Cornell-Dubilier Electronics, South Plainfield, Middlesex County, New Jersey. Superfund Technical Assessment and Response Team, Federal Programs Division, Roy F. Weston, Inc. 25 June 1998.
- Tier II Residential Sampling and Analysis Summary Report, Cornell-Dubilier Electronics, South Plainfield, Middlesex County, New Jersey. Superfund Technical Assessment and Response Team, Federal Programs Division, Roy F. Weston, Inc. 2 July 1998.
- Tier III Residential/Neighborhood Sampling and Analysis Summary Report, Cornell-Dubilier Electronics, South Plainfield, Middlesex County, New Jersey. Superfund Technical Assessment and Response Team, Federal Programs Division, Roy F. Weston, Inc. July 1998.
- Tier I Residential Sampling and Analysis Summary Report, Addendum No. 1, Cornell-Dubilier Electronics, South Plainfield, Middlesex County, New Jersey. Superfund Technical Assessment and Response Team, Federal Programs Division, Roy F. Weston, Inc. 16 February 1999.
- Preliminary Ground Water Assessment Report for the Hamilton Industrial Park Site. Environ Corporation. October 1999.

The following is a chronological summary of the sampling and analytical programs conducted on or in the vicinity of the Site, that has relevance to OU4.

- 11 September 1986 - NJDEP conducted a Site Inspection and collected three surface soil, two surface water, and two sediment samples at the facility property. Exact sample locations are not available. Several metals, volatile organic compounds (VOCs), and Aroclor-1254 were detected in the soil and sediment samples. Information on the investigation event is presented in the *Site Inspection Report*, dated 12 September 1986, and the *Data Validation Review Memorandum*, dated 13 April 1987.
- 8 June 1994 - EPA collected six surface soil, four sediment, and four surface water samples from the facility property during a SIP sampling event. Results of the sampling are summarized in the *Site Inspection Prioritization Evaluation Report*, dated 23 January 1995 (EPA, 1995). VOCs, semi-volatile organic compounds (SVOCs), Aroclor-1254, and various metals were detected in soils at concentrations significantly exceeding background levels. Aroclor-1254, TCE, 1,2-dichloroethene (1,2-DCE), and lead were detected in a sediment sample from Bound Brook near the rear of the property. In addition, elevated concentrations of polycyclic aromatic hydrocarbons (PAHs, a class of SVOCs), Aroclor-1254, lead and zinc were present in the sediment collected near the outfall pipe. Aroclor-1254, Aroclor-1248, 1,2-DCE, and various metals were also detected at elevated concentrations in surface water samples from Bound Brook.
- 13 October 1994 - EPA collected two additional sediment samples from Bound Brook to obtain appropriate background concentrations to compare to the SIP sampling event results (EPA, 1995). These background samples contained total PCB concentrations of 0.7 milligrams per kilogram (mg/kg) and 0.35 mg/kg.
- 29 February 1996 - EPA collected four additional surface soil samples (and a duplicate sample) and four additional sediment samples from the facility property and Bound Brook, respectively. Aroclor-1254 was detected at concentrations up to 77 mg/kg in the soils and up to 520 mg/kg in the sediments, as described in the *Hazard Ranking System Documentation Report*, dated December 1996 (EPA, 1996a). During this Hazard Ranking System (HRS) sampling event, it was noted that the tanks were no longer present on the edge of the northeast embankment.
- 11 June 1996 - EPA completed a Screening Level Ecological Risk Assessment (EPA, 1996b), which included a comparison of surface water and sediment contaminant levels to available screening values. The risk assessment indicated that contamination of stream sediments adjacent to, and apparently associated with, the site was present at levels that have been linked to adverse impacts in benthic organisms in other freshwater systems.
- 27 and 29 June 1996 - EPA collected surface and subsurface soil samples from the facility roadway, the vacant open field area, a foot/bicycle path that crossed the property, and the southeastern and eastern floodplain areas. Two depth intervals were sampled, 0 to 3 inches and 3 to 12 inches below ground surface (bgs) (3 to 18 inches bgs for the roadway only). Aroclor-1254 was detected in on-site surface soils at concentrations as high as 51,000 mg/kg from the field area and at 100 mg/kg in a sample from the floodplain of Bound Brook. Concentrations of Aroclor-1254 ranged up to 5,000 mg/kg in the surface soils along the foot/bicycle path. Lead concentrations ranging from 1,740 mg/kg to 66,600 mg/kg were

measured in surface soil samples collected near the foot/bicycle path and the northeast corner of the fenced area, within the area where exposed waste materials were located. Aroclor-1254 was present in the soils at the surface and beneath the gravel/stone layer of the roadway, up to 340 mg/kg and 22,000 mg/kg, respectively. Lead was detected on the surface of the facility roadway at concentrations as high as 340 mg/kg, and beneath the gravel/stone layer at concentrations as high as 7,460 mg/kg. In addition, EPA collected one sediment sample for total organic carbon (TOC, at 840 mg/kg) and grain size analyses.

- 16 through 20 and 27 June 1997 - EPA initiated a study to determine the impacts of contamination of Bound Brook to human health and the environment. Soil, sediment, water, and biota (fish, crayfish, and small mammals) samples were collected along Bound Brook adjacent to and downgradient of the Site. Samples of edible fish were collected from Bound Brook, New Market Pond, and Spring Lake for use in assessing human health risks. Results of the sampling are presented in the *Bound Brook Sampling and Edible Fish Tissue Data Report*, dated August 1997 (EPA, 1997a).
- 7 August 1997 - EPA collected additional soil, sediment, surface water, and biota samples along the Bound Brook adjacent to and downstream of the facility. Aroclor-1254 concentrations as high as 13 mg/kg (wet weight) and 6.2 mg/kg (wet weight) were measured in the sediment and floodplain soils, respectively. Copper, zinc, lead, and barium were detected in the soils and sediments, at concentrations up to 210 mg/kg, 620 mg/kg, 540 mg/kg, and 380 mg/kg (dry weight), respectively. The fish fillet samples contained detections of two PCBs and seven pesticides. Data collected during this sampling event, in conjunction with the June 1997 concentrations, were utilized to conduct an ecological risk assessment, and the results are presented in the *Final Report, Ecological Evaluation for the Cornell Dubilier Electronics Site* (EPA, 1999a).
- August 1997 through November 1997 - EPA conducted sampling along the Bound Brook floodplain, collecting surface and subsurface soils from the banks and sediments from the streambed. As described in the *Soil and Sediment Sampling and Analysis Summary Report* (8 September 1998), one hundred transects were established along approximately 2.4 miles of the brook, with transects located upstream, midstream, and downstream of the site (Weston, 1998a). Four of the transects were located downstream of the New Market Pond spillway. Mean total PCB concentrations were 7.59 mg/kg for the surface soils; 11.97 mg/kg for the subsurface soils; 2.93 mg/kg for the surface sediments; and 2.34 mg/kg for the subsurface sediments.
- 21 November 1998 - EPA resampled soils at the following Bound Brook transect locations: CCSD1 (Transect CC), DDSS1 (Transect DD), HHSD1 (Transect HH), PPPND2 (Transect PPP), and UUUSD1 (Transect UUU). One surface soil sample and four subsurface soil samples were collected and analyzed for PCBs, as described in the *Soil and Sediment Sampling and Analysis Summary Report, Addendum No. 1*, dated 3 March 1999 (Weston, 1999a). Results indicated Aroclor-1254 at detected concentrations ranging from 1.2 mg/kg to 580 mg/kg. These results revised the mean total PCB concentrations for surface (from 7.59 to 6.88 mg/kg) and subsurface (from 11.97 to 12.28 mg/kg) soils.

- 20 and 21 April 1999 - The Environmental Measurements and Site Assessment (EMSA) section of NJDEP conducted surface (0 to 6 inches) and shallow subsurface (18 to 24 inches) sediment sampling in Spring Lake and along Cedar Brook from Plainfield High School to the lake (NJDEP, 1999). Sediment samples were also collected along a feeder stream from Maple Avenue to Cedar Brook. No PCBs were detected in any of the samples collected. Alpha- and gamma-chlordane were the most prevalent contaminants detected, with concentrations as high as 0.17 mg/kg and 0.13 mg/kg, respectively. DDT and DDD were also listed as primary contaminants, with concentrations as high as 0.69 mg/kg and 0.091 mg/kg, respectively.
- 21 through 23 June 1999 - Additional samples from the Bound Brook floodplain, downstream of Spring Lake, were collected by EPA and analyzed for PCBs. Four areas were sampled: Area 1 (Veteran's Memorial Park), Area 2 (north side of Cedar Brook, between Lowden and Oakmoor Avenues), Area 3 (north side of Bound Brook, in the vicinity of Fred Allen Drive), and Area 4 (located adjacent to stream 14-14-2-3 as identified on the Flood Insurance Map for the Township of Piscataway, south of New Market Avenue and east of Highland Avenue). The investigation results are presented in the *Floodplain Soil/Sediment Sampling and Analysis Summary Report*, dated January 2000 (Weston, 2000). Area 1 samples had total PCB concentrations ranging from non-detect to 25 mg/kg, Area 2 samples had total PCB concentrations ranging from 0.060 mg/kg to 2.0 mg/kg, Area 3 samples had total PCB concentrations ranging from 2.5 mg/kg to 7.5 mg/kg, and Area 4 samples had total PCB concentrations ranging from non-detect to 0.21 mg/kg.
- April through October 2000 - A predecessor company to TtEC, Foster Wheeler Environmental Corporation, conducted a RI field program for the operable units at the Site. Soil sampling from nearby residential, commercial and municipal properties occurred during the Site Reconnaissance for OU1. The Site Reconnaissance for OU2 focused on defining the boundaries of the disposal/fill area in the center portion of the former Cornell-Dubilier Electronics facility and locating potential source areas. PCBs were the most prevalent contaminants found, both on the nearby properties (up to 310 mg/kg total PCBs) and on the site (up to 130,000 mg/kg total PCBs). Perched water (up to 7,400 ug/L) and monitoring well groundwater (up to 84.1 ug/L) also contained PCBs. In addition, VOCs, SVOCs, pesticides, dioxins and furans, and metals were detected at concentrations above screening criteria. The results of the RI investigation were presented in the Data Evaluation Report, the OU1 Remedial Investigation Report and the OU2 Remedial Investigation Report (FWENC, 2001c; 2001a; 2002).

The overall results of the above sampling and analyses indicate elevated concentrations of VOCs, PCBs, and metals, along with SVOCs, pesticides, and dioxins and furans, in the site soils, sediments, and groundwater. Building interiors at the facility were found to contain elevated levels of PCBs and metals. Investigations at residential and commercial properties in the vicinity of the property identified the presence of PCBs in soils and/or in-house dust. Fish collected from Bound Brook were found to contain PCBs at concentrations higher than allowed by the Food and Drug Administration (2 parts per million (ppm)). Section 3 presents further discussion on contamination found at the Site.

To date, the following actions have been taken to reduce the potential for exposure to site contaminants and limit the migration of contaminants from the facility:

- 25 March 1997 - A unilateral administrative order was issued to the current owner of the Hamilton Industrial Park, D.S.C. of Newark Enterprises Inc., which required that a removal action be taken to stabilize the property. The scope of work included paving facility driveways and parking areas, installing security fencing and warning signs to limit access to the property, and installing silt fencing to limit off-site migration of surface soils (EPA, 1997a).
- 7 April 1997 - EPA installed temporary fencing and posted warning signs at both ends of the footpath that crossed the eastern portion of the facility property to block pedestrian access. In addition, EPA personnel overpacked several large capacitors that were leaking oil.
- 8 August 1997 - NJDEP issued an interim fish consumption advisory for Bound Brook and New Market Pond due to EPA findings of elevated PCB concentrations in sediments and fish samples (NJDEP, 1997).
- 29 March 1998 - EPA initiated a removal action to clean the interiors of homes where PCBs were found in indoor dust at levels of potential health concern, i.e., above the risk range used in the Superfund Program.
- 6 August 1998 - Cornell-Dubilier and D.S.C. of Newark Enterprises, Inc. entered into an Administrative Consent Order for a removal action that included the removal and disposal of contaminated soil from five residential properties, and delineation of the vertical and horizontal extent of PCB contamination at one additional property (EPA, 1998).
- 8 August 1998 - NJDEP issued a final fish consumption advisory. The advisory included all parts of the Bound Brook and its tributaries, New Market Pond and Spring Lake (NJDEP, 1998).
- 23 February 1999 - EPA ordered the former owners, Cornell-Dubilier and Dana Corporation, to conduct a removal action at seven additional residential properties (EPA, 1999b).
- 28 April 1999 - A "Participate and Cooperate Order" was issued to D.S.C. of Newark Enterprises, Inc. and Federal Pacific Electric Company for the remediation of Tier II residential properties.
- 14 April 2000 - EPA ordered D.S.C. of Newark Enterprises, Inc. to conduct a removal action of contaminated soils at a property on Spicer Avenue. D.S.C. agreed to perform the work required under the AOC, but subsequently failed to do so. In August 2004, EPA began the removal of PCB-contaminated soil from this property, and the work was substantially completed in September 2004.

1.4 Current Facility Conditions

Currently, facility land use is commercial/light industrial. The Hamilton Industrial Park is located in the western portion of the former Cornell-Dubilier Electronics facility and is largely paved or occupied by buildings. All areas used as driveways, parking areas and walkways were paved by the property owner pursuant to the administrative order issued by the EPA in March 1997. Site control measures, including the installation of a six-foot chain-link fence, posting of warning signs, and implementing engineering controls to limit the migration of contaminants through surface water runoff, were also implemented pursuant to this order. It is anticipated future land use for the facility will remain commercial and/or light industrial.

The northwestern area of the former Cornell-Dubilier Electronics facility is gently sloping, with elevations ranging from approximately 70 to 82 feet above mean sea level (msl). The central portion of the facility property is primarily an open field, with some wooded areas to the south and a semi-paved area in the fenced area in the middle. This area is relatively level, with elevations ranging from approximately 71 to 76 feet above msl. The property drops steeply to the northeast and southeast, and the eastern portion of the property consists primarily of wetland areas bordering Bound Brook. Elevations in this area range from approximately 71 feet above msl at the top of the bank to approximately 60 feet above msl along Bound Brook.

1.5 Identification of Applicable or Relevant and Appropriate Requirements (ARARs)

EPA developed the ARAR concept to govern compliance with environmental and public health statutes. Early identification of potential ARARs allows better planning of field activities in the RI. ARARs are used in the FS process to characterize the performance level that a remedial alternative or treatment process is capable of achieving. Each remedial alternative and treatment process option must be assessed to evaluate whether it attains federal and state ARARs. This section presents a summary of potential ARARs that may be used for evaluating remedial alternatives in the FS.

Applicable requirements are clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. Relevant and appropriate requirements are clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. When establishing performance goals for remedial alternative selection, relevant and appropriate requirements are given equal weight and consideration as applicable requirements. State requirements are ARARs when promulgated, identified in a timely manner, and at least as strict as existing equivalent federal ARARs. Section 121 of CERCLA requires EPA to select remedial actions that will comply with ARARs, unless the criteria for a waiver are met, as discussed below, and EPA waives one or more ARARs.

If no ARARs address a particular situation, other federal and state criteria, advisories, guidance, or proposed rules may be considered for developing remedial alternative performance goals. These To

Be Considered (TBCs) may provide useful information or recommended procedures that supplement, explain, or amplify the content of ARARs.

Each type of ARAR/TBC can be characterized further as contaminant-specific, action-specific, or location-specific. A contaminant-specific ARAR/TBC sets health and risk-based concentration limits in various environmental media for specific hazardous substances or contaminants. An action-specific ARAR/TBC sets performance, design, or other similar action-specific controls on particular remedial activities. A location-specific ARAR/TBC sets restrictions for conducting activities in particular locations, such as wetlands, floodplains, national historic districts, and others. Identification of ARARs continues throughout the RI/FS process as more is learned about site conditions, site contaminants, and remedial action alternatives.

The Preliminary Federal and New Jersey ARARs and TBCs identified for this site are presented in Tables 1-2 to 1-4.

1.6 Project Quality Objectives

Project quality objectives (PQOs) represent the key components for CSM development to better focus the Site investigation. The PQOs provide the common link in application of the CSM in the Site investigation for both reducing uncertainty in the assessment of exposure to and risks from the contaminants of concern within OU4. The following PQOs have been identified for the Bound Brook Corridor:

- Collect SVOCs, pesticides, PCBs, and metals sediment and floodplain soil samples in the Bound Brook Corridor to estimate the nature and extent of contamination in these media above the ARARs identified for the corridor.
- Collect geotechnical data from sediments and floodplains soils of the Bound Brook Corridor for use in the screening and evaluation of remedial alternatives.
- Collect and evaluate hydraulic data in the Bound Brook Corridor for use in understanding the fate and transport of contaminants and for screening and evaluating remedial alternatives.
- Collect VOCs, SVOCs, pesticides, PCBs, and metals surface water samples to identify contaminant distribution.
- Develop a PCSM and maintain a CSM for OU4 that identifies the receptor groups (both human and ecological), exposure media of concern, and exposure pathways and routes for contaminants listed above and detailed in Section 3.
- Collect chemical, biological, and toxicological data to further refine the exposure assessment and risk characterization developed in the baseline ecological risk assessment for Bound Brook (EPA, 2000).
- Collect contaminant data to supplement the existing data set for performing a human health risk assessment for the Bound Brook Corridor.

2.0 ENVIRONMENTAL SETTING

2.1 Topography, Wetlands, and Floodplains

2.1.1 Topography, Wetlands, and Floodplains of the Bound Brook Corridor

The Bound Brook Corridor is located in Middlesex County, New Jersey, and the elevation of the Bound Brook Corridor varies between 50 to 80 feet above msl. Figure 2-1, Topographic Base and Site Location Map for OU4, illustrates the topography of the Bound Brook Corridor, and Figure 2-2 presents the 100- and 500-year floodplains. The low topography of the Bound Brook Corridor has created the watershed features, hydrology, and drainage characteristics found in this region.

The topographic and dynamic hydrologic features of the Bound Brook corridor have helped create wetlands that have been identified and mapped by federal (i.e., National Wetland Inventory (NWI)) and state agencies (i.e., NJDEP). These wetlands are shown on Figure 2-3 (NWI Wetlands of OU4) and Figure 2-4 (NJDEP Wetlands of OU4). Wetlands within the OU4 Bound Brook Corridor are primarily associated with the floodplains of Bound Brook or occur as small isolated pockets in the developed areas surrounding the Bound Brook Corridor.

NWI wetland cover classes identified in the Bound Brook Corridor are: 1) L1OW - Lacustrine Open Water Wetland, 2) PEM or Palustrine Emergent Wetland, 3) PFO/SS1 – Palustrine Forested Scrub/Shrub Wetland, and 4) PFO1- Palustrine Forested Wetland.

L1OW wetlands are generally large areas of open water with active, wave-formed shorelines and no persistent emergent vegetation in the central or deepest zones. Many of these wetlands contain water of sufficient depth to maintain fish populations. Ponds and river channels are included in this wetland category. The bottoms of these wetlands may be unvegetated or support stands of various deepwater pondweeds (Tiner, 1999). These wetlands are associated with the Bound Brook and New Market Pond, as shown on Figure 2-3.

PEM wetlands are dominated by herbaceous or non-woody vegetation and usually have either surface water or saturated soils year-round. Marshes and wet meadows are two familiar PEM wetlands that are indicative of this category. Wet meadows tend to be somewhat drier than marshes, and are located in the southeastern portion of the Bound Brook Corridor and in the vicinity of Spring Lake. The identified PEM wetlands exist as both isolated pockets in the middle of the Bound Brook Corridor and extended stretches of wetlands near Spring Lake and the southeastern region of the corridor.

PFO/SS1 wetlands are dominated by woody species in the sapling and shrub stages. Scrub-shrub wetlands frequently flood in the spring or contain pockets of standing water (Tiner, 1999). The canopy of this wetland type and PFO-1 (Palustrine Forested Wetlands identified above) is dominated by trees, lending to their common lay name of wooded swamps. These wetland types are largely associated with the Bound Brook corridor along the floodplain area, as shown on Figure 2-3. The

identified wetland areas of PFO/SS1 and PFO-1 are located in large areas and stretches throughout the corridor. These wetland types also extend outside the Bound Brook Corridor.

The less common wetland cover classes within and outside the Bound Brook Corridor include: 1) PFO1/EM – Palustrine Forested/Emergent Wetland, 2) PSS1 – Palustrine Scrub/Shrub Wetland, and 3) PSS1/EM – Palustrine Scrub/Shrub Wetland. These wetland cover classes are considered less common and minor for a number of reasons. The PFO1/EM wetland cover class was identified in the upper northwestern end of the Bound Brook Corridor and is isolated in nature. The PSS1 wetland cover class was identified on the map in four isolated areas along the Bound Brook corridor, occurring from the central portion and the lower downstream boundary of the Bound Brook Corridor. The PSS1/EM wetland cover class was identified on the map in two areas located in the southeastern portion of the Bound Brook Corridor.

2.1.2 Topography, Wetlands, and Floodplains of the Former Cornell-Dubilier Electronics Facility Property

Based on the characteristic topographic features of the facility property, two major areas can be described. The northwest area of the Site (hereafter referred to as the developed portion) is characterized by the facility buildings and roadways, and has a gently sloping topography, with elevations ranging from approximately 70 to 82 feet msl. Approximately 13 structures are located here, often subdivided into separate units. In general, open areas on this portion of the Site were paved as a result of a unilateral administrative order; only small fenced areas of vegetation remain. A network of catch basins is located throughout this area to channel storm water flow. Based upon dye testing results from the 2000 RI, it is believed at least a portion of these catch basins drain into two outfalls along the Bound Brook (FWENC, 2002).

The southeast area of the facility consists of vegetation and fields, with some wooded areas to the south and a semi-paved area in the middle fenced area. The Bound Brook flows from the eastern corner across the northeastern border of this area. The undeveloped portion of the property is relatively level, with elevations ranging from approximately 71 to 76 feet msl. The topography drops steeply to the northeast and southeast, and these areas consist primarily of wetland areas bordering the Bound Brook. Elevations range from approximately 71 feet msl at the top of the bank to approximately 60 feet msl along the Bound Brook.

The northeastern border of the facility is the Bound Brook. Most of the facility, including the portion containing the buildings and structures, lies outside of the flood hazard area, and the 100- and 500-year floodplains. The southeastern portion of the facility; however, is located within the flood hazard area, and the 100- and 500-year floodplains of the Bound Brook (FWENC, 2002).

Hydrological characteristics of the Bound Brook floodplain adjacent to the facility have created seven wetlands (four PEM wetlands, two PEM/PSS wetlands, and one PFO wetland) which were delineated during the 2000. Wetland acreage ranged from 0.02 acres to 1.03 acres. Four of the

wetlands are located adjacent to the Bound Brook, and three are in the southwestern portion of the facility (FWENC, 2002).

2.2 Hydrology

The Bound Brook is the largest tributary of Green Brook, a tributary of the Raritan River. The Bound Brook sub-basin drains an estimated 48 square mile area at the Middlesex, NJ confluence with Green Brook. The Bound Brook Corridor includes portions of the main channel of Bound Brook and a smaller segment of its tributary, Cedar Brook. The corridor encompasses 6.0 channel miles of Bound Brook and approximately 1.2 channel miles of Cedar Brook.

The headwaters of Bound Brook are in the Boroughs of Metuchen and Edison. The Bound Brook flows westerly through the Borough of South Plainfield into Piscataway Township (where it is dammed to form New Market Pond), and then through the Borough of Middlesex to the confluence with Green Brook. The Bound Brook transports most of the runoff from South Plainfield (SPEC, 1990).

The Cedar Brook, the largest of the Bound Brook tributaries, drains approximately 6.5 square miles, and begins in the Borough of South Plainfield and flows south through the Middlesex Water Company property and into Spring Lake. A dam at the western end of Spring Lake controls the discharge flow of Cedar Brook into Bound Brook.

Two impoundments, Spring Lake and New Market Pond, occur within the Bound Brook Corridor. Spring Lake is located upstream from the Site and is an impoundment of Cedar Brook. New Market Pond is an impoundment of Bound Brook. Both impoundments are man-made and formed by constructed dams and spillways. These water bodies support secondary contact recreation including boating and fishing.

Flow and discharge data for Bound Brook was identified from a U.S. Geological Survey (USGS) Water Resources gaging station located in Middlesex, New Jersey (NJGS station #01403900). This gaging station is located approximately 4.5 miles downstream from the Site and is approximately one mile below the lower boundary of the OU4 Bound Brook Corridor.

Flow records for this gaging station include historical daily records for the periods of August 1972 to September 1977, May 1996 to September 1998, February to September 2004 and daily records for 2005. Mean monthly flow for the period of record of 1972 to 2004 ranged from 53.3 to 113 ft³/sec. Peak flow for the period of record was nearly 8,000 ft³/sec in 1999 and was associated with extreme precipitation from Hurricane Floyd (USGS, 2005). No flow data from the Bound Brook immediately adjacent to the Site or anywhere above New Market Pond were identified. The Green Brook watershed is currently the focus of a U.S. Army Corps of Engineers flood control project to reduce flood severity within the sub-basins of Green Brook, inclusive of the Bound Brook sub-basin.

Due to the topography of the area, heavy precipitation events cause flooding. Precipitation that falls at the rate of one inch per hour for one hour is not infrequent in this area of New Jersey. Flooding in the Bound Brook basin is tied to flooding in the Green Brook basin, due to topography and increased development in the region. During periods of high water flow, water overflows from the Green Brook to the Cedar Brook watershed, which returns it to the Green Brook 5.5 miles downstream through the Bound Brook. Historically, flooding of such great intensity has occurred during hurricanes (e.g., Hurricane Floyd in 1999) or tropical storms. To alleviate some of the flooding problems, Spring Lake, located just north of the Bound Brook, was dredged in the early 1980s to increase water storage (SPEC, 1990). Figure 2-2 depicts the 100- and 500-year floodplain zones in the Bound Brook Corridor.

2.3 Geology

This subsection provides a general description of the overburden and bedrock geology in the Bound Brook Corridor, and the facility, as determined from the 2002 OU2 RI report and available literature sources. A general overview of soils within the Bound Brook Corridor, and the facility, is also included.

2.3.1 Regional and Bound Brook Corridor Glacial and Surficial Deposits

Quaternary and pre-Quaternary glacial and fluvio-glacial deposits overlie bedrock across much of the northern portion of New Jersey, including the Bound Brook Corridor, and the facility. The primary glacial and surficial geologic units underlying the Bound Brook Corridor consist of the following: 1) Qal - alluvium, 2) Qsdwf - glaciofluvial sand and gravel deposits, 3) Qs - swamp and marsh deposits, 4) Qws - weathered shale, mudstone and sandstone, and 5) Qe - eolian deposits. Figure 2-5 provides the surficial geology of the Bound Brook Corridor. Many of the Wisconsin drift deposits in New Jersey are locally derived. The grain size and coloration of these glacial materials reflect that of the bedrock immediately upglacier of the depositional area (FWENC, 2002).

The Bound Brook Corridor, and the facility, are located in a glacial outwash area that extends south from the Wisconsin terminal moraine found approximately two miles northeast of the Bound Brook Corridor and is covered by glacial stream deposits. These deposits, where undisturbed, consist of reddish-brown to reddish-yellow sand and gravel with minor amounts of silt. These deposits have been locally modified by construction activities. Areas to the south of the project area have been mapped as artificial fill and trash fill. The region to the south and west of the facility consists of weathered shale, mudstone, and sandstone. These materials consist of reddish-brown to yellow sandy, silty clay to clayey, silty sand containing some shale, mudstone, and sandstone fragments. These unconsolidated and weathered bedrock materials can be as much as 30 feet thick but are generally less than 10 feet in thickness (FWENC, 2002 and Stanford, 1999).

2.3.2 Regional and Bound Brook Corridor Bedrock Geology

The Bound Brook Corridor, including the facility, lies within the Piedmont Physiographic Province and is underlain by the late Triassic to early Jurassic Age Passaic Formation of the Newark Supergroup (FWENC, 2002). The regional and site-specific geology for this area is presented on Figure 2-6. The Passaic (historically known as the Brunswick Formation) occupies an upper unit of the Newark Supergroup rocks in the Triassic-Jurassic Newark Basin. The basin filled with thousands of feet of sediments over a period of about 45 million years (USGS, 1998a). The Passaic Formation is the thickest and most aerially extensive unit in the Newark Basin. This formation consists of mostly red cyclical lacustrine clastics including mudstone, siltstone, and shale, with minor fluvial sandstone (Michalski, 1997).

2.3.2.1 *Passaic Formation Bedrock and Structural Geology*

The Passaic Formation is the youngest formational unit of the Newark Group, which consists of (oldest to youngest) the Stockton, the Lockatong, and the Passaic Formations, respectively. The Passaic Formation consists predominantly of reddish-brown feldspathic mudstone and micaceous siltstone, with some claystone and fine-grained sandstone. The reddish color originates from reworked hematite, which comprises 5 to 10 percent of the unit. When exposed to weathering, the Passaic units disintegrate into blocky and nodular-shaped fragments and chips that flake along the bedding plane. The shaley units ultimately disintegrate into a hard clay or saprolite (FWENC, 2002).

The sedimentary units of the Passaic Formation generally dip at about 5° to 15° to the northwest. Specifically, at an exposure in the Rahway area (northeast of the facility), the Passaic Formation unit strikes 50° northeast-southwest and dips 9°-12° to the northwest. The predominant system of fractures at that location strikes about 45° northeast-southwest and are mostly vertical. A second, less prominent system strikes 75° northwest-southeast and is also nearly vertical. Fractures parallel to the formation bedding are reportedly more continuous and extensive than the vertical fractures (Michalski, 1990).

2.3.2.2 *Bedrock Geology of the Former Cornell-Dubilier Electronics Facility Property*

The 2000 RI found that the top of consolidated bedrock underlying the facility ranges from 4 to 15 feet bgs, except in the far northwestern corner of the property where bedrock was encountered immediately underlying the building slabs. The bedrock surface slopes to the south-southeast and consists of red-brown to purplish-red mudstone and siltstone with localized beds of fine-grained sandstone. Each of these units consisted of heavily fractured zones that occurred along the bedding planes. Weathered fracture zones within the bedrock ranged from near vertical to horizontal. The majority of these features were low angle (20 to 30 degrees from horizontal), and the average spacing between fractures ranged from less than one to six inches.

2.3.3 Bound Brook Corridor and Former Cornell-Dubilier Electronics Facility Property Soils

2.3.3.1 *Bound Brook Corridor Soils*

The soils located within the Bound Brook Corridor include several soil series within Middlesex County, New Jersey. These soil series are identified on Figure 2-7. A total of 23 distinct soil types have been identified as occurring within the Bound Brook Corridor. Only those soils which account for the major units present within the corridor are presented below. Discussions on these smaller soil units are provided in the Middlesex County Soil Conservation Survey (USDA, 1987). The majority of the units occur as isolated pockets or fragments from a larger area of the soil series.

The most prevalent soils series within the Bound Brook Corridor include the Parsippany Variant (Pc), Ellington Variant-Urban Land Complex (ESA), Dunellon-Urban Land Complex (DUA), Dunellon Variant-Urban Land Complex (DWA), Dunellon-Variant Sandy Loam (DvA), Reaville-Urban Land Complex (RFA), and Rowland Silt Loam (Ro).

The Pc series is present in the southeastern portion of the Bound Brook floodplain. This series consists of nearly flat, poorly drained black silty loams associated with floodplains and lowland areas. The soils are slightly acidic with a pH in the range of 5.1 to 6.0. The sub-soils consist of brown silty clays that are low in permeability and subject to extensive subsurface ponding. A seasonally high water table of 0-1 foot below the surface results in a low permeability and high flood hazard potential for these soils and they are not suitable for development. Runoff potential is classified as low and these soils can be subject to considerable ponding. Organic matter occurs in the range of 2 to 4 percent.

The ESA soil series consists of nearly level to gently sloping (0 to 5 percent), moderately well drained soils that are formed on glacial outwash or glacial terrace deposits. These soils are often used for urban development, given their well drained nature. ESA soils typically consist of soils with a thickness less than 20 inches to bedrock. Surface soils consist of dark brown sandy loams, approximately 4 inches thick, with a strong brown sandy loam subsurface layer of approximately 16 inches in thickness. These soils have reported permeabilities ranging from 0.6 to 6.0 inches per hour. Soil pH ranges from 5.1 to 6.0; runoff potential is medium; erosion hazard is moderate; and available water capacity is moderate. This unit includes areas that have been covered by more than 20 inches of fill material, commonly from adjacent soil units that have been cut or graded. Organic matter in the surface interval occurs in the range of 2 to 4 percent.

The DUA soil series occurs in the Cedar Brook portion of the Bound Brook Corridor and as a fragment of a larger area extending outside the central portion of the Bound Brook floodplain of the corridor. These soils consist of level to gently sloping, well drained soils, making them highly suitable for urban development. The surface soils consist of a shallow layer (0.5 inch) of very dark brown, sandy loam. Sub-soils consist of dark brown sandy loam to a depth of 60 inches. The

seasonal high water table typically occurs at depths >6 feet in this series. This soil series is not expected to flood with regular frequency. The permeability in the undisturbed areas of this complex is moderate to moderately rapid, with estimates of 0.6 to 2.0 inches per hour for the surface soil interval. Runoff is slow and the erosion hazard is considered to be low. Soil pH occurs in the range of 4.5 to 5.5 and organic matter in the surface soils typically occurs in the range of 2 to 4 percent.

The DWA soil series is present in the upstream portion of the Bound Brook floodplain in the southeastern half of the Bound Brook Corridor. This gently sloping series consists of poorly to well drained soils associated with the Green Brook and Bound Brook floodplains. These soils consist of sandy loams, with slopes that vary between 0 and 12 percent. Surface soils consist of silty, black muck to an average depth of two inches. Sub-soils consist of brown silty loams to a depth of > 40 inches. The moderately to well drained nature of these soils is conducive for urban development. Differences in slope and texture of these soils are the main characteristics that may limit their suitability for urban development in parts of the Bound Brook Corridor. Their close association to floodplains, and tendency to support a seasonally high water table often within 0.5 to 4 feet of the ground surface, limit urban development in low lying areas. Surface soil pH ranges from 4.5 to 5.5 and organic matter ranges from 1 to 3 percent.

The DvA soil series occurs in scattered, large pockets along the floodplain area of Bound Brook in the Bound Brook Corridor. This series consists of gently sloping, moderately well drained soils, making them highly suitable for urban development. The surface soils consist of a shallow layer (2 inches) of dark muck over a brown and pale brown sandy loam to a thickness of 11 inches. Sub-soils consist of brown to reddish brown mottled sandy loam to 60 inches. The lower substratum of these soils may contain thin gravel beds. The permeability in the undisturbed areas of this complex is moderate to moderately rapid. Runoff is slow and the erosion hazard is considered to be slight. Seasonal high water table occurs in the range of 1 to 4 feet. Water levels are typically highest in winter and lowest in summer. Areas where the water table is shallowest are potentially limiting for subsurface dwellings (i.e., basements). These soils have reported permeabilities ranging from 0.6 to 6.0 inches per hour. Runoff potential is slow to moderate. Surface soil pH occurs in the range of 4.5 to 5.5 and organic matter in the surface soils typically ranges from 1 to 3 percent.

The RFA soil complex, which covers the southern half of the facility, consists of nearly level to gently sloping (0 to 5 percent), moderately well drained soils on areas used for urban development. Approximately 40 percent of the unit is composed of Reaville soils; 40 percent is composed of developed lands; 15 percent consists of inclusions of Ellington Variant, Lansdowne, and Klinesville soils and areas of soils that have been covered by more than 20 inches of fill material; and 5 percent consists of inclusions of Rowland soils. This unit includes areas that have been covered by more than 20 inches of fill material, commonly from adjacent soil units that have been cut or graded. This soil is a dark reddish-brown silt loam approximately 8 inches thick, and the subsoil is a light reddish-brown silt loam approximately 12 inches thick. Permeability rates for RFA soils range from 0.06 to 2.0 inches per hour. Soil pH ranges from 5.1 to 6.0; runoff is medium; erosion hazard is moderate,

and available water capacity is moderate, with excess water storage occurring in perched zones in the subsoil during wet periods.

The Ro soils cover the floodplain of Bound Brook near the southernmost boundary of the facility and occur sporadically throughout the Brook's floodplain within the Bound Brook Corridor. It is nearly level and moderately well drained to somewhat poorly drained. Areas where this unit is found typically flood once a year. The Rowland silt loam is brown and approximately 7 inches thick. The subsoil is a dark brown to reddish-brown silt loam approximately 33 inches thick. The substratum is a gray silt loam to a dark gray sandy loam 30 or more inches thick.

2.3.3.2 Former Cornell-Dubilier Electronics Facility Property Soils

Based upon the Soil Survey of Middlesex County, the soil series in the vicinity of the facility include the Ellington Variant-Urban Land Complex (ESA), Reaville-Urban Land Complex (RFA), and Rowland Silt Loam (Ro) (USDA, 1987).

The overburden material at the facility encountered during the 2000 RI consists of an unconsolidated unit and a weathered bedrock unit. The unconsolidated unit ranges in thickness from 0.5 to 15 feet. Based upon the cross sections in the 2002 OU2 RI report, the unconsolidated unit is thin in the northwest and southwest portions of the Site, and thickens towards the Bound Brook. The cross-sections indicate the property is underlain by a thin layer of dry, red brown silt and sand. As the unconsolidated unit thickens towards the Bound Brook, fill material was found intermixed with red-brown silt and sand. However, the 2-foot interval immediately above the weathered bedrock layer consisted of silt and clay. The thin unconsolidated layer across the southwestern and southeastern portion of the property consisted of silt and clay. Sandstone gravel found in areas of the property is likely weathered from the underlying sedimentary formation. The borings completed in the buildings during the 2000 RI indicate the unconsolidated overburden thickness beneath the buildings varies between 0 to less than 30 inches. The overburden was absent beneath a number of the buildings in the northwest corner of the property. The variable thickness of the overburden appears related to a locally high bedrock elevation and the probable removal of soil to allow for the construction of the building slabs directly on the bedrock. These findings are consistent with the ESA and RFA soil units described in the Middlesex County soil survey.

The weathered siltstone unit, approximately 1 to 8 feet thick above the bedrock surface, extends beneath a majority of the property. The weathered zone consisted of red-brown silt to fine sand, with sub-rounded to angular, fine to coarse siltstone gravel and silty clay. This weathered zone mixes with the urban fill material at a number of locations on the facility. The fill material identified throughout the property consisted predominately of cinders, ash, brick, glass, metal, slag, and wood fragments.

2.4 Hydrogeology

This subsection provides a general description of the overburden and bedrock hydrogeology in the Bound Brook Corridor, and the facility, as presented in the 2002 OU2 RI report and available literature sources.

2.4.1 Hydrogeology of Glacial and Surficial Deposits

The primary glacial and surficial geologic units underlying the Bound Brook Corridor, and presented on Figure 2-5, consist of the following: 1) Qal - alluvium, 2) Qsdwf - glaciofluvial sand and gravel deposits, 3) Qs - swamp and marsh deposits, 4) Qws - weathered shale, mudstone and sandstone, and 5) Qe - eolian deposits. Most of these deposits are characterized by high permeability, but due to the limited thickness of the natural and artificial deposits that cover the Bound Brook Corridor, the unconsolidated deposits are not considered a significant groundwater aquifer. The unconsolidated deposits underlying the facility and Bound Brook Corridor are relatively coarse-grained, limited in thickness, and in a perched condition above the regional, bedrock aquifer. Although not a significant hydrostratigraphic unit themselves, these deposits can promote recharge by allowing infiltration in unpaved areas and readily transmitting water to underlying bedrock units. The weathered bedrock zone may inhibit this recharge to the underlying bedrock hydrostratigraphic units (FWENC, 2002).

The hydrogeologic investigation at the facility in the 2000 RI focused on characterization of the shallow groundwater system in the upper part of the Passaic Formation. Based upon the findings presented in the OU2 RI report, perched water was encountered during the completion of test pits and the drilling of monitoring well borings. The shallow unconsolidated materials, overlying the bedrock, exhibited discontinuous zones of perched water, which occurred frequently where unconsolidated natural and fill materials were variable in composition. The depths of the perched water zones were variable across the facility, although they typically occurred in the range of 4 to 8 feet bgs. In comparison, the potentiometric surface of the shallow bedrock typically ranged from 11 to 20 feet bgs. The layers of silt, clay, and weathered siltstone and fill materials provide the relative resistance to vertical flow that allows these perched zones to occur during sufficiently wet periods in the project area (FWENC, 2002).

2.4.2 Bedrock Hydrogeology

The rocks of the Passaic Formation form a complex, heterogeneous, multi-aquifer system comprised of a series of gently dipping lithologic units with different hydraulic properties. The groundwater system can be visualized as a series of lithologic units with relatively high transmissivity separated by units with relatively low transmissivity that form a leaky, multi-aquifer system (USGS, 1998b).

Groundwater in the Passaic Formation is often unconfined in the shallower, more weathered part of the aquifer and confined or semi-confined in the deeper part of the aquifer. The principal means of groundwater flow within the Passaic Formation is through secondary permeability resulting from a series of interconnected fractures. The upper part of the Passaic Formation aquifer system is typically unconfined. However, near-surface bedrock units are highly weathered. Silt and clay derived from the weathering process typically fill fractures, thereby reducing permeability. This relatively low permeability surface zone reportedly extends 50 to 60 feet bgs (Michalski, 1990). Groundwater in the lower portion of the Passaic Formation is generally semi-confined. Recharge is by leakage through fractures in the confining units. Reported horizontal hydraulic conductivity in the unconfined units in the Rutgers study ranged from 0 to 1.2 ft/day, resulting in a median transmissivity value of 4.8 ft²/day. Reported transmissivity values for the confined units in that study ranged from 2 to 910 ft²/day. Published vertical hydraulic conductivity values (estimated from computer model calibration) for the Passaic Formation are about 32 ft/day in rocks less than 75 feet bgs and 0.032 ft/day in rocks at depths between 75 and 500 feet bgs in parts of Mercer, Somerset, and Hunterdon counties (FWENC, 2002).

Based upon potentiometric surface contours from the 2002 OU2 RI report, it appears groundwater flows in a general northwesterly direction. Surface water level elevation measurements collected east of the facility indicate the water level in the Bound Brook was typically higher than nearby groundwater elevations. This observation suggests the Bound Brook is recharging the upper bedrock aquifer in that portion of the property (FWENC, 2002).

2.5 Land Use

The Bound Brook Corridor (including the former Cornell-Dubilier Electronics facility property) is located in Middlesex County, in the central portion of New Jersey. The Bound Brook Corridor is specifically located in the eastern portion of the Borough of Edison, the southern portion of the Borough of South Plainfield, the northern portion of the Borough of New Market, the southern portion of Dunnler and northern portion of the Borough of Middlesex. The Bound Brook Corridor is situated in areas of multiple land use, as shown on Figure 2-8. The types of land use include the following classifications: 1) deciduous forest land, 2) cropland and pasture, 3) residential, 4) industrial and commercial, 5) commercial and services, 6) industrial, 7) open space/watershed surrounding area surrounding Spring Lake, and 8) other urban or built-up land uses.

The majority of the land use within the Bound Brook Corridor consists of residential areas supporting single and multi-family homes. Light commercial properties including convenience stores and other smaller commercial enterprises are also found in the Bound Brook Corridor. Historical development of riparian areas and filling activities have resulted in the development of properties right up to the channel of Bound Brook at certain locations. Areas of open space include a mixture of open grass urban parkland with mowed grass and fragments of deciduous forests mainly associated with the floodplain of Bound Brook and Cedar Brook. The developed nature of the land use within the Bound Brook Corridor contributes to a rapid conveyance of storm water across and over impermeable surfaces. This storm water is ultimately collected and discharged via a storm sewer system into Bound Brook and its tributaries present in the Bound Brook Corridor.

2.6 Climatology

The climate of Middlesex County, New Jersey and the Bound Brook Corridor is classified as temperate. Periodic extremes in temperature occur seasonally despite the proximity of the Atlantic Ocean. Hot spells, lasting from days to weeks, may occur during the summer months due to air masses flowing over the long trajectory of warm land from the west-southwest. During the winter months, extreme cold temperatures may be brought to the region by cold air traveling southeastward from Hudson Bay (FWENC, 2002). In Newark, New Jersey (approximately 19 miles northwest of the Bound Brook Corridor), the mean annual temperature is 54.5°F (NOAA, 2006). The average high temperature in July, is approximately 85°F, and the average low temperature in January is approximately 21°F (WC, 2006). In Newark, the average wind velocity is 10.2 miles per hour from the southwest. The average relative humidity is 72 percent and 54 percent at 1 a.m. and 1 p.m., respectively (FWENC, 2002).

The rate of precipitation within the Bound Brook Corridor is relatively consistent during the course of the year. However, summer thunderstorms, and occasional tropical storms, can produce heavy precipitation. In 1999, Hurricane Floyd produced significant flooding in this area, with the Raritan River and its tributaries cresting at record levels (i.e., 11 feet above flood stage). Severe winter storms may also produce heavy precipitation when cold air from the northeast collides with moist air from the southeast. These storms move up the Atlantic Coast past New Jersey; the amount of the precipitation is determined by the speed of the storm along the coast (FWENC, 2002). The average annual rainfall in the Borough of South Plainfield is approximately 49.63 inches (WC, 2006).

2.7 Ecology

The developed nature of the Bound Brook Corridor restricts the availability of open space to those supporting active recreational activities (i.e., recreational fields and mowed parkland), riparian habitat associated with flood prone or flood control wetland areas along Bound Brook and its tributaries, and the aquatic habitat associated with stream channels and man-made impoundments. While recreational fields and parkland afford open space, the pedestrian and vehicular traffic

associated with these areas often is a limiting factor for more reclusive wildlife species. Likewise, avian and mammalian species that have adapted to the cosmopolitan nature of these areas can exploit the resources present. Species that exploit edge ecotones often are in numerically greater abundance than species favoring larger, contiguous parcels of woodland habitats. The developed nature of the landscape within the Bound Brook Corridor makes the forested and emergent wetlands and undeveloped upland habitats associated with the Bound Brook floodplain more critical as habitat refugia for wildlife species found in the corridor.

Areas where riparian tree canopies have been removed for development will contribute to greater light penetration and elevated water temperatures in the summer months. Runoff from the developed areas of the Bound Brook watershed has contributed non-point source pollutants such as sediments and contaminants associated with road runoff to favor more pollution-tolerant species of fish and invertebrates. Fishery surveys conducted by NJDEP and EPA have identified the fishery as being a centrarchid(sunfish and basses)/cyprinid (minnows)/catostomid (suckers) dominated community. A single migratory fish species, the American eel, *Anguilla rostrata*, has been documented from the Bound Brook Corridor. Site reconnaissance data of the Bound Brook also identified the Asian clam, *Corbicula fluminea*, an invasive clam species, as being numerically abundant in finer grained sediments present in the brook. Currently, the NJDEP classifies the Bound Brook reach within the Bound Brook Corridor as FW-2 non-trout waters. The designated uses for this classification include primary and secondary contact recreation and the protection, maintenance and propagation of warm water aquatic life.

3.0 CONTAMINANT CHARACTERIZATION

This section presents the history of investigations at the Site, other known contaminated sites, and other potential sources that occur in the Bound Brook Corridor.

3.1 Potential Sources of Contamination

3.1.1 Former Cornell-Dubilier Electronics Facility

Allegedly, Cornell-Dubilier Electronics disposed PCB-contaminated materials and other hazardous substances at the facility during its period of operations (1936 to 1962). A former employee has claimed that the rear of the property was saturated with transformer oils and capacitors were also buried behind the facility during the same time period (EPA, 1996a).

An evaluation of historical information was performed to determine potential contaminant source areas. Aerial photographs of the property dating from the 1940s to the 1990s indicated extensive areas of surface discolorment in the central portion of the facility. In addition, property owner documents contain information on fuel oil tanks located to the northeast (one 11,000-gallon and two 8,000-gallon aboveground tanks), east (one 125,000-gallon aboveground tank) and south (one 5,000-gallon tank) of Building No. 11. Additional information on the tanks, including removal dates of the northeastern and southern tanks, is unavailable.

In 2000, a geophysical survey and excavations of test pits, generally in the central portion of the facility, were performed to investigate the boundaries, and determine the physical characteristics of the subsurface debris, and identify and characterize potential source areas. The results indicated buried materials, including capacitors (it was noted that some of the capacitor boxes appeared corroded and/or partially burned), ceramic electrical components, crystalline powder, general demolition debris, miscellaneous metallic debris, and drum components.

Results of previous investigations and the 2000 RI at the facility indicate elevated concentrations of PCBs, dioxin/furans, VOCs, PAHs, pesticides, and metals in the shallow and/or subsurface soils. Specific findings include:

- PCBs were present in the soils across the entire facility, at concentrations up to 130,000 mg/kg (central portion of the property). This is the area where capacitors were excavated, and direct disposal of PCB-contaminated materials would account for the extremely elevated concentrations detected.
- Due to the presence of charred debris in the test pits and the fact that burning PCBs can result in the generation of dioxins/furans, three shallow soil samples were analyzed for dioxins and furans. All three of the locations contained detectable concentrations of these compounds (i.e., concentrations ranged up to 13,510 picograms per gram (pg/g) for individual dioxin/furan constituents and 52,850 pg/g for the dioxin/furan homologs).

- VOCs, typically chlorinated hydrocarbon compounds such as trichloroethene (TCE) and DCE, were present at concentrations above screening criteria values in the southern and central - and to a lesser extent, floodplain (shallow soil only) - portions of the property.
- The elevated concentrations of SVOCs, primarily PAHs, were present in the soils may be related to either: 1) the debris present in the excavated test pits; 2) the fuel oil tank areas historically present at the Site; and/or 3) the oil found “on top of the groundwater” by the property owner and NJDEP in 1990 (see Section 1.3.3).
- Although present at relatively elevated levels in soils, especially in the east-northeast, central, and south-southwest portions of the property, no specific record of pesticide production by Cornell-Dubilier Electronics has been documented. The occurrences in/around the buildings may be the result of small-scale pest control efforts; however, the concentrations in the undeveloped portion of the property, especially in the Bound Brook floodplain, are less likely to originate from direct application for pest control by personnel working on the site, and instead, may be related to disposal practices and/or other sources.
- A majority of the maximum concentrations for the inorganic constituents in the shallow soils (about 75 percent) was present on the developed portion, and therefore, may be related to the industrial nature of that part of the site (historically and/or presently). In opposition, the subsurface soils tended to contain the more elevated metal concentrations in the central portion of the property, which is undeveloped. These results may be a result of the debris present in this area.
- The potential for PCB non-aqueous phase liquid (NAPL) to exist in the soils was evaluated as part of the 2000 RI. For soils, if greater than 10,000 mg/kg of contamination exists (i.e., one percent of the soil mass), then a NAPL may be present (Bedient et al., 1994). Based on the Total PCB concentrations (up to 130,000 mg/kg), the potential exists for a NAPL to be present in the central portion of the facility property. Significant accumulation of NAPL was not present in the descriptions of the soils in this area, although some coloration of the soils, an “oily sheen” on the split-spoon, and/or staining and an odor were noted.

Groundwater encountered in the overburden soil and weathered bedrock intervals during field activities for the 2000 1 RI was sampled, and the following results were noted:

- Elevated PCB concentrations (i.e., individual constituents up to 5,100 micrograms per liter (ug/L) and Total PCBs up to 7,400 ug/L) were present predominantly in the central portion of the facility;
- Nineteen VOC compounds were identified in the perched water samples, and detected concentrations ranged from 0.4 ug/L (1,1,2,2-trichloroethane (TCA); benzene) to 15,000 ug/L (TCE). Locations MW11 and MW12 contained the highest number of constituents (i.e., both samples contained 17 VOCs) and the most elevated concentrations (i.e., the samples contained maximum concentrations for 53 percent of the detected VOCs, at levels up to 15,000 ug/L).

- The perched water samples collected from the test pits contained 26 identifiable SVOCs, including phenols, PAHs, and phthalate esters. Ten pesticides were detected in the test pit perched water samples.

An investigation of the on-site drainage system was conducted during the 2000 RI. Open floor drains, metal plates, possible historic floor trenches, etc. were noted and mapped in a field logbook. In addition, potential outfall locations were surveyed along the length of the facility's boundary with the Bound Brook, and a total of 11 possible pipe outfalls were found. Dye testing was then conducted at eight on-site locations, and the investigation indicated the following:

- An open hole/former floor drain in Building No. 13 is connected to the large catch basin between Building No. 13 and the facility's northeast fenceline. It was further determined this large catch basin is connected to an outfall in Bound Brook near the railroad bridge.
- The catch basin southwest of Building No. 14 is connected to the catch basin on the southeast side of Building No. 14, and subsequently connected to an outfall which flows into an unnamed tributary to Bound Brook, near the boundary of the wetlands area.
- Sediment samples and perched water samples were collected from the drainage system and analyzed for VOCs, SVOCs, pesticides, PCBs, metals and cyanide. Total PCBs were detected in sediment samples from 31 mg/kg (DS06B) to 210 mg/kg (DS07). Perched water samples were found with concentrations of total PCBs ranging from 0.13 ug/L to 13.7 ug/L.
- No VOCs were detected in excess of screening criteria in the sediment samples or perched water samples collected from the drainage system. PAHs were the predominant SVOCs in excess of criteria in sediment samples with concentrations ranging from 150 ug/kg to 11,000 ug/kg.
- Pesticides were detected in all of the sampled sediment locations ranging in concentration from 58 ug/kg to 33,000 ug/kg. Pesticides were detected in perched water samples from DS03 and DS06A with concentrations ranging from 0.012 JN ug/kg to 0.036 JN ug/kg.
- All 23 TAL metals and cyanide were detected in the drainage system sediments with concentrations ranging from 0.14 J mg/kg to 122,000 J mg/kg. Twenty metals were detected in the perched water sampled from the drainage system with concentrations ranging from 0.14 B ug/L to 72,700 ug/L.

The historical occurrence of elevated concentrations of PCBs in the soils and sediments associated with the facility make it a significant source of organochlorine compounds in the Bound Brook Corridor.

3.1.2 Known Contaminated Sites

A limited file review was conducted on known contaminated sites within or adjacent to the Bound Brook Corridor. The files were obtained from a NJDEP file search and environmental concerns have been summarized for each site identified. The documents (including limited, associated correspondence) that are listed have been reviewed to prepare the summaries.

The summaries outlined in this section are for those sites that occur within a one quarter mile distance along the Bound Brook Corridor. They represent the most proximal sites that have the potential to be contributing contaminants via a single or multiple migration pathways to the Bound Brook Corridor.

The listed concentrations of contaminants are generally the maximum concentrations that triggered investigative and remedial actions at the properties. These concentrations were used to assess the worst-case contributions of contaminants to the local soils and groundwater, and potentially to the Bound Brook Corridor.

Woodbrook Road Dump (aka Dismal Swamp), Woodbrook Road, South Plainfield, NJ

The Woodbrook Road Dump site is an inactive, illegal dumping area of approximately 70 acres. The Superfund site is located on two properties north of Woodbrook Road. It is heavily wooded and undeveloped, and is bordered by the Bound Brook and wetlands of the Dismal Swamp. These two properties were operated as illegal dumps by previous owners in the 1940s and 1950s. Household and industrial wastes were accepted until the dump was shut down by the State of New Jersey in 1958. The current owner is Texas Eastern Transmission Corporation.

The Site is being addressed through federal (EPA) and potential responsible parties' actions. Partially buried leaking capacitors were discovered in September 1999. In 2000, a removal action was completed to address these buried capacitors. Subsequently, a soil investigation revealed soils and sediments contaminated with high levels of inorganics, VOCs and PCBs. The groundwater is also contaminated with inorganics, VOCs and PCBs.

CP Manufacturing (Aka Kentile Floors), 101 Kentile Road, South Plainfield, NJ

An RI Report dated March 1997 had approximately 16 Areas of Concern (AOCs) were noted in the investigation. The property was used to manufacture rubber and vinyl floor tiles for residential and commercial use.

Soils on the property were found to be contaminated with SVOCs at a maximum of 526 mg/kg, including butylbenzylphthalate, bis (2-ethylhexyl) phthalate, and di-n-octylphthalate. Several PAHs were detected at low levels, below the New Jersey Soil Cleanup Criteria (NJSCC). Maximum VOCs totaled 95.5 mg/kg and included chloroethene, benzene, and toluene. Total petroleum hydrocarbons (TPH) were detected at a maximum concentration of 17,600 mg/kg. Metals, including cadmium (64.6 mg/kg), lead (3,640 mg/kg) and zinc (5,720 mg/kg), were also detected in the soil.

Groundwater samples indicated levels of chlorinated solvents, including 1,2-DCE, tetrachloroethene (PCE), and TCE above the New Jersey Groundwater Quality Standards (NJGWQS). 1,2-DCE was detected at 2.2 ug/L, PCE at 4.6 ug/L, and TCE at 160 ug/L.

No other information detailing environmental contamination was reviewed for this property. While this site may have the potential to contribute VOCs, SVOCs, TPH and metals to the Bound Brook Corridor, it is not considered a significant contributor of organochlorine compounds.

Eco Pump Corporation, 2387 South Clinton Avenue, South Plainfield, NJ

Soils contaminated with VOCs were removed in 1987, under the NJDEP Bureau of Industrial Site Evaluation. A remedial cleanup plan, dated September 1990 addressed contamination caused by former machining operations. The property was used to manufacture liquid transfer pumps and the use of cutting oils and solvents was common. In 1993, groundwater treatment by a pump and treat system has been in operation since February 2002.

A groundwater plume consisting of VOCs, including benzene, toluene, ethyl benzene, and xylene (BTEX) and chlorinated solvents (including carbon tetrachloride, 1,1-DCE, 1-2, DCE, MTBE, TCE, and vinyl chloride) was identified. During early investigation activities, TCE was detected at 370,000 ug/L and 1-2, DCE at 7,200 ug/L. BTEX has been detected at high concentrations in the more recent groundwater sampling activities. Benzene was detected at 1,531 ug/L, toluene at 13,006 ug/L, ethylbenzene at 8,020 ug/l and xylene at 21,402 ug/L.

No other information detailing environmental contamination was reviewed for this property. While this site may have the potential to contribute VOCs to the Bound Brook Corridor, it is not considered a significant contributor of organochlorine compounds.

Hmieleski Trucking, 108 New Era Drive, South Plainfield, NJ

An RI Report dated February 2000 and a RAWP dated March 2003 was reviewed.

Soil contamination was detected at the location of several diesel, gasoline and waste oil USTs. Soil samples from the UST areas indicated BTEX and PCE exceeded the NJSCC. Soil borings collected from the oil-water separators identified chromium exceeding the NJSCC and elevated TPH levels at the discharge pipe. A waste trench and fill material on the property were found to be contaminated with beryllium and/or chromium in excess of the NJSCC. Samples also indicated elevated levels of TPH. Groundwater samples near the former USTs and oil-water separators indicated BTEX and MTBE were above the NJGWQS.

No other information detailing environmental contamination was reviewed for this property. While this site may have the potential to contribute VOCs, TPH, and metals to the Bound Brook Corridor, it is not considered a significant contributor of organochlorine compounds.

Crown Bullion and Refining Co. (Aka Non-Ferrous Metals), 304 Pulaski Street, South Plainfield, NJ

An RI Report dated October 2001 was reviewed. The report details 16 AOCs which include underground storage tanks (USTs), above ground storage tanks (ASTs), piping, chemical and waste storage, transformer/capacitors, smelting furnaces, laboratories, lagoons, and material loading areas. Historically, the property was used by a variety of companies that refined and recycled precious metals.

Metals, TPH, and PAHs were detected in soil in excess of the NJSCC. Silver was detected at 779 mg/kg, copper at 5,110 mg/kg, and cadmium at 254 mg/kg. TPH was detected at 123,000 mg/kg. PCBs were also detected in soil at 2.8 mg/kg. Several contaminants detected in groundwater were in excess of the NJGWQS. Elevated concentrations of metals were as follows: arsenic (1,020 ug/L); chromium (1,030 ug/L); copper (38,000 ug/L); mercury (15.7 ug/L); nickel (1,120 ug/L); selenium (612 ug/L); lead (7,350 ug/L); zinc (8,140 ug/L); cadmium (3,590 ug/L); and antimony (769 ug/L). Concentrations of VOCs were: benzene (33 ug/L) TCE (1.3 ug/L), PCE (1.4 ug/L) and xylene (89 ug/L).

No other information detailing environmental contamination was reviewed for this property. While this site may have the potential to contribute PAHs and metals to the Bound Brook Corridor, it may be considered a contributor of organochlorine compounds.

United Steel Deck, 14 Harmich Road, S. Plainfield, NJ

The property was used to fabricate steel decking for use in building construction by United Steel. Multiple AOCs were identified with being associated with the manufacturing process by the NJDEP. An RI report was prepared in October 2005 for the multiple AOCs identified.

Eight groundwater monitoring wells were sampled at the property. VOCs detected in the groundwater were benzene at 3.1 ug/L and chlorobenzene at 83.0 ug/L, both at levels above the NJGWQS. No SVOCs were detected in exceedance of the NJGWQS.

Several metals were detected in the groundwater above the NJGWQS, including arsenic, aluminum, cadmium, iron, lead, manganese, and sodium. Arsenic concentrations were detected at a maximum of 28.2 ug/L. Cadmium contamination was detected at a maximum of 60.7 ug/L, and lead at 26.6 ug/L. Historically, cadmium and lead have not been detected above NJSCC values in soil samples.

No other information detailing environmental contamination was reviewed for this property. While this site may have the potential to contribute metals to the Bound Brook Corridor, it is not considered a significant contributor of organochlorine compounds.

Chevron Chemical Company, LLC (Also Adjacent Abramson Property), Former Ortho Products Facility, South Plainfield, NJ

This property was used to formulate and package liquid and solid pesticides, herbicides, fungicides, and fertilizers. Formulating and packing operations were conducted on the property from 1952 through 1985. In 1985, the formulation and packing operations ceased, and the property was used solely as a warehouse.

- *Preliminary Assessment for RCRA Corrective Action Program, Chevron Chemical Co, Ortho Division, South Plainfield, New Jersey, dated November 1985, prepared by the Division of Waste Management, Bureau of Hazardous Waste Planning and Classification, USEPA*

The Preliminary Assessment stated eight solid waste management units were identified at the Chevron facility. The assessment also identified several AOCs. Buried disposal sites were noted to contain arsenic and the pesticides DDT, DDD, dieldrin, and chlordane. Impacts to groundwater from benzene and xylene were also noted. Elevated levels of chlordane and toxaphene were reported in the railroad loading area soils. Soil and groundwater samples were found to contain chlordane, hexachlorobenzene, DDT, DDD, xylene and other organic chemicals.

- *A Site Inspection Report dated March 21, 1990 prepared by NUS Corporation for the Environmental Services Division, United States Environmental Protection Agency (USEPA)*

A Site Inspection Report was prepared to address potential release of hazardous materials. Hazardous waste waters were generated by washing down blending and formulating tanks with water and occasionally solvents. The waste water contained dilute methoxychlor, lindane, arsenic, and toxaphene. These wastes were drummed for off site disposal. An unlined disposal pond was filled in the early 1970s. Prior to that, the disposal pond received runoff from the drum storage area and storage tank area via a drainage ditch.

An abandoned septic leach field was reportedly used for sanitary waste disposal from the property. Low levels of pesticides were detected in the soil of the abandoned leach field. An incinerator was reportedly used for the burning of garbage and cardboard, but analysis indicated high levels of pesticides in samples collected at the former incinerator.

Soil samples collected from the property for the period of 1979 to 1989 indicated the presence numerous contaminants. Maximum concentrations of the following contaminants were detected in the soil: arsenic (29 mg/kg); cadmium (0.9 mg/kg); copper (25 mg/kg); barium (116 mg/kg); lead (159 mg/kg); mercury (25 mg/kg); zinc (156 mg/kg); chlordane (5,900 mg/kg); lindane (38.8 mg/kg); hexachlorobenzene (3.5 mg/kg); 4,4'-DDE (140 mg/kg); DDD (417 mg/kg); DDT (920 mg/kg); toxaphene (50,650 mg/kg); benzene (0.055 mg/kg); chlorobenzene (14.5 mg/kg); ethylbenzene (106 mg/kg); and xylene (555 mg/kg).

Groundwater samples collected from 1979 through March 1987 indicated the presence of various organic and inorganic contaminants. Concentrations of the following contaminants were detected in the groundwater samples: arsenic (200 ug/L); copper; pentachlorophenol (23 ug/L); lindane (6

ug/L); benzene (53.1 ug/L), ethylbenzene (8.96 ug/L); and toluene (8.48 ug/L). Isophorone, carbon tetrachloride, and dieldrin were also detected in the groundwater. Drainage ditches on the property flow directly into an unnamed tributary of Bound Brook. This tributary, located approximately 1,200 feet southeast of the property, flows west into the channel of Bound Brook.

- *Final Report Assessment of Storm Water Runoff Data and Potential Environmental And Human Health Effects from Chevron Chemical Company's South Plainfield, New Jersey, Facility, dated December 1983, prepared by Versar Inc.*

Storm water runoff samples were collected during two storm episodes in 1983. All detections occurred at locations either exiting or downstream of the Chevron property. Arsenic and copper were detected at concentrations of 44 ug/L and 31 ug/L, respectively. Benzene and 1,1-DCE were detected at concentrations of 4 ug/L and 6 ug/L, respectively. Chlordane and pramitol were detected at 110 ug/L and 22 ug/L. Pramitol was noted at high concentrations (570 ug/L) at an upstream location.

- *Supplemental Remedial Investigation Report Addendum, dated July 2003, prepared by Blasland, Bouck & Lee, Inc..*

The Supplemental RI Report was prepared to present additional soil and groundwater investigation results from the former Chevron property. The investigation activities were performed to delineate chlordane in soils, and determine the presence of potential NAPL in subsurface soil in the vicinity of former source areas.

Horizontal delineation indicated chlordane contamination was present at concentrations slightly above the NJSCC past the property boundaries. Depths of contamination ranged from 6.5 to 24 feet bgs. Chlordane (17 mg/kg), dieldrin (0.39 mg/kg), and heptachlor (0.43 mg/kg) were detected in the vertical delineation soil samples.

The NAPL investigation determined no VOCs and SVOCs were detected above the Residential Direct Contact NJSCC for the soil. Ethylbenzene, xylene, 1,2,4-trichlorobenzene, naphthalene, and hexachlorobutadiene were the only compounds with detectable levels.

Passive groundwater sampling in the suspected NAPL areas indicated several VOCs (1,1,2-TCE, benzene, chlorobenzene, ethylbenzene, and xylene) were at concentrations above NJGWQS. Also, concentrations of pesticides (BHC, chlordane, DDD, DDE, dieldrin, endosulfan I, and endrin) were above the NJGWQS.

No other information detailing environmental contamination was reviewed for this property. Results of the file review identified this site as a potential source of organochlorine compounds, in the form of organochlorine pesticides, VOCs, metals and arsenical-based herbicides, to the Bound Brook Corridor.

Gasoline/Fuel Underground Storage Tank Sites

Several properties within or adjacent to the Bound Brook Corridor were found to have been contaminated by underground storage tanks (USTs) containing gasoline or other petroleum fuels. The site name, address and corresponding reference document(s) that were reviewed are listed below.

Perry Technology, Inc. (Aka. A.J. Maglio, Inc.)

1253 New Market Street, South Plainfield, NJ

Remedial Investigation Report, Bell Environmental Consultants, Inc., March 1995.

Consolidated Freightways (formerly Central Transport International Inc.)

105 New Era Drive, South Plainfield, NJ

Remedial Action Work Plan, Leggette, Brashears, & Graham, Inc., June 2001.

Remedial Investigation Work Plan, Viridian Environmental Consultants, April 2005.

Hall's Fast Motor Freight, Inc. (Aka S&M Waste Oil, Inc.)

330 Oak Tree Avenue, South Plainfield, NJ

Remedial Investigation Report, A. Cameron, PG, June 5, 1995.

Former Shell Station (Owned/leased by Motiva Enterprises LLC)

90 Maple Avenue, South Plainfield, NJ

Correspondence between the NJDEP and Shell Oil Company dated April 10, 1997, regarding tank removal activities in December 1992.

South Plainfield Municipal Building

2480 Plainfield Avenue, S. Plainfield, NJ

Remedial Action Work Plan, PMK Group, January 1997.

Former Snyder Foundation Property

4201 Kennedy Road, South Plainfield, NJ

Remedial Investigation Report/Remedial Action Work Plan , Environmental Liability Management, Inc., June 1997.

Tank closure and/or removal activities have been documented at these sites. Identified contaminants within the soil and groundwater consisted mainly of VOCs, SVOCs, TPH and some metals (primarily lead). While these properties may have the potential to contribute limited VOCs, SVOCs, metals and TPH to the Bound Brook Corridor, they are not considered a significant contributor of organochlorine compounds.

The following table identifies details information on the USTs and contaminants that were present at each site in the soil and groundwater.

Site Name	Tank Information	Contaminants Above NJ Criteria	
		Soil (NJSCC)	Groundwater (NJGWQS)
Perry Technology, Inc.	Two (2) gasoline USTs	xylene	benzene, xylene, and methyl-tert butyl ether (MTBE)
Consolidated Freightways	One (1) 10,000-gallon gasoline/diesel UST	TPH	benzene, ethylbenzene, xylene, acenaphthene, fluorene, naphthalene, bis (2-ethylhexyl) phthalate
Hall's Fast Motor Freight, Inc.	One (1) 2,000-gallon #2 fuel oil UST, one (1) 4,000-gallon gasoline UST, two (2) 6,000-gallon gasoline UST, one (1) 10,000 gallon #2 fuel oil UST	lead, TPH	benzene, MTBE
Former Shell Station	Gasoline UST tank field, waste oil tank field	none	benzene, ethylbenzene, toluene, xylene, MTBE
South Plainfield Municipal Building	Two (2) gasoline/fuel USTs	none known	benzene, ethylbenzene, toluene, xylene, MTBE
Former Snyder Foundation Property	Two (2) diesel USTs, one (1) gasoline UST	none	benzene

3.1.3 Other Potential Sources

During the NJDEP file review, two separate reports referenced a suspected former landfill located in the floodplain at the confluence of Cedar Brook and Bound Brook. No file records of such a landfill in this area were located during the file search, and, therefore, no details regarding the history or exact location of this landfill are available.

Storm related discharge from the developed properties within the Bound Brook Corridor is conveyed via a common storm sewer system which directs this runoff to discharge outlets located on Bound Brook. Non-point source pollution from diffuse sources in developed areas, as well as potential illegal dumping of oil or other waste materials down the storm drains, may also contribute to the pollutant load to Bound Brook.

An active Conrail railroad right-of-way currently runs parallel to the Bound Brook section of the Bound Brook Corridor. The use of wood preserving chemicals such as creosote in the ties along the track, and the possible historical use of oil for dust control, may contribute contaminants to the soils and sediments of the floodplains, wetlands and Bound Brook.

Review of Sanborn maps did reveal the presence of several properties with industrial histories within the corridor area. Sanborn coverage was available only for the Dunellen section of OU4. Sanborn maps were reviewed from 1919 (1 map sheet), 1927 (2 map sheets), and 1947 (2 map sheets). The majority of the area covered by the maps was residential. There were several companies called by different names throughout the years, located along the Bound Brook, including:

- National Cooperage and Products (1919);
- New Market Supply Coal and Feed (1919); C.E. Kelly Company Coal and Feed (1927);
- E.C. Kelly Company Hay, Grain, and Feed (1919); C.E. Kelly Company Hay, Grain, and Feed (1927);
- New Market Roller Mills (1919); Middlesex Milling Company Rolling Mill (1927 and 1947); and
- Pure Asphalt Products Company (1927); G.S. Ziegler and Company (1947).

The cooperage and hay, grain, and feed companies most likely would not provide any threat of chemical contamination to the Bound Brook. Coal was stored in bins with nearby railroad access at the Coal and Feed facility. The roller mill facility likely dealt with metals. The asphalt company produced red battery wax, sewer seal, pitch, and asphalt.

3.2 Types of Contamination

3.2.1 Sediments

In June 1997, Weston sampled sediments in Bound Brook from 13 areas (A1 to A7, A9 to A14) as part of Phase II and III investigations. The ranges of concentrations for VOCs, SVOCs, pesticides, PCBs, and metals detected in sediment samples are as follows:

- VOCs: 0.001 mg/kg to 7.7 mg/kg
- SVOCs: 0.02 mg/kg to 170 mg/kg
- Pesticides: 0.01 mg/kg to 0.07 mg/kg
- PCBs: 0.03 mg/kg to 600 mg/kg
- Metals: 0.04 mg/kg to 25,000 mg/kg

In 1997 and 1998, Weston sampled the sediments of Bound Brook upstream, midstream and downstream of the facility for PCBs. One hundred transects along Bound Brook were sampled, as well as four transects downstream of the New Market Pond Spillway. The 104 transects were split into 9 reaches of the Bound Brook (Figure 3-1). The sediment samples were collected from the middle of the streambed of Bound Brook from two depth intervals, 0 to 6 inches and 18 to 24 inches (Weston, 1998).

A total of 181 sediment samples were collected from the 9 reaches along the center of Bound Brook. Aroclor 1016, Aroclor 1221, Aroclor 1232, and Aroclor 1242 were not detected in any of the sediment samples from Bound Brook. Forty samples did not have detections of PCBs. Total PCBs ranged as follows for each of the nine reaches:

- Reach 1: 0.17 mg/kg to 0.32 mg/kg
- Reach 2: 0.065 mg/kg to 22 mg/kg
- Reach 3: 0.082 mg/kg to 21 mg/kg
- Reach 4: 0.097 mg/kg to 1.6 mg/kg

- Reach 5: 0.52 mg/kg to 39 mg/kg
- Reach 6: 0.10 mg/kg to 13.6 mg/kg
- Reach 7: 0.011 mg/kg to 25 mg/kg
- Reach 8: 0.059 mg/kg to 22 mg/kg
- Reach 9: 0.047 mg/kg to 0.12 mg/kg

Sediment samples from Spring Lake, along Cedar Brook from Plainfield High School to the lake, and a feeder stream from Maple Avenue to Cedar Brook were collected in April 1999 by NJDEP. The samples were analyzed for pesticides and PCBs. No PCBs were detected in the sediment samples. Eight pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, gamma-chlordane, dieldrin, endrin aldehyde, and heptachlor epoxide) were detected in at least one of the 36 sediment samples. Concentrations ranged from 0.0057 mg/kg (4,4'-DDD; SL-1 at 0-6 inches) to 0.69 mg/kg (4,4'-DDT; SL-3 at 0-6 inches) (NJDEP, 1999).

In June 1999, Weston collected 6 sediment samples from two different areas, A2 and A4, and analyzed them for PCBs. Aroclor 1254 was detected in 5 of the sediment samples, with concentrations ranging from 0.055 mg/kg (A4-20) to 0.58 J mg/kg (A2-19). No other PCBs were detected (Weston, 2000).

During the 2000 RI, sediment samples were collected from the facility storm drainage system. Ranges of concentrations for each parameter group are as follows:

- VOCs: 0.003 mg/kg to 0.070 mg/kg
- SVOCs: 0.15 ug/kg to 11 mg/kg
- Pesticides: 0.058 mg/kg to 33 mg/kg
- PCBs: 31 mg/kg to 210 mg/kg
- Metals and Cyanide: 0.14 mg/kg to 122,000 mg/kg

3.2.2 Surface Water and Perched Water

Eight surface water samples were collected in June 1997 from Bound Brook by Weston. Five VOCs (1,1,2,2-tetrachloroethane, cis-1,2-DCE, trans-1,2-DCE, MTBE, and TCE) and three SVOCs (diethyl phthalate, di-n-butyl phthalate, and bis(2-ethylhexyl) phthalate) were detected in at least one of the surface water samples. Four of the eight surface water samples did not have detections of VOCs or SVOCs. One sample, AQ6, had detections of all VOCs and SVOCs, except MTBE, with concentrations ranging from 1 J ug/l (trans-1,2-DCE, diethyl phthalate, di-n-butyl phthalate, and bis(2-ethylhexyl) phthalate) to 4 J ug/l (TCE). Surface water sample AQ5 had four detections of volatile organic compounds (1,1,2,2-tetrachloroethane, cis-1,2-DCE, trans-1,2-DCE, and TCE) ranging in concentration from 1.1 J ug/l (trans-1,2-dichloroethene) to 5.2 ug/l (TCE). MTBE was detected only in surface water samples AQ1 and AQ9 (1.7 J ug/l and 1 J ug/l, respectively).

Fourteen inorganic compounds (aluminum, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc) were detected in at least one of the filtered or unfiltered surface water samples. Concentrations ranged from 1 ug/l (nickel);

AQ5 and AQ7) to 86,000 ug/l (calcium; AQ2). Aluminum, barium, calcium, iron, magnesium, manganese, potassium, sodium, vanadium, and zinc are common constituents of surface water and are present in most, if not all, of the surface water samples. Chromium, copper, lead and nickel were detected at concentrations ranging from 1 ug/l (nickel; AQ5 and AQ7) to 30 ug/l (nickel; AQ9).

Perched water samples were collected from the facility storm drainage system during the 2000 RI. Concentrations of the various parameter groups are as follows:

- VOCs: 0.3 ug/L to 27 ug/L
- SVOCs: 10 ug/L of bis(2-ethylhexyl)phthalate at DS01
- Pesticides: 0.012 ug/L to 0.036 ug/L
- PCBs: 0.13 ug/L to 13.7 ug/L
- Metals and Cyanide: 0.14 ug/L to 72,700 ug/L

3.2.3 Floodplain Soils

In June 1997, Weston performed a Phase II investigation on the Bound Brook area and collected floodplain soil samples from four different areas (Weston, 1998). VOCs, SVOCs, pesticides, PCBs, and metals were detected in the samples. Ranges of concentrations for each parameter group are as follows:

- VOCs: 0.003 mg/kg to 3.2 mg/kg
- SVOCs: 0.13 mg/kg to 180 mg/kg
- Pesticides: 0.02 mg/kg to 0.034 mg/kg
- PCBs: 1 mg/kg to 580 mg/kg
- Metals: 0.059 mg/kg to 97,000 mg/kg

Weston sampled 100 transects along Bound Brook and four transects downstream of the New Market Pond Spillway in 1997 and 1998. As described in Section 3.2.1, the transects were grouped into 9 reaches. The floodplain soil samples were collected 5 feet and 10 feet from where the stream met the bank on each side of Bound Brook from two depth intervals, 0-6 inches and 18-24 inches (Weston, 1998).

A total of 418 samples were collected from the north bank and 397 samples were collected from the south bank. Seventy-nine samples along the north bank and 81 samples along the south bank did not have detections of PCBs. Concentrations for each of the nine reaches ranged as follows for the north bank:

- Reach 1: 0.062 mg/kg to 6.7 mg/kg
- Reach 2: 0.11 mg/kg to 8.1 mg/kg
- Reach 3: 0.41 mg/kg to 39 mg/kg
- Reach 4: 0.45 mg/kg to 4.6 mg/kg
- Reach 5: 0.031 mg/kg to 180 mg/kg
- Reach 6: 0.32 mg/kg to 470 mg/kg

- Reach 7: 0.0062 mg/kg to 28 mg/kg
- Reach 8: 0.032 mg/kg to 15 mg/kg
- Reach 9: 0.049 mg/kg to 0.2 mg/kg

Concentrations for each of the nine reaches ranged as follows for the south bank:

- Reach 1: 0.067 mg/kg to 85 mg/kg
- Reach 2: 0.12 mg/kg to 27 mg/kg
- Reach 3: 0.14 mg/kg to 830 mg/kg
- Reach 4: 0.39 mg/kg to 250 mg/kg
- Reach 5: 0.0098 mg/kg to 110 mg/kg
- Reach 6: 0.104 mg/kg to 220 mg/kg
- Reach 7: 0.079 mg/kg to 24 mg/kg
- Reach 8: 0.18 mg/kg to 7.1 mg/kg
- Reach 9: 0.051 mg/kg to 0.17 mg/kg

Ninety-two floodplain soil samples were collected in June 1999 by Weston from four areas (A1 to A4) and analyzed for PCBs (Weston, 1999a). Thirty-two samples were collected from area A1. One sample (A1-14) had a detection of Aroclor 1248 at a concentration of 0.21 mg/kg and 31 samples had concentrations of Aroclor 1254 ranging from 0.082 mg/kg (A1-5) to 25 mg/kg (A1-26). Sixteen samples were collected from area A2 and all of the samples had detections of Aroclor 1254, with concentrations ranging from 0.095 mg/kg (A2-4) to 2 mg/kg (A2-17). Samples were collected from area A3 at 26 locations and all of the samples were found with concentrations of Aroclor 1254, ranging from 2.5 mg/kg (A3-21) to 7.5 mg/kg (A3-14). Area A4 was sampled at 18 locations. Thirteen of the samples had concentrations of Aroclor 1254 ranging from 0.04 mg/kg (A4-19) to 0.21 mg/kg (A4-15).

Floodplain soils were collected from three residential properties in July 2000 as part of the OU1 RI (FWENC, 2001a). The samples were analyzed for PCBs. Seven samples out of 146 were found with Aroclor 1254, with concentrations ranging from 25 ug/kg (RS32-34 at 0-2 inches bgs) to 710 ug/kg (RS31-40 at 0-2 inches bgs and RS33-31 at 0-2 inches bgs). Aroclor 1260 was found in four samples, ranging in concentration from 9.8 ug/kg (RS33-14 at 0-2 inches bgs) to 340 ug/kg (RS31-68 at 0-2 inches bgs).

In September 2000, floodplain soil samples were collected as part of the OU2 RI (FWENC, 2002). Six samples were collected from 0 to 6 inches (SS01 to SS06) and a sample from 6 to 12 inches was collected at SS06. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, PCB congeners, dioxins/furans, and inorganics. Concentrations ranged as follows:

- VOCs: 0.002 mg/kg to 22 mg/kg
- SVOCs: 0.049 mg/kg to 21 mg/kg
- Pesticides: 0.13 mg/kg to 1200 mg/kg
- PCBs: 0.43 mg/kg to 19,000 mg/kg
- PCB Congeners: 0.00065 mg/kg to 6 mg/kg

- Dioxins/Furans: 1.3 pg/g to 14,420 pg/g
- Inorganics: 0.19 mg/kg to 47,700 mg/kg

3.2.4 Biota

During the Phase II and Phase III investigations, biota was collected and analyzed (USEPA, 1999). Crayfish, forage fish, and small mammals were collected during Phase II, while edible fish were collected during Phases II and III. Aquatic biota (i.e., crayfish, forage fish, and edible fish) were sampled from multiple locations from Bound Brook (Figure 3-2).

3.2.4.1 *Crayfish*

Crayfish were collected from six locations in Bound Brook adjacent to, downstream of, and upstream (reference area) of the former Cornell-Dubilier Electronics facility property. The crayfish were analyzed for SVOCs, pesticides, PCBs, and Target Analyte List (TAL) metals. Four SVOCs (bis(2-ethylhexyl)phthalate, di-n-butylphthalate, diethylphthalate, and isophorone) were detected in crayfish ranging in concentrations from 0.25 mg/kg (bis(2-ethylhexyl)phthalate; A9-3) to 1.9 mg/kg (di-n-butylphthalate; A3-13). No pesticides were detected in crayfish samples. Aroclor 1254 was the only PCB detected in the samples, with a concentration range of 0.4 mg/kg (A1-1) to 2.4 mg/kg (A2-3). Twenty TAL metals were detected in the crayfish samples. Concentrations ranged from 0.015 mg/kg (mercury; A4-4) to 49,000 mg/kg (calcium; A5-2).

3.2.4.2 *Fish*

Forage fish were collected from 6 locations and edible fish were collected from 10 locations. Both types of fish were analyzed for pesticides, PCBs and metals.

Forage Fish

No pesticides were detected in the forage fish. Aroclor 1254 was the only PCB detected in the forage fish samples, with concentrations ranging from 0.21 mg/kg (A9-PS-3) to 20 mg/kg (A2-PS-1). Twenty TAL metals were detected in the forage fish, ranging in concentration from 0.01 mg/kg (mercury; A4-PS-1) to 24,000 mg/kg (calcium; A6-PS-6).

Edible Fish

Nine pesticides (alpha-chlordane, gamma-chlordane, 4,4'-DDD, 4,4'-DDE, dieldrin, endrin, endrin aldehyde, heptachlor epoxide, and methoxychlor) were detected in the edible fish samples from Phases II and III. Concentrations ranged from 0.001 mg/kg (heptachlor epoxide; A9-CC-1) to 0.3 mg/kg (alpha-chlordane; A1-CC-1). Aroclor 1248 and Aroclor 1254 were detected in the edible fish samples from Phases II and III. They ranged in concentration from 0.02 mg/kg (Aroclor 1248 in numerous samples) to 42 mg/kg (Aroclor 1254; CC-A12-1). Twenty TAL metals were detected in the edible fish samples from Phases II and III, ranging in concentration from 0.03 mg/kg (mercury; A1-CC-1) to 6,800 mg/kg (calcium; PS-A14-2).

3.2.4.3 Mammals

Small mammals were collected from 4 locations (T1 to T4) (Figure 3-3). T1 to T3 were adjacent or downgradient of the former Cornell-Dubilier Electronics facility property and T4 was a reference station upgradient. The mammals were analyzed for pesticides and PCBs. Three pesticides, 4,4'-DDE, dieldrin, and heptachlor epoxide, were detected in the mammal samples. Concentrations of the pesticides ranged from 0.01 mg/kg (dieldrin; T1-14-6, T2-2-7, and T2-12-8) to 0.07 mg/kg (heptachlor epoxide; T4-1-27). Aroclor 1254 was the only PCB detected in the mammal samples, ranging in concentration from 0.15 mg/kg (T3-3-15) to 5.4 mg/kg (T1-14-10).

3.3 Fate of Contaminants

The fate of contaminants in the environment varies widely due to both compound or element chemistries and the environmental characteristics to which they may be released. This fate discussion focuses on the chemical fate of the contaminants of interest specifically.

3.3.1 Polychlorinated Biphenyls

PCBs are highly persistent chemicals which strongly adsorb to soils, sediments, and organic matter, and sorption is likely the dominant environmental process affecting the fate of PCBs for OU4. The fate of PCBs within surface water would be dominated by sorption to the underlying sediments with transport within streams/rivers being primarily a physically based process mediated via sediment bed load transport mechanisms (i.e., erosion/deposition processes). The relatively low water solubility of these chemical compounds indicates that, although transport in the water column of dissolved and particulate phase PCBs in surface waters may occur to a very limited extent, water transport could still be a contributing mechanism affecting the fate of PCBs. Volatilization can occur, and it would primarily involve the lesser chlorinated PCBs. The processes of photolysis, hydrolysis, oxidation, and biodegradation are insignificant factors in determining the fate of these compounds. Bioaccumulation is an extremely important environmental fate process for site-related PCBs in aquatic organisms, and terrestrial plants and organisms.

3.3.2 Polychlorinated Dioxins/Furans

Sharing similar characteristics as to those for PCBs, dioxins/furans are very persistent in the environment due to low aqueous solubility, volatility, and reactivity (i.e., susceptibility to photolysis, hydrolysis and oxidation), high resistance to microbial degradation, high sorptive affinity to clays and organic matter, and high bioaccumulation potential.

3.3.3 Volatile Organic Compounds

VOCs are in general not very persistent in the environment, principally due to their high volatility, low adsorption to soils, inability to substantially bioaccumulate, and high water solubility. These attributes make VOCs highly mobile in environmental matrices.

3.3.4 Pesticides

Pesticides are typically highly persistent chemicals which strongly adsorb to soils, sediments, and organic matter. As such, soils and/or sediments typically serve as sinks for pesticide residuals. The relatively low water solubility of pesticides indicates surface water and/or groundwater transport is a likely mechanism affecting the fate of the more water soluble pesticides such as the BHC isomers, but not as important a mechanism for compounds with more reduced aqueous solubilities such as DDE and DDT. However, transport of particles to which strongly sorbed pesticides adhere may occur, which would increase the importance of this mechanism in surface water and groundwater. Very limited volatilization is expected, and the processes of photolysis, hydrolysis, oxidation, and biodegradation are not likely to be major factors in determining the fate of these compounds. Bioaccumulation within terrestrial and aquatic organisms, particularly fish, will be of major importance due to the strong tendency for pesticides to substantially bioaccumulate.

3.3.5 Semi-Volatile Organic Compounds - Polycyclic Aromatic Hydrocarbons

The predominant SVOCs detected were PAHs. PAHs are classified as SVOCs as a group but are very prevalent in anthropogenic pollutant sources. PAHs are relatively persistent in soil/sediment matrices, due primarily to low water solubility (the higher the degree of aromaticity, the lower the water solubility), high resistance to photolytic, oxidative, and hydrolytic degradation, and high affinity for organic matter and soil particles. As indicated for PCBs and pesticides, surface water transport of particles to which strongly sorbed PAHs adhere may occur, as may transport of dissolved PAHs in the water column (i.e., those with higher water solubilities, such as naphthalene) to a limited extent. Bioaccumulation of PAHs is generally a transitory process, since most PAHs with less than five rings are readily metabolized by higher organisms.

3.3.6 Metals

In general, the metals of potential concern including copper, lead, selenium, and zinc associated with OU4 are persistent and of limited mobility within environmental matrices under normal environmental conditions. This persistence is primarily related to recycling mechanisms within environmental matrices for some metals (e.g., arsenic, copper, lead, and mercury), and removal mechanisms (precipitation, cationic exchange, adsorption, etc.) which decrease mobility. Chemical speciation of metals in the environment results in metals in both solid and aqueous media. However, the fate reactions and behavior of these metals under site geochemical conditions may lead to an increase or decrease in their concentrations in specific matrices. With respect to the inorganic contaminants on the facility, the geochemical conditions favor leaching from the contaminated soil into surface stormwater runoff.

4.0 PATHWAYS AND CONTAMINANT MIGRATION

Contaminants may migrate from a source area via a variety of mechanisms. The importance of a specific mechanism is controlled by the specific physical, geochemical, climatic, and hydrologic conditions at a given area, as well as by the physicochemical characteristics of the contaminated media. Potential sources of contamination were discussed in Section 3.1, and this section focuses on the potential pathways for the transport of contaminants of concern into and within the Bound Brook from the former Cornell-Dubilier Electronics facility and other known sites/sources. The potential pathways include:

- Direct disposal of contaminated materials in the Bound Brook and/or adjacent environs;
- Migration of contaminants within surface runoff (storm water/suspended soil particulates);
- Migration of contaminants within facility drainage systems;
- Migration of contaminants from groundwater to surface water (groundwater recharge);
- Migration of contaminants within surface water and sediments;
- Migration of contaminants into biota; and
- Migration of contaminants into air.

4.1 Direct Disposal of Contaminated Materials

During the 2000 RI, a partially buried capacitor was observed in a wetland area along Bound Brook, indicating improper disposal practices were employed during historic operations at the facility, and potentially this activity could occur at other contaminated sites (within the Bound Brook Corridor). Chemicals present within the disposed materials may leach into the surrounding environment by the percolation of rain and/or gravity, and then be transported into Bound Brook by surface runoff or transitory events which “flood” the adjacent wetlands. This may then cause contaminants to become solubilized and spread laterally to uncontaminated areas by adsorption or residuals remaining when the ponded water recedes and/or percolates into the soil. Depending on the flow of the water during these “flood” events, transport of contaminants adsorbed onto entrained soil particles may also occur.

4.2 Migration of Contaminants within Surface Runoff

During storm events, contaminants present in the upper soil layers may become solubilized in the storm water and be transported via preferential runoff routes. In addition, if the stormwater runoff flow is sufficient, contaminated soil particulates may be entrained in the surface runoff and be transported from facility areas and potentially other similar sites that are not paved and/or vegetated. Depending on the topography of the specific property, surface runoff may flow towards the Bound Brook.

For the facility, there exists in the eastern portion of the property one man-made surface water drainage ditch (designed and constructed pursuant to the site stabilization order of 1997) that directs stormwater surface runoff from the facility to the wetland area adjacent to Bound Brook. In addition, the property's topography drops steeply in the northeast and southeast portions, and these areas consist primarily of wetland areas bordering Bound Brook. Elevations range from approximately 71 feet above msl at the top of the bank to approximately 60 feet above msl along Bound Brook.

Gravitational forces have constructed several other natural overland drainage ditches/preferential stormwater routes leading from the facility property to Bound Brook/adjacent wetlands or unnamed tributaries thereof.

Previous sampling data substantiate the above transport scenario as numerous contaminants related to the former facility were detected adjacent to and downstream of the facility in unnamed tributaries, Bound Brook, and/or New Market Pond (i.e., PCBs, VOCs, SVOCs, pesticides, and metals). Contaminants that exhibit high affinities to soil particles/organic matter (i.e., PCBs, pesticides, and to a limited extent, some PAHs and metals) are present at elevated concentrations in the sediments of Bound Brook (e.g., PCBs up to 520 mg/kg).

4.3 Migration of Contaminants within Facility Drainage Systems

In addition to, or instead of, drainage ditches to carry transitory surface water, developed properties may have a system of catch basins and storm sewer lines. Contaminants may, during storm events, become solubilized and/or entrained (if adsorbed onto soil particles and the flow is sufficient) in the surface runoff from underlying contaminated soil and transported via these drainage pathways. The destination for the discharge from these lines may or may not be known, and may include Bound Brook, unnamed tributaries, and/or other surface water bodies (Spring Lake, New Market Pond). Deposition within the storm sewer conduits may also occur, and contaminant residuals, if present within the sediments in the pipes, would serve as a continuing source of contamination.

Numerous catch basins/storm sewer lines form a drainage system for the developed portion of the facility. During the 2000 RI, it was discovered an open hole/former floor drain in Building No. 13 is connected to the large catch basin between Building No. 13 and the site's northeast fenceline, which discharges to an outfall in Bound Brook near the railroad bridge. In addition, this investigation indicated the catch basin southwest of Building No. 14 is connected to the catch basin on the southeast side of Building No. 14, and subsequently connected to an outfall location, which flows into an unnamed tributary to Bound Brook, near the boundary of the wetlands area.

During the 2000 RI, sampling of the drainage system substantiated the above contaminant transport scenario as numerous site-related contaminants were detected (i.e., PCBs, VOCs, and metals in the drainage system water; PCBs [up to 140 mg/kg], VOCs, PAHs, pesticides, and metals in the drainage system sediments) and in the unnamed tributary and Bound Brook (i.e., PCBs, VOCs, SVOCs, pesticides, and metals) adjacent to and downstream of the facility. Additionally, VOCs, PCBs, pesticides, and metals were detected in the water column of these systems/waterbodies. Although contaminated surface water is involved, the sediments within these conduits serve as the primary sinks for site-related contaminants migrating off the facility, particularly within the drainage system, to the unnamed tributary and Bound Brook.

4.4 Migration of Contaminants from Groundwater to Surface Water

Groundwater that may become contaminated beneath a site as a result of overlying contaminated soil and/or buried material or other suspected potential source(s) may migrate through the subsurface aquifer, thereby spreading and dispersing the contaminants. Migration of contaminants in groundwater is controlled by two processes: advection and dispersion. Advection is the process by which dissolved contaminants are transported by the bulk motion of groundwater flow. Dispersion is the spreading of dissolved contaminants as they move with groundwater and results from two basic processes: molecular diffusion and mechanical mixing. Both advection and dispersion act on contaminants in solution. Contaminants associated with large soil particles generally are not transported by groundwater; however, some transport of very fine particles (i.e., very fine clay particles, colloids) may occur.

Depending on local hydrogeologic flow patterns, groundwater may discharge to a surface water body, or vice versa. Constituents present in the groundwater (dissolved and/or adsorbed to very fine particulates) could migrate within the groundwater and enter a surface water body through groundwater infiltration and recharge.

Based on results from groundwater sampling in 1999 and 2000 at the facility, contaminants that are migrating to and potentially within groundwater include VOCs, PCBs (likely due to co-solvent effects from the elevated levels of VOCs as PCBs typically have high adsorptive affinities which would restrict their movement into/within groundwater), and metals. During the 2000 RI, mapping of the upper bedrock potentiometric surface suggested a northwesterly flow, which is almost parallel to the portion of Bound Brook bordering the northeast side of the facility. In addition, as discussed in Section 2.4, preliminary investigation of the hydrogeology near the facility (2000 RI) indicates the Bound Brook may be recharging the upper bedrock aquifer and would, therefore, not represent a groundwater discharge point. However, the determination of Bound Brook as a “gaining” or “losing” stream is not definitive at this time, and additional study of the flow patterns of the groundwater, and the contaminants contained therein, will be performed as part of the OU3 investigation.

4.5 Migration of Contaminants within Surface Water and Sediments

Once in a surface water body (water and/or sediment), migration and transport of contaminants generally occurs in two ways: via transport of contaminated material in the sediment load and through transport of dissolved components. Sediment transport is controlled by physical processes and is dependent on the rate of flow, which determines the sediment load capacity of the water body. In more stagnant bodies of water (or more stagnant areas within a surface water body), contaminated sediments will accumulate without further significant transport. Increased flow rates increase the capacity to transport sediment away from sources (i.e., downstream). Points of deposition where sediments may accumulate are dependent on the river/stream system. In contrast to sediment transport, transport of dissolved components is a chemical process, generally controlled by the rate of release of the contaminant from the source, the solubility of the contaminant, and the rate of influx of a contaminated media (e.g., rate of groundwater discharge, rate of surface runoff into the water body). The amount of contaminant transported is a function of the equilibrium dissolution/precipitation conditions of both the constituent and the water system.

Sample results from the Bound Brook and neighboring water bodies (1997 through 2000) substantiate the significance and importance of the above contaminant transport scenario. Elevated concentrations are present primarily within the sediments and/or floodplain soils (i.e., PCBs, pesticides, VOCs, PAHs, and metals), and also in the water column (i.e., PCBs, VOCs, and metals), of Bound Brook and its associated water bodies (i.e., New Market Pond).

4.6 Migration of Contaminants Into Biota

Biota (aquatic and/or terrestrial plants or organisms) may accumulate contaminants directly through bioconcentration or indirectly by bioaccumulation through the food chain. The potential for bioaccumulation may be quantified by equilibrium bioconcentration factors (BCFs), which define the ratio of a chemical concentration in animal or plant tissue to the concentrations of the same chemical in the environmental media of contact. Organic chemicals with high BCFs (such as PCBs, dioxin, pesticides, etc.) are typically insoluble and lipophilic (non-polar) and, thus, tend to reside in animal fat tissue. Some heavy metals, notably mercury and silver, may also bioaccumulate.

Since edible fish fillet samples collected by EPA from Bound Brook adjacent to the facility property (August 1997) contained two PCBs and seven pesticides, and NJDEP has issued a final fish consumption advisory for all parts of Bound Brook or its tributaries, New Market Pond and Spring Lake (August 1998) due to PCB concentrations present in rounds of fish sampling, the migration of contaminants detected in the surface water bodies (water and/or sediment) into biota, especially edible fish species, is an extremely important environmental transport mechanism. Based on fish BCFs and organism depuration rates, this transport mechanism will be especially important for PCBs, dioxins/furans (although not analyzed in the surface water bodies at this time), pesticides, and some metals (e.g., mercury, thallium and silver, and potentially zinc and barium).

Migration of contaminants into terrestrial biota is also an extremely important environmental transport mechanism potentially affecting algae and terrestrial plants, invertebrates, reptiles, birds, and mammals along the Bound Brook corridor. This transport mechanism would be especially important for PCBs, dioxins/furans (although not analyzed in the surface water bodies at this time), pesticides, and certain metals (e.g., arsenic, lead, cadmium, copper, chromium, manganese, mercury, and zinc). Weathered Aroclor-1254 was present at concentrations up to 5.4 J mg/kg (wet weight) in small mammals collected from Bound Brook floodplain soil areas during the 1997 EPA study (EPA, 1997a; EPA, 1999a).

4.7 Migration of Contaminants Into Air

Contaminants may migrate into air via two distinct emission mechanisms: entrainment of contaminated particulates by the wind (i.e., fugitive dust emissions), and volatilization, primarily of organic compounds. The extent of particulate entrainment at a site is governed in large part by climatic conditions (dry, windy conditions are more conducive to entrainment than wet, calm conditions). Other factors that affect entrainment of particulates include the activities that occur or have occurred on the Site, the extent of paved and/or vegetative areas, and the grain size distribution of the surficial soils. Volatile organic compounds can migrate into air from surface and subsurface

soils. Volatilization from surface materials is essentially unrestricted, and as such is governed only by the physicochemical characteristics of a given compound under ambient conditions. Volatilization from subsurface materials is more complex and factors such as soil moisture and permeability must be taken into account. Many of the soil contaminants present exhibit elevated adsorptive affinities to soil particles (e.g., PCBs, SVOCs, and metals). As a result of this, exposed surficial soil particles with contaminants adsorbed to their surfaces can become entrained into the air during dry, windy periods and be transported with the prevailing winds until they are deposited off the property or in other areas within the facility via wet or dry deposition processes. Prior investigative results indicate that the airborne entrainment of contaminated soil particulates has been a significant environmental transport mechanism.

5.0 POTENTIAL RECEPTORS

Human health and ecological receptors are those groups potentially subject to exposure from contaminants present in the sediments, floodplain soils, and the surface water of Bound Brook. Receptors are defined as any group of organisms potentially subject to exposure to a stressor (in this PCSM defined as chemical stressors in the form of contaminants) present in environmental media within the corridor. This section documents the potential exposure scenarios associated with the Bound Brook Corridor. These potential current and future exposure scenarios are determined by the environmental setting in the Bound Brook Corridor. As discussed in Section 2.0 Environmental Setting, the Bound Brook Corridor is located in a highly developed area with multiple land uses (e.g., residential, commercial, recreational, agricultural). The land uses and environmental setting of combine to create a number of potential routes of exposure to detected contaminants and a number of receptor groups who may be exposed to these contaminants.

5.1 Human Health

The Bound Brook Corridor consists of an approximate 6-mile length of Bound Brook (3.7 miles downstream of the Cornell-Dubilier Electronics facility and 2.3 miles upstream of Cornell-Dubilier Electronics facility measured in channel miles and its associated floodplain. Several types of land uses are currently present within the Bound Brook Corridor, as identified on Figure 2-8. They include residential, industrial, commercial, deciduous forest land, cropland and pasture, reservoirs (e.g., Spring Lake), and other urban or built-up areas such as parking and storage facilities. For this preliminary analysis, it was assumed these current land uses would remain consistent in the future.

Based on an examination of the land uses within the Bound Brook Corridor, the following potential human receptors were identified:

- Resident (child and adult);
- Lake recreator (child and adult);
- Shoreline recreator (child and adult);
- Park recreator (all ages);
- Park worker (adult);
- Commercial/industrial worker (adult);
- Construction worker (adult);
- Culvert maintenance worker (adult);
- Outfall maintenance worker (adult);
- Railroad maintenance workers (adult); and
- Utility worker (adult).

These potential receptors may be exposed to contaminants in the various environmental and biological media of OU4 via routes such as incidental and intentional ingestion, dermal absorption (through direct contact), and inhalation. Through their projected activities, these potential receptors may be exposed to contamination that may be present in the OU4 sediment, surface water, groundwater, fish, floodplain soils, locally-grown produce, and air. The use of surface and groundwater for domestic consumptive purposes (i.e., potable water source) was not assessed

because there are no public water intake pipes in Bound Brook and groundwater will be addressed in OU3. A description of each of the receptors listed above is presented in the following sections.

5.1.1 Resident

Residences have been developed that abut the Bound Brook stream channel and floodplain. Therefore, child and adult residents are likely potential human receptors relative to these portions of the Bound Brook Corridor. Possible outdoor activities of the adult resident include property maintenance, landscaping, and gardening, while possible outdoor activities of the child resident may include leisure and exercise. Based on their expected activities, the child and adult residents would be exposed to the floodplain soils via incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. These receptors may also be exposed to the surface water and sediment associated with the portion of Bound Brook abutting his/her home via incidental ingestion or dermal absorption, and exposed to fish containing contamination and produce via ingestion. Fishing advisories do exist for Bound Brook (NJDEP, 2006), but no informational warning signs were apparent during a previous site visit. Consequently, it is conservatively assumed that residents may not be aware of these advisories and may consume their catch or may choose to ignore such warnings.

5.1.2 Lake Recreator

The child and adult lake recreators are assumed to use the two surface water impoundments within the Bound Brook Corridor (i.e., Spring Lake and New Market Pond) for recreational and leisure activities. These activities may include jogging, sunbathing, wading, and fishing. Both lakes support boating and fishing activities, as they both contain boating access points. New Market Pond was stocked once in 1998 with channel catfish by the NJDEP. These lake recreators are expected to be exposed to media only in these impoundments since: 1) aerial photographs indicate spillways are located at these impoundments (limiting the boats within the boundaries of the impoundment) and 2) Bound Brook is generally too shallow to be navigable.

These recreational users are assumed to access the site on a semi-regular basis for some period of years, for a moderate amount of time depending on the activity. Based on their expected activities, the child and adult lake recreators may be exposed to floodplain soils via incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. They may also be exposed to the local surface water and sediment via incidental ingestion or dermal absorption. The lake recreators are also conservatively assumed to catch and eat the fish tissue caught in these water bodies and potentially be exposed to body burden contaminants.

5.1.3 Shoreline Recreator

The child and adult are assumed to use portions of the Bound Brook Corridor for recreational and leisure activities (i.e., wading, hiking, jogging, fishing) along the Bound Brook Corridor. These recreators differ from the lake recreators in that these individuals are not assumed to be exposed at the impoundment areas, but rather along Bound Brook. The shoreline recreators are not assumed to be boating due to the physical characteristics of Bound Brook.

The shoreline recreational users are assumed to access portions of the Bound Brook Corridor on a semi-regular basis for some period of the year, for a moderate amount of time depending on the activity. The shoreline recreators include trespassers of the commercial/industrial facilities located within the Bound Brook Corridor, or individuals legally utilizing areas within the Green Acre properties owned by the municipality. Observation of the wooded areas and wetlands within the Bound Brook Corridor revealed several unmaintained trails as being present in these areas. The shoreline recreator could come into contact with floodplain soils via incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. In addition, they could be exposed to the local surface water and sediment while wading in Bound Brook or fishing from shore via incidental ingestion or dermal absorption. These receptors also could be exposed to contaminants in the body tissues of locally caught fish and other fish via ingestion. The presence of edible fish species is supported by the findings of the EPA report "Bound Brook Sampling and Edible Fish Tissue Data Report, Cornell-Dubilier Electronics Site, South Plainfield, NJ" (EPA, 1997a). In this report, EPA ERT collected adult carp, largemouth bass, white suckers, pumpkinseed, and bluegills. All of these species are consumable. Anecdotal evidence (i.e., the observation of fish hooks and lures) indicates that fishing does occur along Bound Brook. Similar to the impoundments, fishing advisories do exist for Bound Brook (NJDEP, 2006), but no informational warning signs were apparent during a site visit. Once again, it was conservatively assumed the shoreline recreators may not be aware of these advisories and would consume their catch.

5.1.4 Park Recreator

Two parks were identified within the Bound Brook Corridor. One of these parks, Veterans Memorial Park, was built in the floodplain between the Bound Brook and Cedar Brook, approximately 1.25 miles west of the Cornell-Dubilier Electronics facility property. A park is also associated with a small area adjacent to New Market Pond. Park recreators would be performing many activities that are similar to the shoreline recreator (i.e., recreational and leisure activities). However, it is likely the park recreators may spend more time at the park or use the park for a greater portion of the year (and therefore more time within the Bound Brook Corridor) due to the use of any open fields or space within the park. Park recreators are only assumed to be exposed to site contamination within the parks, and nowhere else in the Bound Brook Corridor. The park recreators could come into contact with floodplain soils via incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. They could also be exposed to the local surface water and sediment via incidental ingestion or dermal absorption. It is currently not known whether fishing is allowed or occurs at these parks; therefore, to be conservative, it has been assumed that the park recreator does fish and consumes the catch.

5.1.5 Park Worker

A park worker at the two parks within the Bound Brook Corridor would have routine access and exposure to any contaminated environmental media there. The responsibilities of the park worker include performing caretaking activities such as landscaping or mowing the athletic fields and repairing of any structures related to the small pond or other features within the parks. The park worker could come into contact with floodplain soils via incidental ingestion, dermal absorption, or

inhalation of particulates or released volatiles. The park worker may also perform some limited excavation work, exposing him/her to the subsurface soil. The park worker may also be exposed to the local surface water and sediment via incidental ingestion or dermal absorption.

5.1.6 Commercial/Industrial Worker

A commercial/industrial worker is assumed to be an adult working indoors and outdoors at a business located within the Bound Brook Corridor. Outdoor activities such as storing /palletting of materials in the “back lot,” and maintenance of the grounds (i.e., landscaping), would most likely limit this receptor’s exposure to the floodplain soils to incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. The use of wheeled vehicles such as a forklift or bobcat on any unpaved areas would enhance dust generation and potentially inhalation pathway exposures. It is not currently expected that work-related activities for the commercial/industrial workers would involve any contact with sediment, surface water or local fish.

5.1.7 Construction Worker

A construction worker is assumed to be an adult working full time (for the duration of the construction project) in the demolition and removal of existing structures, and the construction of new buildings and structures. These structures would be assumed to be located in the floodplain soils. Due to the shallow depth to groundwater (4 to 8 feet below ground surface), the construction worker may be exposed to groundwater during a portion of the demolition/ construction period. The construction worker would come into contact with floodplain soils via incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. Should conditions exist to allow it, the construction worker also could be exposed to the local groundwater via incidental ingestion, dermal absorption, or inhalation of volatiles. The use of excavation and grading equipment and heavy vehicles in disturbed areas during construction may enhance dust generation for this receptor. It is not currently expected that work-related activities for the construction worker would involve any contact with the local sediment, surface water, or fish.

5.1.8 Culvert Maintenance Worker

There are a number of culverts that support roads and railroad tracks that span Bound Brook within the Bound Brook Corridor (EPA, 1998). In the future, these structures will need to be maintained. Periodic maintenance of these culverts would involve activities that would bring a worker into contact with the local sediment, surface water, and floodplain soils, and potentially lead to exposure to detected contaminants. It is currently not expected that work-related activities for the culvert maintenance worker would include contact with the local fish.

5.1.9 Outfall Maintenance Worker

There are also a number of surface run-off or sewer outfall pipes discharging through or at be maintained or periodically replaced (EPA, 1998). In the future, these structures will need to be maintained or periodically replaced. Periodic maintenance of these pipes would involve activities that would bring a worker into contact with the local sediment, surface water and nearby floodplain soils, and potentially lead to exposure to detected contaminants via incidental ingestion and dermal absorption. It is not currently expected that work-related activities for the outfall maintenance worker would include contact with the local fish.

5.1.10 Railroad Maintenance Worker

An active Conrail railroad right-of-way currently runs parallel to the Bound Brook. Multiple railroad bridges span Bound Brook (EPA, 1998). A railroad maintenance worker would be responsible for maintaining the road bed and rail lines, and keeping the right-of-way clear of obstructions and large vegetation. The activities for this potential receptor include inspection of the tracks, periodic replacement of railroad ties, and inspection and clearance of the right-of-way. The performance of these activities would involve exposure to the floodplain soils via incidental ingestion, dermal absorption, and inhalation of particulates and released volatiles. The railroad worker is currently not expected to come into contact with local sediment, surface water, or fish during the performance of their duties.

5.1.11 Utility Worker

It is currently not known if utilities are located within the boundaries of the Bound Brook Corridor and in which media (i.e., floodplain soils or sediment) they are located. Pending resolution of this uncertainty, a utility worker is being considered for this initial assessment of potential exposure pathways and receptors. The utility worker is assumed to be an adult working periodically at the site to install new, or repair existing, buried utilities. The utility worker is assumed to potentially come into contact with floodplain soils and receive contaminant intake via incidental ingestion, dermal absorption, or inhalation of particulates or released volatiles. Given the relatively shallow depth to groundwater, a utility worker may come into contact with groundwater and be exposed via incidental ingestion, dermal absorption, or inhalation of released volatiles. It is currently not expected that work-related activities for the utility worker would include contact with local sediment, surface water, or biota during the performance of their duties.

5.2 Ecological Receptors

Ecological receptors represent plants and animals associated with habitats or undeveloped environments found within the Bound Brook Corridor.

5.2.1 Benthic Macroinvertebrates in Sediments

Benthic macroinvertebrates observed in waters adjacent to and downstream of the former Cornell-Dubilier facility included crayfish (*Orconectes sp.*) and Asian clams (*Corbicula fluminea*). Other

invertebrates associated with the aquatic habitats include aquatic insects with life histories inclusive of either fully aquatic or developmental stages requiring aquatic habitats. Representative insect groups with such characteristics include caddisflies, midges, mosquitos, black flies, crane flies, fish flies, aquatic beetles, dragonflies, damselflies and other families of insects with semi-aquatic life histories. Non-insect invertebrates likely include amphipods, isopods, aquatic snails, freshwater clams and mussels and aquatic annelids (i.e., aquatic earthworms and leeches) and crayfish. Benthic macroinvertebrate communities represent a key link in the aquatic food chain by acting as both important detrital processors of coarse organic matter and as a prey base for adult and juvenile fish. Impairment of this community could indirectly affect the abundance or diversity of fish species whose diet consists of benthic invertebrates.

A benthic macroinvertebrate survey was conducted in 1993 by the EPA. This report was not available for review prior to formulation of their PCSM. Results of the survey concluded the benthic macroinvertebrate community had been severely impacted adjacent to the former Cornell-Dubilier Electronics facility. A direct relationship between this degraded condition and a particular group of contaminants could not be defined; however, contaminants associated with the former Cornell-Dubilier Electronics facility were suspected as contributing to this impaired status.

5.2.2 Freshwater Fish

The USGS national water-quality assessment program has documented 26 fish species from Bound Brook at Middlesex, N.J. In addition to this survey, EPA (1993c) conducted fish community structure and tissue sampling in the vicinity of the former Cornell-Dubilier Electronics facility. Fish species recorded from these studies represent those typically associated with a warm water fishery and many were classified as being pollution tolerant (USGS, 1998a). Dominant fish observed in the Bound Brook included the spottail shiner (*Nortropis hudsonius*), silvery minnow (*Hybognathus regius*), white sucker (*Catostomus commersoni*), tessellated darter (*Etheostoma olmstedi*) and American eel (*Anguilla rostrata*). The above species are classified as being insectivores, feeding on invertebrates but also feeding opportunistically on small fish or fish larvae. Piscivorous fish species encountered included largemouth bass (*Micropterus salmoides*), redfin pickerel (*Esox americanus*) and rock bass (*Ambloplites rupestris*). Of these species, the largemouth bass was the most dominant piscivorous species observed. Other fish groups identified included catfishes, carp and minnows and sunfish.

EPA (1993c) collected tissue samples from five fish species observed in the waters adjacent to and downstream from the former Cornell-Dubilier Electronics facility. The species sampled included bottom feeding fish [carp (*Cyprinus carpio*) and white suckers (*Catostomus commersoni*), bullhead (*Ameiurus* sp.)] and pelagic fish [sunfish (*Lepomis gibbosus*), largemouth bass (*Micropterus salmoides*)].

Fish represent the most diverse aquatic vertebrate group present in Bound Brook and its impoundments. Fish also represent a key exposure pathway for exposure to sediment and surface contaminants in humans. The diversity of species and trophic guilds represented within the aquatic food chain make this group of receptors very important within the aquatic food chain. The diverse dietary guilds present provide an important exposure pathway for the introduction of bioaccumulating contaminants throughout the aquatic food chain. This pathway allows for the

accumulation of lipophilic compounds within fish tissues to concentrate through the various trophic levels present. This biomagnification process provides the basis for piscivorous (fish eating) wildlife to be exposed to contaminants through the consumption of contaminated fish from the Bound Brook Corridor.

5.2.3 Mammals

Observations of 11 mammalian species were made from the Bound Brook Corridor and Cornell-Dubilier Electronics facility (Table 5-1) (FWENC, 2002). EPA (1999) documented a similar list of species and collected white-footed mice (*Peromyscus leucopus*) for body burden analysis.

Based upon trophic guild assignment of Myers et al. (2006) the documented species consisted of two carnivores [red fox (*Vulpes vulpes*) and domestic dog (*Canis* sp.)], five herbivores [muskrat, (*Ondrata zibethicus*), groundhog (*Marmonta monax*), white-tail deer (*Odocoileus virginianus*), eastern gray squirrel (*Scirus carolinensis*), and eastern cottontail (*Sylvilagus floridanus*)] and five omnivores [white-footed mice (*Peromyscus leucopus*), eastern chipmunk (*Tamias striatus*), rat (*Rattus* sp.), raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*)].

Representative species assessed in the risk assessment by EPA (2000) at the Site included:

- Omnivorous mammal – raccoon (*Procyon lotor*);
- Carnivorous mammal – red fox (*Vulpes vulpes*);
- Small herbivorous mammal – eastern cottontail (*Sylvilagus floridanus*); and
- Large herbivorous mammal – white-tail deer (*Odocoileus virginianus*).

All of the species observed are resident to New Jersey and non-migratory in nature. Though not directly observed, piscivorous mammals may occur within the Bound Brook Corridor. Riparian and floodplain habitats afford the most likely habitat for these species. EPA (1999a) stated habitat suitability may be a limiting factor for piscivorous mammals. Mink are more tolerant of human disturbance than the river otter (*Lutra canadensis*), another piscivorous species found in New Jersey and also a state listed threatened species. . The developed nature of the Bound Brook Corridor, and the fragmented areas of habitat present, are likely not suitable to support the river otter.

Mammals represent an important upper trophic level group of receptors. Mammals have been shown to be among the most sensitive to the reproductive effects from exposure to PCBs and other organochlorine compounds (i.e., dioxins and furans). Mammalian species that are largely carnivorous or piscivorous in diet are particularly susceptible to the biomagnifying characteristics of these compounds.

5.2.4 Birds

Forty avian species have been observed within the Bound Brook Corridor and at the former Cornell-Dubilier Electronics facility (Table 5-1). Of these species, one was a carnivorous raptor [red-tailed hawk (*Buteo jamaicensis*)], three were piscivores [belted kingfisher (*Ceryle alcyon*), great blue heron (*Ardea herodias*), and green heron (*Butorides virescens*)], four were herbivores [Canada goose (*Branta canadensis*), song sparrow (*Melospiza melodia*), American goldfinch (*Carduelis tristis*), and domestic pigeon (*Columbia livia*)], and nine were mainly insectivores [barn swallow (*Hirundo rustica*), hairy woodpecker (*Picoides villosus*), yellow warbler (*Dendroica petechia*), common

yellowthroat (*Geothlypis trichas*), northern oriole (*Icterus galbula*), killdeer (*Charadrius vociferous*), house wren (*Troglodytes aedon*), American robin (*Turdus migratorius*), and great-crested flycatcher (*Myiarchus crinitus*)]. The remaining 23 species were omnivores, with diets consisting mainly of insects, seeds or berries.

Representative species assessed in the risk assessment by EPA (1999a) at the Site included:

- Carnivorous raptor – red-tailed hawk (*Buteo jamaicensis*);
- Piscivorous avian species – belted kingfisher (*Ceryle alcyon*);
- Insectivorous avian species – American robin (*Turdus migratorius*); and
- Omnivorous waterfowl – mallard duck (*Anas platyrhynchos*).

Birds represent the most diverse terrestrial vertebrate group present in the OU4 Bound Brook Corridor and are important upper trophic level group of receptors. Many species are migratory in nature and thus populations are subject to considerable fluctuation during the Fall and Spring migratory periods. Birds are known to be among the most sensitive to the reproductive effects from exposure PCBs and organochlorine pesticides such as DDT and its metabolites, chlordane and dieldrin. Bird species that are largely carnivorous or piscivorous in diet are particularly susceptible to the biomagnifying characteristics of these compounds. Birds are also known to be highly susceptible to lead exposure at elevated concentrations.

5.2.5 Reptiles

Observations of four reptile species were made in the Bound Brook Corridor and the former Cornell-Dubilier Electronics facility (Table 5-1) (EPA, 1999a). These species included the common musk turtle (*Sternotherus odoratus*), the eastern painted turtle (*Chrysemys picta picta*), the eastern box turtle (*Terrapene carolina*), and the snapping turtle (*Chelydra serpentina*). All of these species are omnivorous with diets consisting of insects, plants, small fish, and carrion. The young of the eastern painted turtle and eastern box turtle are mainly carnivorous, becoming more herbivorous as they mature. Snapping turtles are mainly carnivorous but do ingest plant material (Myers et al., 2006). Turtles are known to bioaccumulate lipophilic contaminants such as PCBs, organochlorine pesticides and heavy metals.

No reptile species were assessed for exposure or risk in the ecological evaluation performed by EPA (2000). Reptiles represent an important link and key vertebrate group whose omnivorous or carnivorous diets lend this group for the potential exposure to bioaccumulating contaminants within the aquatic food chain. Taking of turtles for human consumption (i.e., snapping turtles are administered for take in the state by the NJDEP Bureau of Freshwater Fisheries) would not be considered a significant fishery in this area.

5.2.6 Amphibians

Observations of two reptilian species were made at the former Cornell-Dubilier Electronics facility (Table 5-1) (FWENC, 2002). These species included one carnivorous [bullfrog (*Rana catesbeiana*)] and one insectivorous [green frog (*Rana clamitans melonata*)] anuran species (Myers et al., 2006). Amphibians are a vertebrate group highly dependent upon both aquatic and terrestrial resources for

their life histories. Reproduction and development in this group is dependent upon water bodies where eggs and larvae (i.e., tadpole stage for frogs/toads or axolotl for salamanders) are largely isolated from fish predators. This developmental process in aquatic habitats results in a high potential for exposure to contaminants in surface water and sediments.

Amphibians were not assessed for exposure or characterized for risk in the ecological evaluation performed by EPA (2000). A lack of individuals present in the habitats sampled, and the lack of a reliable frog assay, prevented this group from being assessed. Harvesting of ranid species for human consumption is administered by the NJDEP Bureau of Freshwater Fisheries. However, harvesting of frogs for human consumption would not be considered a significant fishery in this area.

5.2.7 Terrestrial and Aquatic Plants

Plants in both terrestrial and aquatic environments form the basis of the food chain as the primary producers. Plants provide a key link in the conversion of sunlight into biologically available energy sources. Additionally, plants provide biological cover, habitat complexity, foraging browse, and mast needed by wildlife in both aquatic and terrestrial habitats. Many contaminants, particularly metals, can be phytotoxic and can be bioaccumulated by plants from soils or sediments. As a group, plant communities in the stream, wetland and floodplain habitats were not assessed directly in the ecological evaluation by EPA (1999a). Rather, this group was assessed collectively as a functional assessment of other endpoints evaluated at the ecosystem level or organization.

5.2.8 Terrestrial Soil Invertebrates

Terrestrial invertebrates function as critical converters of coarse organic matter and assist in the cycling of detritus and nutrients within the terrestrial food chains. Organic matter decomposition is aided by invertebrates through the reduction of coarse organic matter to fine organic matter and the production of frass or castings. Additionally, soil invertebrates act as an important prey base for insectivorous wildlife which are dependent upon the biomass of insects, annelids and isopods present in the soil. Soil invertebrates were not directly assessed for exposure or characterized for risk in the ecological evaluation performed by EPA (1999a).

6.0 SITE CLOSURE AND EXIT STRATEGY

The FS for OU4 will be the basis for identifying the Site closure and exit strategy, which will be documented in the ROD. The FS will identify exposure pathways of concern for human health and the environment, identify remedial action objectives (RAOs), present general response actions to meet the RAOs, identify and screen remedial technologies and process options, and assemble and evaluate remedial alternatives for each media of concern for OU4, considering the likely end uses of the Bound Brook Corridor.

This section of the PCSM presents preliminary remedial alternatives that have been identified for each media of concern in the Bound Brook Corridor (i.e., sediment, surface water and surface soil) to achieve site closure. During the RI/FS, data collection, refinement of alternatives, and development of new/additional alternatives will be performed to focus the investigation and develop the most appropriate remedial alternatives to facilitate site closure consistent with anticipated future uses of the Bound Brook Corridor.

During the RI, the media of potential concern within OU4 – sediment, surface water, and surface soil (i.e., floodplain soils) – will be investigated to determine which media are impacted and pose an unacceptable risk to human health and/or ecological receptors. Based on the PCSM, potential receptors that may be exposed to an unacceptable risk via one or more of these media include, but are not necessarily limited to:

- Resident;
- Shoreline/Lake Recreator;
- Park Recreator;
- Park Worker;
- Commercial Industrial Worker;
- Construction Worker;
- Culvert/Outfall Worker;
- Railroad Maintenance Worker;
- Utility Worker;
- Fish;
- Birds;
- Mammals;
- Benthic macroinvertebrates;
- Amphibians/Reptiles;
- Terrestrial/Aquatic Plants; and
- Soil Invertebrates.

A range of preliminary remedial alternatives for each media of concern has been identified to address the potential risks to human health and/or ecological receptors from the impacted media. The following sections identify and provide a brief description and evaluation of the preliminary remedial alternatives for the potentially impacted media associated with OU4.

6.1 Sediment

Preliminary alternatives that have been identified for sediments in OU4 fall into the following major categories:

- No Action;
- Limited Action;
- In Situ Capping;
- In Situ Treatment; and
- Removal/Treatment/Disposal.

As discussed below, within some of these categories, multiple sediment alternatives may be developed and evaluated during the FS process.

6.1.1 No Action

The No Action alternative for sediment includes no remedial activities, no institutional controls, and no long term monitoring. The No Action alternative does not mitigate risks to human health or the environment (i.e., ecological receptors). The No Action alternative is required under CERCLA to be retained as a baseline for comparison of other alternatives, and therefore will be developed and retained throughout the FS process.

6.1.2 Limited Action

The Limited Action alternative does not involve active remediation, but may include institutional controls and/or monitoring. Institutional controls, such as warning signs, fishing restrictions, permit requirements, etc., can mitigate risks to human health, but not the environment. Monitoring Site conditions provides a method to assess increases or decreases in risk due to natural processes, or associated with other remedial actions (e.g., source control measures). During the course of the RI/FS, a number of institutional controls and monitoring strategies will be evaluated, and multiple Limited Action alternatives may be developed for further evaluation, including alternatives involving Monitored Natural Recovery (MNR) or Enhanced Natural Recovery (ENR).

6.1.3 In Situ Capping

In Situ Capping provides containment of contaminants, thereby reducing human health and ecological risks, and mitigating transport mechanisms between media. During the RI, data will be collected to identify areas that may be suitable for capping, and to provide the necessary data for evaluation of the capping alternative. Multiple capping alternatives may be developed during the FS, ranging from hot spot capping to large scale capping within OU4, depending on the findings of the human health and ecological risk evaluations and the potential for other alternatives to mitigate these risks. Capping alternatives may be developed in conjunction with other alternatives (e.g., institutional controls, removal, etc.) to provide the most cost-effective closure strategy for the Bound Brook Corridor.

6.1.4 In Situ Treatment

In Situ treatment options for sediment (e.g., enhanced microbial degradation, oxidation, stabilization, etc.) are, for the most part, innovative technologies that are not well established and have not yet experienced widespread implementation. During the RI, developments associated with *in situ* treatment technologies will be tracked, and data will be collected, if appropriate, to support the evaluation of *in situ* remedies. The FS will identify *in situ* treatment alternatives that may be viable, either for specific portions of OU4, or the overall Bound Brook Corridor, based on the results of the technology development and data collected.

6.1.5 Removal/Treatment/Disposal

Removal alternatives for sediments may include conventional excavation or dredging, depending on the specific conditions encountered at locations requiring remediation. Removal technologies generally provide the greatest long-term risk reduction for both human health and the environment, as the contaminants are removed from the Site, with no opportunity for recontamination or migration between media. However, short-term risks are often higher for removal alternatives, due to the potential to mobilize contaminants, and also during transportation and disposal of contaminated media. During the RI, data will be collected to support the evaluation of potential removal alternatives ranging from hot spot removals to complete removal of contaminated sediments. Different treatment options for dredged/excavated sediment will also be considered. The FS will evaluate these alternatives, with full consideration given to the short-term and long-term risks associated with these alternatives.

6.2 **Surface Water**

Preliminary alternatives that have been identified for surface water in OU4 fall into the following major categories:

- No Action
- Limited Action
- Treatment

6.2.1 No Action

The No Action alternative for surface water includes no remedial activities, no institutional controls, and no long term monitoring. The No Action alternative does not mitigate risks to human health or the environment (i.e., ecological receptors). The No Action alternative is required under CERCLA to be retained as a baseline for comparison of other alternatives, and therefore will be developed and retained throughout the FS process.

6.2.2 Limited Action

The Limited Action alternative does not involve active remediation, but may include institutional controls and/or monitoring. Institutional controls, such as warning signs, fishing restrictions, permit requirements, etc., can mitigate risks to human health associated with surface water. Risks to the

environment are not mitigated by institutional controls. Monitoring site conditions provides a method to assess increases or decreases in risk due to natural processes, or associated with other remedial actions (e.g., sediment remediation and/or other source control measures implemented for surface soil).

6.2.3 Treatment

Treatment alternatives associated with surface water impacts are generally limited to source control measures, which will be addressed under sediment and surface soil remedial alternatives. However, the potential for direct treatment of surface water under certain conditions (e.g., small stream flow impacting a particularly sensitive receptor) may be considered during the RI/FS.

6.3 **Surface (Floodplain) Soil**

Preliminary alternatives that have been identified for surface soil in OU4 fall into the following major categories:

- No Action
- Limited Action
- Capping
- In Situ Treatment
- Removal/Treatment/Disposal

As discussed below, within some of these categories, multiple remedial alternatives may be developed and evaluated during the FS process.

6.3.1 No Action

The No Action alternative for surface soil includes no remedial activities, no institutional controls, and no long term monitoring. The No Action alternative does not mitigate risks to human health or the environment. The No Action alternative is required under CERCLA to be retained as a baseline for comparison of other alternatives, and therefore will be developed and retained throughout the FS process.

6.3.2 Limited Action

The Limited Action alternative does not involve active remediation, but may include institutional controls and/or monitoring. Institutional controls, such as warning signs, access restrictions, use restrictions, etc., can mitigate risks to human health associated with surface soil; however, risks to the environment are not mitigated by institutional controls. Monitoring provides a method to assess increases or decreases in risk due to natural processes, or associated with other remedial actions (e.g., source control measures implemented for other OUs).

6.3.3 Capping

Capping provides containment of contaminants, thereby reducing human health and ecological risk, and mitigating transport mechanisms between media. During the RI, data will be collected to identify areas in the floodplain that may be suitable for capping, and provide the necessary data for evaluation of the capping alternative. Multiple capping alternatives may be developed during the FS, ranging from hot spot capping to large scale capping of the floodplain within OU4, depending on the findings of the human health and ecological risk evaluations. Capping alternatives may be developed in conjunction with other alternatives (e.g., institutional controls, removal, etc.) to provide the most cost-effective closure strategy for the Site.

6.3.4 In Situ Treatment

In Situ treatment alternatives for surface soil in the Bound Brook floodplain may include technologies such as enhanced microbial degradation, oxidation, stabilization, etc. During the RI, data will be collected to support the evaluation of these *in situ* technologies. The FS will identify *in situ* treatment alternatives that may be viable, either for specific portions of OU4, or the overall Site, to mitigate the risks to human health and the environment associated with floodplain soils. In addition, the effectiveness of each alternative to mitigate migration of contaminants from floodplain soil to surface water and/or sediment will be evaluated.

6.3.5 Removal/Treatment/Disposal

Removal alternatives for surface soil in the Bound Brook floodplain would generally be implemented using conventional excavation equipment and techniques. Removal technologies generally provide the greatest long-term risk reduction for both human health and the environment, as the contaminants are removed from the Site, with no opportunity for recontamination or migration between media. However, short-term risks are often higher for removal alternatives, due to the potential to mobilize contaminants, and also during transportation and disposal of contaminated media. During the RI, data will be collected to support the evaluation of potential removal alternatives ranging from hot spot removals to complete removal of contaminated surface soil in the floodplain. Different treatment options for excavated soil will also be considered. The FS will evaluate these alternatives, with full consideration given to the short-term and long-term risks associated with the various alternatives.

7.0 UNCERTAINTIES

The Triad Approach embraces uncertainty reduction as the foundation for an adaptive management approach. Uncertainty reduction relies upon the identification of key data gaps representing critical knowledge or understanding specific to the CSM. Therefore, integration of the CSM with the known uncertainties provides for the Triad Approach to be applied to both focus the investigation and prioritize remedial planning needs.

7.1 Uncertainty Associated

Uncertainty implies a lack of knowledge about certain facts, or the application of assumptions which can sometimes be clarified through additional focused study (EPA, 2005). The Triad Approach embraces uncertainty or more specifically, uncertainty management as a means of refining the understanding of how a contaminant interacts with processes and within components of a CSM for a hazardous waste site.

Given the complex environmental aspects addressed in environmental investigations, assumptions are often applied to account for an unknown characteristic or parameter. This approach relies upon anecdotal or empirical knowledge to support the use of assumptions. In the presence of uncertainty, practice dictates that unless data are available to suggest otherwise, error should be addressed conservatively in the application of assumptions.

Uncertainty was divided into four areas for this project, based on the review of the historical data and reports, for the Bound Brook Corridor:

- Uncertainty related to Nature and Extent of Contamination;
- Uncertainty related to the Human Health Risk Assessment;
- Uncertainty related to the Ecological Risk Assessment; and
- Uncertainty related to Site Closure and Exit Strategies.

7.1.1 Uncertainty Related to Nature and Extent of Contamination

The following sources of uncertainty were identified from the review of the historical data collection activities within the Bound Brook Corridor (OU4):

- With the exception of floodplain soil data collected as part of the OU2 investigation, all of the sediment, surface water and floodplain soil data were collected prior to the catastrophic flooding associated with Hurricane Floyd in 1999. This event caused extensive flooding within the Bound Brook and Green Brook sub-basins. The impact (if any) from the catastrophic flows and flooding of Hurricane Floyd or future storm events on the distribution of PCB contamination in sediments and floodplains remains uncertain.
- The Bound Brook Corridor extends beyond the historical sampling area investigated by regulatory agencies and their contractors. Likewise, sampling within New Market Pond, and below the New Market Pond spillway, was limited in extent and did not extend to the lower

limits of the Bound Brook Corridor. The nature and extent of PCB contamination in New Market Pond and the associated floodplain soils remains uncertain.

- Contaminants detected in the sediments and floodplain soils included organochlorine pesticides, VOCs, SVOCs, metals and PCBs. While these contaminants are associated with soils sampled from the facility, other sites have been identified as potential sources of these compounds to the Bound Brook Corridor. The significance of these individual sources, and their role in the distribution of contaminants, remains uncertain.
- The distribution of hydrophobic organic compounds such as PCBs in aquatic environments is influenced by geotechnical characteristics of the sediments and floodplain soils. Organically enriched silts and fine sands tend to act as sinks for this group of compounds. The relationships between contaminant concentrations relative to fine grained sediments, TOC and other physical characteristics within the Bound Brook Corridor have not been fully quantified and remain uncertain.
- Uncertainty exists in the distribution of contaminants in soils that may have been subject to development following possible contamination by flooding. The presence of contamination in developed portions of the Bound Brook Corridor remains uncertain.
- The existing PCB database for chemical analyses for sediments and surface soils consists of data for total PCBs (EPA, 1998) and a subset of homolog data sets (EPA, 2000). The fractional representation of homolog Aroclors relative to the total PCB concentration data within the Bound Brook Corridor remains uncertain.
- Detection limits for PCBs and DDT in surface water remained above the NJDEP/EPA interim guidance value for the protection of piscivorous wildlife. Risks posed via this media to piscivorous wildlife receptor groups remain uncertain.

7.1.2 Uncertainty Related to the Human Health Risk Assessment

A human health risk assessment has not been completed for the Bound Brook Corridor. In generation of the preliminary human health CSM, assumptions were made with respect to the physical characteristics of the Bound Brook Corridor, the representativeness of the data collected to date from across the corridor, and the completeness of specific exposure scenarios. For the human health risk assessment, sources of uncertainty were categorized into two primary types: (1) exposure-related uncertainty and (2) data-related uncertainty. Specific sources of uncertainty for each type are presented below.

7.1.2.1 *Uncertainty With Exposure-Related Aspects*

Exposure-related uncertainties result from the lack of data or knowledge on the pathways, routes or completeness of exposure for human receptors to come into contact with contaminants present in the Bound Brook Corridor, such as:

- The presence of occupied buildings in the floodplain of the Bound Brook Corridor will be an important factor in the assessment of exposure and risk to the identified human receptors.

- Open space in the form of fragmented forested properties, riparian edges and open parkland are associated with the Bound Brook Corridor. The extent to which human recreators are exposed to sediments in the ponds/lakes and Bound Brook remains uncertain.
- Variability in the activities and presence of commercial/industrial workers that may work within the Bound Brook Corridor remains un-quantified and thus uncertain.
- The presence of residential or community gardens within the Bound Brook Corridor that may be cultured by local residents, and the types of crops raised for consumption, remains uncertain.
- How the current fish advisory is applied and enforced to minimize consumption of fish by recreational fishermen, and the extent to which local fish are consumed, remains uncertain.
- In commercial/industrial areas within the floodplain, vehicular traffic patterns within dirt-covered parking or access areas of the Bound Brook Corridor need to be assessed for particulate and dust generation. Also, any significant intrusive activities expected at the commercial/industrial facilities is uncertain.
- The association of parkland with the impoundments and types of recreational opportunities available needs to be confirmed for the recreator scenario. Types of passive and active use scenarios for the parks and impoundments are uncertain. The current understanding of such activities relies upon assumed or estimated exposure scenarios and thus are uncertain relative to the Bound Brook Corridor.

7.1.2.2 Uncertainty with Data-Related Aspects

Data-related uncertainties account for a lack of analytical data or the distribution of contaminants in specific media for human receptors to be exposed to within the Bound Brook Corridor. These data-related aspects include:

- Based upon the varied land uses and recreational opportunities in non-developed portions of the Bound Brook Corridor, the availability of adequate background concentrations for floodplain soils (surface and subsurface), sediment, surface water, fish tissue and ambient air for chemicals of concern are uncertain relative to human health risk concerns.
- The availability of both the quantity and quality of soil, sediment, surface water, fish tissue and air data for calculating defendable exposure point concentrations for use in human health modeling remains uncertain.
- The degree of homogeneity of contaminant types/concentrations and their distributions relative to locations of likely exposure by the various human receptors has not been fully assessed.

7.1.3 Uncertainty for the Ecological Risk Assessment

A detailed ecological evaluation of select portions of Bound Brook and Cedar Brook within the Bound Brook Corridor was performed by EPA (EPA, 2000). The evaluation assessed exposure and characterized risks to 9 assessment endpoints in the corridor. Lines of evidence used in the evaluation included field surveys of fish and benthic macroinvertebrate communities, acute toxicity testing of sediments with a representative benthic macroinvertebrate, and tissue sampling of fish, crayfish and small mammals. Risks posed by contaminants to higher trophic level receptors were characterized using deterministic modeling with species-specific parameters referenced from available ecological risk guidance documents.

Uncertainty in ecological risk assessments is divided into three basic categories: (1) conceptual model uncertainties; (2) natural variation and parameter error; and (3) model error (EPA, 1997c). Uncertainties associated with the ecological evaluation and data collection activities are discussed below for each of the above categories.

7.1.3.1 Conceptual Model Uncertainties

- Contaminants in sediments are subject to dynamic physical processes. These processes may bury, mix, dilute or transfer contaminants within the system. The effects from Hurricane Floyd on the patterns and distribution of contaminants, and their bioavailability in Bound Brook sediments and floodplain soils, remain uncertain.
- A CSM specific to the Bound Brook Corridor of OU4 was not developed in the ecological evaluation (EPA, 2000).
- Risks to amphibians could not be assessed due to the low abundance of amphibians (i.e., frogs) and the lack of a consistent frog bioassay test for evaluating exposure to environmental media within the Bound Brook Corridor. Therefore, risks to this group of receptors was not characterized and remain uncertain.
- Risks to reptiles have not been characterized, and remain uncertain.
- Risks to piscivorous mammals were not assessed in the ecological evaluation. The presence or absence of piscivorous mammal populations, or the suitability of the existing habitat to support these receptors, has not been performed. The sensitivity of this receptor group, in particular the mink, to PCBs is well documented. The potential presence or absence of this receptor group within the Bound Brook Corridor remains uncertain.
- The gastrointestinal tracts of forage fish were removed from the samples prior to chemical analysis. The absence of this tissue introduced uncertainty through an underestimation of contaminant body burdens. The resulting uncertainty would contribute to an underestimation in exposure and risk in the fish and wildlife risk characterizations. The effect of this underestimation on the risk characterizations remains uncertain.

- Risks to omnivorous small mammal species were characterized. However, small insectivorous mammals, whose diet consists of insects and earthworms, were not evaluated for exposure in the ecological evaluation. Risks to this receptor group remain unaddressed and uncertain.
- Exposure of soil invertebrates to contaminants in floodplain soils has not been quantified. Risks to this receptor group remain uncertain.
- The toxicological evaluation of whole sediments with the amphipod *Hyalella azteca* revealed only one potential area resulting in an acute effect on survival. The benthic community survey identified Bound Brook as having a severely impaired benthic community. The lack of correlation between the toxicological testing and benthic community survey endpoints made identification of the contaminants contributing to the impaired state difficult. Hydrophobic compounds which partition to sediments are often associated with longer term chronic exposures in toxicological testing. The lack of a chronic exposure test in differentiating contaminant effects introduces uncertainty in the benthic community assessment endpoint and understanding if a single or combined contaminant group is contributing to the impaired state. A preliminary remedial goal (PRG) for the benthic community could not be established. This lack of a clear causative contaminant(s) results in uncertainty in achieving protectiveness of the benthic community endpoint.
- The ecological evaluation states that development of a PRG for semi-aquatic wildlife was not feasible given the lack of correlation between organochlorine pesticides and PCB concentrations in sediments, crayfish and fish. Uncertainty is associated with understanding the relationships between abiotic media and biota in relation to accumulation of organochlorine pesticides.
- The Bound Brook Corridor extends beyond the sampling reaches for which historical sampling data are available. Exposure and risks to ecological receptors in the segments of the Bound Brook Corridor extending upstream from the facility and from the New Market Pond dam downstream to the Bound Brook Corridor boundary remain uncertain.

7.1.3.2 Natural Variation and Parameter Error

Uncertainties in natural variation relate to the dynamic processes which govern the distribution of contaminants in alluvial systems. These processes may in part be related to physical, chemical or other influences.

- Data on naturally occurring metals have been collected for characterizing ambient concentrations of these elements in soil, sediment and surface water. Assessing the variation of concentrations in these media has not been performed. This uncertainty remains to be statistically quantified to better address the natural variability of these elements relative to concentrations observed within the Bound Brook Corridor.

- How physical and geochemical factors affect the distribution of contaminants has not yet been quantified. Uncertainty exists with how hydrophobic organic compounds and other contaminants detected are distributed in relation to environmental characteristics.

7.1.3.3 Model Error

Model error reflects how an assumption applied in the presence of uncertainty may contribute to an over- or underestimation of exposure or risk to a particular receptor or assessment endpoint. Evaluation of upper trophic level wildlife species commonly relies upon assumed exposure parameters in the exposure assessment. This requires that a set of pre-determined exposure parameters (i.e., body weight, food ingestion rates, dietary composition, etc.) be applied. Sources of uncertainty associated with such model error include the following:

- The wildlife exposure models in the ecological evaluation employed deterministic methods for assessing exposure and characterizing risk. Uncertainty lies in the application of a single set of exposure parameters and how representative they are to endemic populations in the Bound Brook Corridor. A range of exposure parameters for a given population is necessary to understand how variations in these parameters relative to life history affect the risk determinations.
- Exposure to contaminants via ingestion of contaminated prey by wildlife receptors was assumed to represent 100 percent of the dietary intake. For example, the red fox's diet was assumed to consist of 100 percent small mammals. The lipophilic nature of many organochlorine compounds would result in a biased high estimate of exposure based upon a dietary contribution of 100 percent animal matter. This assumption was applied as a conservative estimate for exposure to avoid underestimating the potential risks to the identified wildlife receptors. The use of a range of dietary parameters is needed to reduce uncertainty in the exposed populations regarding individual variation in dietary exposure.
- The areal foraging effort for wildlife receptors was assumed to represent a 100 percent use of the individual study areas assessed in the ecological evaluation regardless of home range characteristics for the receptor evaluated. Species-specific home range and how it might overlap or extend beyond study area reaches, and this subsequent effect on risk, was a source of uncertainty in the wildlife risk characterizations. Integration of aerial habitat coverage, species home range and contaminant data is necessary to reduce this uncertainty in the exposure assessment and risk characterizations.
- Body burden data collected for crayfish from the reaches sampled (excluding A6 where no crayfish were available) were used to assess exposure in insect-eating birds whose diet consists of largely semi-aquatic insects. The species evaluated in the ecological evaluation was the red-winged blackbird (*Agelaius phoeniceus*), a largely omnivorous species that does not actively capture semi-aquatic insect prey on the wing. Use of the tree swallow (*Tachycineta bicolor*), a species that has a diet consisting of semi-aquatic insects, may be more representative to the exposure routes and habitats present.

- Data regarding uptake and accumulation of contaminants in soil invertebrates, and exposure and risk to insectivorous ground bird species in floodplain habitats remain uncertain.
- Small insectivorous mammals whose diet consists of insects and earthworms were not evaluated for exposure in the ecological evaluation. Representative species could include the short-tailed shrew (*Blarina brevicauda*) in floodplain habitats and the little brown myotis (*Myotis lucifugus*) over aquatic habitats. Risks to these receptor groups remain uncertain.

7.2 Site Closure and Exit Strategy Uncertainty

This section discusses uncertainties associated with the design, implementation and overall effectiveness of the preliminary Site closure and exit strategies discussed in Section 6.0.

7.2.1 Uncertainty in Site Characterization

Many of the uncertainties discussed previously, related to the nature and extent of contamination, HHRA, and ERA can have a substantial impact on the applicable remedial strategies for the Site developed during the Feasibility Study. The preliminary remedial alternatives identified in this PCSM are based on the current understanding of the Site. As additional investigation activities are completed, and the uncertainties in the Site characterization are reduced, the potentially applicable remedial alternatives may also change.

7.2.2 Uncertainty in Remedial Alternative Effectiveness

Several of the NCP evaluation criteria for remedy selection involve the effectiveness of the remedial alternatives, including: overall protection of human health and the environment (one of the threshold criteria); reduction of toxicity, mobility, and volume through treatment; long-term effectiveness; and short-term effectiveness. Potential uncertainties associated with the effectiveness of remedial alternatives include the following:

- Due to the dynamic nature of the Site, the extent of areas requiring remediation may be altered by natural processes during the course of the remedy selection, design and implementation.
- The long-term effectiveness and stability of certain in situ technologies (e.g., stabilization/solidification) that may be considered during the Feasibility Study is uncertain. Treatability studies may provide indications of satisfactory performance that may not translate to long-term effectiveness under actual Site conditions.
- Remedy effectiveness relative to long-term stability during severe storm events is uncertain given the limited historical data on post-remedial monitoring conducted to date.
- Remedy selection is likely to be based on known or potential future land uses, identified from local zoning ordinances and/or the State Master Plan. Inconsistencies in these plans, or future uses not consistent with these plans, create uncertainty in the overall effectiveness of remedial alternatives that are developed based on specific future land uses.

- Due to the complexity of the Site, there would be significant uncertainty in this estimated timeframe for achieving the target levels for remedial alternative that include natural recovery.
- For capping alternatives, there would be significant uncertainty associated with the lifetime of the cap under dynamic Site conditions; the long-term integrity of the cap would need to be monitored, and long-term maintenance could be required to ensure the long-term effectiveness of this alternative.
- During implementation of a removal or capping remedial alternative, all practical efforts would be made to minimize suspension and migration of contaminants; however, there is significant uncertainty regarding the mobilization of contamination during implementation of these alternatives.

7.2.3 Uncertainty in Remedial Alternative Implementability

Technical and administrative feasibility are considered for the evaluation of the Implementability criterion. Potential uncertainties associated with the implementability of some of the remedial alternatives include the following:

- Several of the potential remedial alternatives may include innovative technologies. The availability of services and materials to implement certain technologies may be limited.
- Substantial uncertainty may exist regarding the technical implementability of in situ technologies under actual Site conditions. As discussed above, treatability studies may indicate a technology is feasible, but this may not translate to a cost-effective field-scale implementation

7.2.4 Uncertainty in Compliance with ARARs

The second threshold NCP criterion is compliance with ARARs. Changes in the regulatory environment (e.g., new regulations) can alter the target cleanup levels for remedial alternatives to meet this criterion. Uncertainties associated with changing regulations persist throughout the RI and FS phases of the project; however, this uncertainty is eliminated at the ROD stage, when ARARs are “frozen”.

7.2.5 Uncertainty in State and Community Acceptance

State and Community Acceptance are two separate NCP criteria that are evaluated during the public comment period, after preparation of the FS. Potential uncertainties associated with the State and/or community acceptance of the remedial alternatives include the following:

- The State, local community, or other stakeholders may not agree with the EPA’s preferred remedy.

- The State, local community, or other stakeholders may not agree with any of the remedies presented in the FS (the FS will present a range of alternatives, so it will be unlikely that none of the remedies presented will be acceptable to the stakeholders).

8.0 PRELIMINARY CONCEPTUAL SITE MODEL

The CSM is a visual or pictorial representation of the interaction or relationships between the potential sources of contaminants at the Bound Brook Corridor and the environmental media to which human and ecological receptors may potentially be exposed. Figure 8-1, adapted from EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (EPA, 2005), is a generalized CSM providing a pictorial representation of both the human and ecological threats associated with sites containing contaminated sediment, surface water, and floodplain soils. This representation applies to the migration and exposure pathways being considered in the Bound Brook Corridor.

For this report, PCSMs were also developed separately for human health and ecological exposure scenarios using available site-specific information. The incorporation of site-specific information into the development and refinement of a CSM provides a more realistic and accurate representation of the potential exposures and risks posed by contaminants. The preliminary human health and ecological exposure CSMs are described below.

8.1 Human Health Conceptual Site Model (HHCSM)

A preliminary HHCSM for potential exposure pathways for the human receptors identified in Section 5.1 is presented in Figure 8-2. The exposure of people to contaminants present in OU4 was evaluated through the consideration of exposure pathways. An exposure pathway is the linkage by which a released chemical/contaminant results in an exposure to a receptor. An exposure pathway includes a: 1) source; 2) exposure medium; 3) exposure route; and 4) receptor. An exposure pathway is considered incomplete if one or more of these four components is absent. A complete exposure pathway does not imply that exposures are actually occurring, only that the potential exists for the exposure to occur. Current and future land use activities and circumstances are considered in the identification of pathways and potential human receptors for the CSM. For OU4, it was assumed future land uses at the site will be consistent with current land uses.

The CSM first considered the primary sources and release mechanisms (current and historical) that resulted in contamination being present within the Bound Brook Corridor. As presented on the left-hand side of Figure 8-2, the primary sources of contamination are the Cornell-Dubilier Electronics facility, as well as other hazardous waste sites and potential sources. As further described in Section 3.1 of this report, several hazardous waste sites within or adjacent to the OU4 Project area corridor were identified by the state environmental agency to have had historical chemical releases.

Contaminants may have migrated from these primary sources of contamination, or been dispersed by natural processes or human activities via secondary or tertiary transport of migration mechanisms into other media. In the Bound Brook Corridor, these mechanisms potentially include the migration or transport of contaminants from one environmental media to another via wind re-suspension and dispersion, mechanical redistribution, surface run-off, volatilization, erosion, leaching, groundwater discharge, surface water flow, or biotic uptake. These transport and migration mechanisms were then evaluated to determine if a link existed between the contaminated media (or secondary and tertiary sources) and the exposure media. Depending upon the pathway considered, potential exposure media

at OU4 include floodplain soil, air, groundwater, surface water, sediment, homegrown produce, and aquatic fish (as dietary items).

A second use of a CSM is to identify how those exposure media may be contacted by potential receptors such that contaminant uptake to the receptor may result (i.e., an exposure route). Exposure routes include incidental and/or intentional ingestion, dermal absorption, and inhalation (of particulates or gaseous contaminants). Based on an examination of the many current land uses now associated with OU4, several receptors were identified, including residents, recreators, and workers (see Section 5.1 for further details). The right-hand side of the CSM indicates which exposure pathways are believed to be complete or incomplete for each identified receptor, based on the currently available information.

8.2 Ecological Conceptual Site Model (EcoCSM)

The PCSM for potential exposure pathways for OU4 contaminants relative to the ecological receptors identified in Section 5.2 is presented in Figure 8-3. The primary environmental media of concern are surface water, sediments (0-0.5 ft.), and shallow floodplain soils (0-1.0 ft.) for ecological receptors within the Bound Brook Corridor. The sources and migration mechanisms for the ecological CSM mirror those identified in the human health model. However, components such as groundwater are not considered to be a direct contact medium and are rather evaluated as a potential for discharge to surface water in assessing exposure to ecological receptors.

The complex relationships relative to habitat diversity and receptors present within terrestrial and aquatic food chains are difficult to fully quantify with regard to exposure between trophic levels in a single CSM. Therefore, a conceptual food chain model is often presented as a means of demarking trophic level interactions. Figure 8-4 presents a preliminary conceptual food chain model for the Bound Brook Corridor. The ecological food chain model is divided into broad compartments consisting of the exposure media of concern, primary producers, trophic level 1 primary consumers, level 2 primary consumers, and trophic level 3 tertiary consumers. The trophic classifications represent the position of specific groups of ecological receptors within a theoretical food chain that apply to the habitats present in the Bound Brook Corridor. The trophic level classifications are further differentiated into feeding guilds or functional groups including herbivores, omnivorous, piscivorous and carnivorous receptor species (Figure 8-4).

The primary pathways of exposure to site-related contaminants for ecological receptors include direct contact with contaminated environmental media, dietary ingestion of contaminated prey items, and direct or incidental ingestion of contaminated abiotic media during feeding. The first exposure route considers a direct absorption route where the primary producers and first and, to a lesser extent, second trophic level consumers come into contact with contaminants in environmental media. The second mechanism, ingestion of prey items, applies to trophic levels 1 through 3, and accounts for an indirect mechanism of exposure to contaminants, especially those that bioconcentrate or biomagnify within food webs. This pathway considers the direct accumulation and concentration of contaminants within plant or animal tissues, and the subsequent ingestion of these organisms by higher trophic levels. This exposure route often results in greater exposure to bioaccumulating and/or biomagnifying contaminants in predatory species associated with trophic level 3 and 4 consumers. The high bioaccumulation potential of PCBs and dioxins are examples of

contaminants with this upward concentration trend within the terrestrial and aquatic food chains. This pathway also includes the ingestion of contaminants via drinking water ingestion of surface water.

The last mechanism involves the incidental ingestion of sediments or soils containing contaminants during other behavioral activities such as grooming (i.e., ingestion of dust or soil particles during cleaning behavior) and feeding (i.e., ingestion of dust or soil particles during ingestion of food). This pathway is typically considered in trophic level 2 through 4 receptors, and represents a small fraction of the dietary ingestion rate for these receptors.

Other mechanisms of exposure include inhalation of volatile chemical or dust particles with absorbed contaminants and dermal absorption of contaminants across skin membranes. The inhalation route applies only to volatile organic compounds. Since most species inhabit open environments and given the rapid dilution of VOC compounds in ambient air, this pathway is typically not considered significant for ecological receptors. Dermal absorption is also not typically considered a significant pathway since higher trophic level receptors (i.e., birds, mammals and reptiles) are covered in hair, feathers or scales. The only exception are the amphibians (i.e., frogs, toads and salamanders) which have highly permeable skin which lacks a barrier such as scales, hair or feathers to offset this exposure route.

8.3 Data Needs

On the basis of the PCSM and understanding of site conditions, specific data needs have been identified as critical to be addressed in future investigative work in the Bound Brook Corridor. The data needs have been developed based upon the identified uncertainties for the project. These data needs represent additional or new data and information requirements for the Bound Brook Corridor CSM. Table 8-1 summarizes the data needs for the PCSM. These data needs will be the basis for designing an investigative strategy that will be presented and refined during the Systematic Project Planning meeting.

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