Loureiro Engineering Associates, Inc.

RDMS DocID 00100157

July 13, 2001

State of Connecticut
Department of Environmental Protection
Bureau of Water Management
Permitting, Enforcement & Remediation Division
79 Elm Street
Hartford, CT 06106

Pratt & Whitney
CTD990672081
R-9
RDMS # 100157

Attn.: Mr. Richard C. Hathaway, Jr.

RE: Response to July 6, 2001 Comments on Remedial Action Work Plan & Request for Variance Willow Brook and Willow Brook Pond

Dear Mr. Hathaway:

Loureiro Engineering Associates, Inc. (LEA) has prepared this letter on behalf of our client, United Technologies Corporation, Pratt & Whitney Division (UTC/P&W), to provide responses to the comments raised in your July 10, 2001 correspondence. This letter is formatted to provide each comment followed by the response to the comment in italics. Submitted herewith are the following documents:

1. Attachment No. 1: Revised Text, Tables, Drawings - Remedial Action Work Plan;
2. Attachment No. 2: Revised Text and Figures - Request for Variance, Engineered Control of Polluted Soils;
3. Attachment No. 3: Public notice documentation; and
4. Attachment No. 4: Single copy of revised text and tables from the Remedial Action Work Plan and the Request for Variance, Engineered Control of Polluted Soils with revisions highlighted.

Though the text edits were minimal with respect to the overall document, they did result in the overall repagination of both the Remedial Action Work Plan and the Request for Variance, Engineered Control of Polluted Soils. As a result, Attachment No. 4 has been provided in an effort to eliminate the need to read through the entirety of each document to identify the revisions made to text.

Remedial Action Work Plan (November 2000, revised May 2001)

1. Section 2.0, Statement of Work, second paragraph, last sentence; also section 2.3.5., Site Restoration, second paragraph: These sections should state "Environmental Land Use Restriction", not "deed restriction"..

The Remedial Action Work Plan (RAWP) has been revised to address this comment. Attachment No. 1 contains the revised page of the RAWP.

2. Section 2.3.2, Demolition and Removal of Existing Structures; also Request for a Variance, section 3.2.1. Process Water Buildings: The plan proposes to remove soil and sediment below the process water buildings to a standard of 25 ppm PCBs. This is not acceptable because an engineered control is not proposed to be placed in those areas. A numeric cleanup standard appears to be necessary for the surfaces of related structures. The buildings and components associated with the process water buildings are not depicted as being within the limits of the remediation project. (Drawing 1-1.)

   The RAWP and Request for Variance have been revised to reflect a remediation in accordance with the Commercial Industrial Direct Exposure Criteria and GB Pollutant Mobility Criteria for soil located within the project limits in the vicinity of the process water buildings. The limits of the remediation project (Drawing 1-1) have been revised to include the area within the footprint of the process water buildings and components. Attachment No. 1 contains the revised pages of the RAWP and the revised Drawing 1-1. Attachment No. 2 contains the revised pages of the Request for Variance.

   For consistency, we have also modified the description of the remediation for the area of the wetland to reflect the removal of PCBs at concentrations greater than the Residential Direct Exposure Criteria.

3. Section 2.3.2, Demolition and Removal of Existing Structures: Former Oil-Water Separator (also section 4.2.2, Post-Excavation Confirmatory Sampling). Please clarify that confirmation samples will also be analyzed for PCBs to determine compliance with the 25 ppm cleanup level for soil in the former oil-water separator area.

   It was the intent that PCB analysis was to be performed on post-excavation confirmatory samples obtained in the former oil-water separator area. However, in response to this comment, the RAWP has been revised to clarify the intent. Attachment No. 1 contains the revised page of the RAWP.

4. Section 4.2.2, Post-Excavation Confirmatory Sampling, PCB Confirmatory Soil Sampling: Composite sampling is not acceptable to confirm attainment of the 1 ppm cleanup standard which applies to areas outside the engineered control.

   The RAWP has been revised to provide for the collection of post-excavation confirmatory individual grab samples within those areas of the project that are located outside the limits of the engineered control. In addition, Drawing 4-1 and Table 4-1 have been revised, as appropriate, to address the revision to the confirmatory sampling methodology in those areas of the project. Attachment No. 1 contains the revised pages, table and drawing prepared in response to this comment.

5. Table 4-3, Required Containers, Preservatives, and Analysis: TPH should be added to Table 4-3.

   The RAWP has been revised to include TPH in Table 4-3. Attachment No. 1 contains the revised table in response to this comment.

6. Section 5.0, Quality Assurance Project Plan, Table 5-1: The extractable TPH method is preferred over EPA Method 418.1. TPH should be added to the list of parameters in sections 5.1.4, 5.1.6, and 5.3.4.

   The Remedial Action Work Plan (RAWP) has been revised to include extractable TPH in the list of parameters in the above referenced table and sections. Attachment No. 1 contains the revised table and pages in response to this comment.

7. Appendix D, Dust Control Plan: There must be an action level for respirable particulate matter of 150 micrograms per cubic meter. Continuous monitoring is required around the perimeter of the work area during dry conditions.

   Appendix D of the RAWP has been revised to provide for an action level for respirable particulate matter of 150 micrograms per cubic meter. Appendix D has also been revised to provide for the performance of real-time particulate monitoring during excavation and handling of PCB contaminated soil and sediment at the site. The revised Dust Control Plan also contains a provision for continuous monitoring during off work hours based on predicted weather conditions and observations made during the day of operation. Attachment No. 1 contains the revised pages of the Dust Control Plan prepared in response to this comment.

Request for Variance, Engineered Control of Polluted Soils (January 2001, revised May 2001)

8. Section 4.6, Public Notice (also Remedial Action Work Plan, Section 2.2.1, Project Permits and Approvals, Connecticut Department of Environmental Protection): Verification of public notice of the request to use an engineered control must be submitted, with a written verification that no comments were received within the 30 day period after the public notice.

   Attachment No. 3 includes a copy of the public notice, as published in the Hartford Courant on April 28, 2001 and an executed affidavit from the Hartford Courant certifying the publication. By submission of this letter, we are providing verification, in writing, that no comments were received within the 45-day period following publication of the notice.

9. Appendix D, Post-Remediation Groundwater Monitoring Plan, Figure 1: The well locations should be clarified. There appear to be 12 locations shown, not 13 as noted in the plan, and it is not clear which locations are within the brook and pond.

   Appendix D of the Request for Variance (RFV) has been revised to reflect that there are to be 12 groundwater monitoring wells installed following completion of remediation. Figure 1

has also been revised to more clearly depict the groundwater monitoring wells locations to be installed within and around the periphery of the pond. Attachment No. 2 contains the revised document and figure prepared in response to this comment.

10. Appendix E, Post-Remediation Maintenance and Monitoring Program: The plan proposes that there will be annual inspections of the engineered control, at a minimum. This is not sufficient.

    Appendix E of the RFV has been revised to provide for the performance of documented inspections on an annual basis and following a rain event in which greater than or equal to 2-inches of rain are received over a 24-hour period and informal inspections (observations) are to be performed by maintenance personnel during regular mowing of the engineering control and maintenance of the areas surrounding Willow Brook and Willow Brook Pond. Attachment No. 3 contains the revised document prepared in response to this comment.

We hope that the above responses and the attached information adequately address your comments and meet with your satisfaction. UTC initiated the implementation of this project on July 2, 2001 and is committed to the completion of the project during this construction season. Your approval of the Remedial Action Work Plan and the Request for Variance, Engineered Control of Polluted Soils is essential to the successful completion of the project. Should you have any further questions or comments, please do not hesitate to contact Lauren Levine of UTC at (860) 728-6520 or me.

Sincerely

LOUREIRO ENGINEERING ASSOCIATES, INC.

Brian A. Cutler, P.E.
Vice President

cc: Lauren Levine, UTC
Juan Perez, U.S. EPA
Kim Tisa, U.S. EPA
Ernest Waterman, U.S. EPA - w/o attachments
Elsie Patton, DEP - w/o attachments
Janet Kwiatkowski, DEP - w/o attachments
Melissa Toni, DEP – w/o attachments
Cori Rose, ACOE – w/o attachments
Michael Dayton, Town of East Hartford – w/o attachments

Pratt & Whitney
CTD990612081
R9

Attachment No. 1

Revised Pages
Remedial Action Work Plan

Pratt & Whitney
CTD990672081
R9

REMEDIAL ACTION WORK PLAN

United Technologies Corporation
Pratt & Whitney
Willow Brook and Willow Brook Pond
East Hartford, CT

November 2000
Revised May 2001

Prepared for

UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
400 Main Street
East Hartford, CT 06018

Prepared by

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REMEDIAL ACTION WORK PLAN
TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
- **1.1 General** 1
- **1.2 Background Information** 3
- **1.3 Summary of Previous Investigations** 7
- **1.4 Nature and Extent of Contamination** 11

2.0 STATEMENT OF WORK 12
- **2.1 General** 12
- **2.2 Pre-Construction Activities** 13
- **2.3 Construction Activities** 15
- **2.4 Post-Construction Activities** 24

3.0 PROJECT SCHEDULE 25

4.0 FIELD SAMPLING AND ANALYSIS PLAN 26
- **4.1 Introduction** 26
- **4.2 Remedial Action Field Sampling** 27
- **4.3 Sample Designation System** 32
- **4.4 Sample Handling and Documentation** 33
- **4.5 Management of Sampling-Related Materials and Wastes** 34
- **4.6 Field Quality Assurance/Quality Control** 34

5.0 QUALITY ASSURANCE PROJECT PLAN 36
- **5.1 Introduction** 36
- **5.2 Project Organization and Responsibilities** 40
- **5.3 Quality Assurance Objective for Measurement of Data** 43
- **5.4 Sampling Procedures** 45
- **5.5 Sample and Document Custody** 45
- **5.6 Calibration Procedures and Frequency** 48
- **5.7 Analytical Procedures** 48
- **5.8 Data Reduction, Review, and Reporting** 49
- **5.9 Field and Laboratory Quality Control Checks** 51
- **5.10 Performance and System Audits** 54
- **5.11 Data Assessment Procedures** 55
- **5.12 Reports to Management** 58

TABLES

Table 4-1 Confirmatory Sampling Summary
Table 4-2 Quality Control Analyses Summary
Table 4-3 Required Containers, Preservatives, and Analysis Holding Times for Solid, Aqueous, and Vapor Samples
Table 5-1 Recommended Project Specific Practical Quantitation Limits for Constituents for Which Analysis may be Conducted
Table 5-2 Recommended Accuracy and Precision Data Quality Objectives
Table 5-3 Recommended Matrix Spike and Laboratory Control Sample Precision and Accuracy Objectives

Table 5-4 Quality Assurance project Plan - Field Calibration Frequency
Table 5-5 Quality Assurance Project Plan - Field Measurements Quality Control

FIGURES

1-1 Site Location Map
1-2 Willow Brook Pond - PCBs in Soil/Sediment
1-3 Willow Brook - PCBs in Soil/Sediment
2-1 Detail – Erosion Controls
2-2 Detail – Culvert Transition at Bypass Channel
2-3 Detail – Chain Link Fence
2-4 Detail – Bypass Channel
2-5 Detail – Bypass Channel Energy Dissipater
2-6 Detail - Pond Bottom Cap
2-7 Detail - Stream Channel
2-8 Detail – Composite Cap
2-9 Detail – Wetland Restoration
2-10 Willow Street Roadway Realignment
3-1 Schedule for Willow Brook and Willow Brook Pond Remediation Project
4-1 Proposed Sampling Grid
4-2 Sample Labels
4-3 Custody Seal
4-4 Field Sampling Record
4-5 Sample Chain of Custody

DRAWINGS

Drawing 1-1 Existing Site Plan
Drawing 2-1 Site Preparation
Drawing 2-2 Bypass Channel
Drawing 2-3 Excavation Areas
Drawing 2-4 Site Restoration
Drawing 2-5 Channel Improvements
Drawing 4-1 Potential Confirmatory Sampling Locations

APPENDICES

A Summary of Historical Analytical Results
B Standard Operating Procedures
C CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater to the Sanitary Sewer
D Willow Brook/Willow Brook Pond Dust Control Plan

1.0 INTRODUCTION

1.1 General

This Remedial Action Work Plan (RAWP) has been developed to present the approach and strategy for the remediation of Polychlorinated Biphenyl (PCB) contaminated sediment within Willow Brook and Willow Brook Pond at the United Technologies Corporation (UTC), Pratt & Whitney (P&W) manufacturing facility in East Hartford, Connecticut (Site). A Site Location Map is included as Figure 1-1. The remediation approach consists of the excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 milligram per kilogram (mg/kg or parts per million (ppm)).

Following excavation, a geotextile, soil and rock cap (engineered control) will be installed over the entirety of Willow Brook Pond and the open channel of Willow Brook from Willow Brook Pond to Main Street. The exceptions to this approach is the wetland downgradient of the dam where excavation of PCBs at concentrations greater than the Residential Direct Exposure Criteria will be performed and the area backfilled and planted to restore the wetland, and the footprint of the process water facility where excavation of PCBs at concentrations greater than the Commercial Industrial Direct Exposure Criteria (for soils within 4 feet of the ground surface) and the GB Pollutant Mobility Criteria (for soils above the seasonal high water table) will be performed prior to the placement of backfill. This particular alternative necessitates a variance to the criteria of the Remediation Standard Regulations (RSRs). In accordance with 22a-133k-2(f)(2)(A) and (B) of the Regulations of Connecticut State Agencies (RCSA), a request to use an engineered control (Request for Variance) was submitted to the Commissioner of the Connecticut Department of Environmental Protection (CTDEP) in January 2001 and was subsequently revised in response to CTDEP comments in May 2001. This report, coupled with the May 2001 revision of the January 2001 Request for Variance, have been prepared to satisfy these requirements. The Request for Variance is incorporated herein by reference.

Following remediation, the open channel of Willow Brook from the pond to Main Street will be restored to the current configuration. In response to a request by the Department of Environmental Protection (DEP) staff, the Willow Brook stream channel will be slightly modified between the dam that impounds Willow Brook Pond and Main Street to reduce the slope of the banks to control potential erosion and to modify the character of the channel bottom to create a low flow channel with pools and eddies. Willow Brook Pond will be restored to the current configuration. The proposed sediment cap will be installed throughout the pond bottoms. Due to the thickness of the cap (3-feet) and based on the proposed sediment removal volume, the final bathymetry within the ponds will be slightly modified to accommodate the proposed cap section.

The limits of the project are defined in two separate areas (upstream of the dam and downstream of the dam) and each area in two separate parts. The limits of the project area upstream of the dam is defined in two parts, Willow Brook Pond and the area of the former oil/water separator. The project area downstream of the dam is defined in two parts, the stream channel of Willow Brook Pond and the wetland area. It is recognized that the potential exists that contamination may exist outside these project limits. However, the intent of this remediation project is to address soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. Measures to address contamination beyond those limits described below would be addressed in the future as separate projects.

1.1.1 Upstream of the Dam

Willow Brook Pond: With one exception, the lateral limit of the project area of Willow Brook Pond, inclusive of the small embayment west of the Process Water Facility and the footprint of the process Water Facility, is defined as the horizontal location of the ordinary water level (reference Drawing 1-1). The single exception is the location east of the upper section of Willow Brook Pond in the vicinity of a single soil boring WT-SB-132 (see Appendix A). The project area encompasses this boring to the limits shown on Drawing 1-1. Remediation, if necessary, beyond the limits shown will be performed as a separate project.

Former Oil/Water Separator: The lateral limits of the project area in the vicinity of the former oil/water separator is currently defined as the lateral limit of soils containing PCBs at concentrations greater than 25 ppm. However, it is recognized that the potential exists that PCBs and other constituents may exist in soils outside this lateral limit that would require remediation as part of the project. The current estimate of the lateral limits of the project in this area are depicted on Drawing 1-1.

1.1.2 Downstream of the Dam

Stream Channel Cap: The lateral limit of the project area for the stream channel cap is the 10-year flood elevation (22.0 to 24.0 feet above mean sea level) as shown on Drawing 1-1).

Wetland Area: The lateral limit of the project area for the wetland is currently defined to the south by the northern limit of the stream channel cap and to the north, east and west as the lateral limit of soils containing PCBs at concentrations greater than the Residential Direct Exposure Criteria. The lateral limits of these areas are also depicted on Drawing 1-1.

As discussed subsequently in this section, semi-volatile organic compounds, petroleum hydrocarbons and select metals were also detected in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. These constituents are commingled with soil and sediment containing PCBs. These constituents will remain in place in those areas in which they are commingled with soil and sediment containing less than 25 ppm PCBs and will be rendered inaccessible with the geotextile, soil and stone cap.

In summary, the components of the remediation approach include:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;

- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below and the footprint of the process water facility) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;
- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and
- The implementation of two institutional controls consisting of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

1.2 Background Information

The UTC/P&W facility is located at 400 Main Street in East Hartford, Connecticut, and is approximately 1,100 acres in size. P&W initiated aircraft engine manufacturing operations in East Hartford in December 1929. Current site operations are conducted in a 6.5 million square foot complex and include administration and management, manufacturing, testing, research and development and ancillary services. All of these activities take place in the western portion of the 1,100-acre property. The Rentschler Airport and the Klondike Area occupy the eastern portion of the property. P&W previously used these two areas as an airport and a storage/testing area, respectively.

The Willow Brook and the Willow Brook Pond remediation area is about 4 acres in size as depicted in Drawing 1-1. The site is within a mixed residential, commercial, and industrial area of East Hartford, Connecticut. Property usage in the vicinity of the proposed RA area includes the following:

- UTC/P&W parking facilities and the Rentschler Airport, to the east;
- Apartment complex and residential areas to the north;
- A commercial business, parking facilities, and UTC/P&W manufacturing to the south; and
- Predominantly commercial areas with some residential to the west (across Main Street).

1.2.1 Site Description

Willow Brook is a small stream transecting the UTC/P&W facility from the northern portion of the Rentschler Airport through to the northwest portion of the current UTC/P&W operations complex. Willow Brook flows in a southwesterly direction in an open channel from the Rentschler Airport, is then hard-piped underground to the inlet of Willow Brook Pond, and continues from the pond as an open channel to a culvert under Main Street. From Main Street, Willow Brook flows in an open channel for a distance of approximately 2,500 feet to the confluence with the Connecticut River (see Figure 1-1). Willow Brook Pond is a man made water body located in the northern portion of the Site (See Drawing 1-1). The pond, a single body of water when first created, has been modified various times through the years. It is now comprised of two ponds subdivided by a culvert.

Known water discharges to surface water that have existed at one point in time or another at the P&W East Hartford Facility include Discharge Nos. 001 through 015. The principal discharge from the facility is Discharge 001. Discharge 001 is the discharge of effluent from the dilute wastewater treatment plant at

Colt Street. The other water discharges are permitted through the National Pollutant Elimination System (NPDES) program and are comprised mostly of cooling water and stormwater runoff. Only Discharge Nos. 001 through 004 and 007 through 009 are or were associated with Willow Brook or Willow Brook Pond. These discharges contained basement dewatering, industrial waters and process wastewater. Some of the discharges to the pond were routed through an oil/water separator. A map showing site wide discharge locations was previously provided in the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997.

The majority of the water historically drawn from Willow Pond was used in buildings as a source of process water. The water was then collected and rerouted back to Willow Pond via NPDES discharge 003 and 004 and the Willow Brook via NPDES discharge 002. Historically water has discharged through the Experimental Test Airport Laboratory (ETAL) to Willow Brook upstream of Willow Pond. Basement dewatering operations and industrial waters had discharged through an oil/water separator into the brook. This building has been demolished and the oil/water separator water was removed.

During routine draining of Willow Brook Pond in September 1997, an oil sheen was noticed seeping through the sediment. P&W reported the sheen to the United States Coast Guard and the CTDEP in accordance with discharge reporting requirements. Following the detection of PCBs in a sample, the CTDEP issued P&W a NOV, No. PCB 97-08, on November 7, 1997. In response to the NOV, UTC/P&W developed a sampling work plan and conducted three phases of remedial investigation from December 1997 to April 1999. These investigations identified the probable sources and provided the analytical data to sufficiently define the horizontal and vertical limits of contamination allowing development of a remediation plan.

1.2.2 Physical Setting

Physiography

The UTC/P&W East Hartford facility lies within the Central Lowland province of Connecticut, a north-south trending valley system, which is approximately 20 miles wide at East Hartford. The valley system consists of a series of parallel valleys separated by linear north-south trending ridges. The Connecticut River flows southward just west of the site and drains the northern part of the valley system, ultimately discharging to Long Island Sound. The Connecticut River Valley, which is 5 to 6 miles wide and flat (local relief on the order of 30 feet), has created a broad floodplain and eroded terraces in the flatter portion of the valley system. The central portion of the Connecticut River Valley was occupied during deglaciation of the area by a large glacial lake. This lake, known as Glacial Lake Hitchcock, was formed during the northward retreat of the last continental ice sheet and existed about ten thousand years ago.

A regional drainage divide between the Connecticut River Basin and Hockanum Regional Basin lies to the north of the site and approximately 3 miles to the east of the site. The Hockanum River is a tributary of the Connecticut River.

Surface Water

From a review of the "Water Quality Classifications Map of Connecticut," published in 1987 by the CTDEP, surface water quality in Willow Brook has been designated as "B" along its entire reach to the confluence with the Connecticut River. As noted, the Willow Brook/Connecticut River confluence is approximately 2,500 feet from the Main Street culvert. The "B" designation indicates Willow Brook is known or presumed to meet water quality criteria for recreational use, fish and wildlife habitat,

agricultural and industrial supply, and navigation. The Connecticut River has been designated "SC/SB." This designation indicates that the water quality in the river does not presently meet class "SB" water quality criteria for one or more designated uses, but the goal is to meet class "SB" criteria. Designated uses for class "SB" include potential for certain fish and wildlife habitat, recreational boating, industrial supply, and other legitimate uses including navigation.

Storm water

Surface water drainage in the immediate vicinity of Willow Brook and Willow Brook Pond is predominantly overland sheet flow. Storm water in the adjacent plant area is handled by a number of catch basins, roof drainage systems, and storm drain pipelines, which discharge directly into Willow Brook or through an oil/water separator prior to discharge to Willow Brook. The Flood Insurance Rate Map, prepared by the Federal Emergency Management Agency and dated October 23, 1981, for East Hartford, Connecticut (Community No. 090026 0003-D Panel 3 of 4), shows the projected 100-year floodplain of the Willow Brook area. Most of the flood-prone areas depicted along Willow Brook lie between the 100-year to 500-year floodplain.

Meteorology

The climate of central Connecticut is a cool, humid, modified oceanic type. Winters are long and moderately cool; summers are short and mild. The mean annual temperature is approximately 50 degrees Fahrenheit (°F), ranging from an average of approximately 28°F in January to an average of 73°F in July. The average annual precipitation of approximately 44 inches is fairly evenly distributed throughout the year (National Oceanic and Atmospheric Administration, 1990); snowfall is about 40 inches per year (Soil Conservation Service, 1962). The prevailing wind is from the south or southwest in spring and summer and from the north or northwest the rest of the year.

1.2.3 Regional and Site Geology

Regional Geology

The geology of the region consists of sedimentary and igneous bedrock overlain by unconsolidated sediments. The UTC/P&W East Hartford facility is situated in the central portion of the Hartford Basin of the Newark Terrain. The rocks of the Hartford Basin were originally deposited as sediments or as the result of volcanic activity in a rift valley setting. The bedrock stratigraphy consists of four terrigenous sedimentary rock formations: the New Haven, Shuttle Meadow, East Berlin, and Portland. These units are composed of interlayered reddish siltstones, sandstones, and conglomerates. The sedimentary formations are separated from each other by three laterally continuous basalt units: Talcott, Holyoke, and Hampden Basalts. The bedrock layers dip gently eastward and are crosscut by numerous steep faults.

The unconsolidated sediments in much of the region can be divided into three major units: glacial till and limited deposits of stratified sand and gravel, glaciolacustrine deposits, and post-glacial fluvial deposits. These three units were deposited in this order, with the till and the limited stratified sand and gravel deposits generally lying directly over bedrock.

The till is poorly sorted and varies widely from a non-compact mixture of sand, silt, gravel, and cobbles with trace amounts of clay to a compact mixture of silt and clay with some sand, gravel and cobbles. The till is typically less than 10 feet thick in the vicinity of the UTC/P&W facility. The stratified sandy sediments (stratified drift) are much less extensive than the till and usually consist of sand, gravel and silt

deposited by melt water in contact with or in front of the glacier. These sediments appeared to be of limited extent and occurred in relatively thin layers (less than 10 feet) beneath the UTC/P&W facility.

Glaciolacustrine deposits include both lake-bottom sediments consisting of silt and clay and sand and gravel deposits formed by beaches and deltas in the lake. Thicknesses of lacustrine clays and silts as great as 270 feet have been reported beneath the UTC/P&W facility. These deposits are thickest in areas of deep bedrock valleys, one of which trends north-south and underlies the Main Plant Area. In a few isolated cases, thin layers of gravelly sands have been documented within the deeper portion of the glaciolacustrine unit.

Post-glacial fluvial sediments generally consist of sand and gravel deposited as the Connecticut River flowed across the exposed lake bed and cut stream terraces into the exposed lacustrine clays and silts, creating stream terrace deposits. These deposits are laterally extensive over the UTC/P&W facility, and are typically 15 to 30 feet thick across the facility.

Site Geology

Bedrock beneath the UTC/P&W facility consists of red sandstone and siltstone of the Portland Formation. Depth to bedrock within the facility boundaries is over 300 feet in the Main Plant Area, and approximately 30 feet along the eastern property boundary. Near the western property boundary along the Connecticut River, depth to bedrock is about 150 feet. A north-south trending, buried bedrock valley underlies the UTC/P&W facility; this buried valley may have been a pre-glacial channel of an ancient river following a similar course to that of the Connecticut River.

A thin layer of glacial till, up to 10 feet thick, typically directly overlies bedrock. A gravelly sand stratified drift deposit has been reported above or in place of the till in a few isolated instances.

Glaciolacustrine lake bottom sediments occur over most of the UTC/P&W facility, and range in thickness from 9 to 270 feet. These deposits thicken towards the central part of the facility (near the Main Plant Area) and are generally absent near the eastern boundary of the site.

The deposits consist of laminated (varved) silts and clays with red fine sand partings. The color varies from gray near the surface to red at the base of the unit. The presence of local sand or gravel lenses within the glaciolacustrine unit near its base has also been reported, but these are not assumed to be laterally extensive.

Beneath the eastern portion of the site, the contact between the silt and clay and overlying sediments is distinct. However, in the Main Plant Area, an intermediate layer of fine sand and silt that varies in thickness from approximately 5 to 20 feet occurs between these two deposits. A similar zone may occur at the base of the glaciolacustrine unit as well; these zones are typical of depositional facies changes that are characteristic of the depositional environment (glaciolacustrine).

Post-glacial fluvial deposits on the UTC/P&W facility are floodplain sediments of the Connecticut River. As the river cuts a channel through the floodplain, terraces were formed along the banks. The stream terrace deposits occur across the facility and generally range from 15 to 30 feet in thickness. These deposits increase in thickness toward the central part of the facility where greater erosion of the top of the glaciolacustrine silt and clay may have occurred along a former (perhaps earlier post-glacial), abandoned channel of the Connecticut River. These deposits generally consist of uniform brown fine, or fine-to-medium, sand. More recently deposited laminated silt and sand (alluvium) occurs near the western

boundary of the site. This alluvium is thickest near the Connecticut River and likely interfingers with the older stream terrace deposits. Other recent alluvial deposits are found scattered across the facility near existing and former streams or wetland areas.

1.3 Summary of Previous Investigations

This section presents a summary of the three previous phases of investigation conducted at Willow Brook and Willow Brook Pond from December 1997 to April 1999. A summary of the analytical results for the entire sampling program is included as Appendix A in a series of detailed site plans developed by LEA during the remedial investigation.

The investigations identified some probable sources and provided the analytical data to define the horizontal and vertical limits of contamination in sufficient detail to allow for the development of a remediation plan. Figures 1-2 and 1-3 present an overview of the delineation of the extent of PCBs in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond.

Phase I: *Report on PCB Investigation for Willow Brook and Willow Brook Pond Sediment*, prepared by LEA, dated February 13, 1998. The purpose of this report was to present the findings of the PCB investigation conducted on Willow Brook and Willow Brook Pond sediment in order to address the requirements of item (1) of the third paragraph of the NOV, No. PCB 97-08 issued by the CTDEP and dated November 7, 1997. The sampling was performed in accordance with the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997, and approved by the CTDEP on December 22, 1997.

The report describes the field activities performed based on a predetermined sampling grid and presents the analytical results of the investigations. A Toxic Substances Control Act (TSCA) sampling grid was developed to specify the number and location of samples for the investigation in accordance with USEPA's guidance document *"Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup"*. Two separate sampling grids were prepared for the east and west surface water bodies of Willow Brook Pond. The sampling was performed in accordance with the approved Work Plan, with the exception that the pond was not drained in response to CTDEP's concerns about sediment disturbance. Detectable PCB values on the sediment samples collected ranged up to a maximum concentration of 617 ppm total PCBs at sampling point WT-SD-33, located immediately downgradient of the subsurface connector between the eastern and western surface water bodies comprising Willow Brook Pond. Relatively high PCB concentrations were also observed in sediment samples collected in the vicinity of this location in both water bodies. Relatively elevated PCB concentrations were also observed along Willow Brook immediately downstream of Willow Brook Pond. A total PCB concentration of 327 ppm was observed in the sediment at location WT-SD-54. The results of the investigations indicated the presence of elevated PCB concentrations throughout Willow Brook Pond and in the section of Willow Brook between the pond and Main Street. The PCB concentrations observed beyond that point were below 1 ppm.

Selected sediment samples were also analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and the RCRA eight metals (arsenic, barium, cadmium, chromium, mercury, lead, silver, selenium) plus nickel, zinc.

Among the limited sediment samples analyzed for these parameters, elevated levels of SVOCs were detected in the sediment at location WT-SD-47 in the eastern water body of Willow Pond. Some of the highest SVOC concentrations reported in that sample included pyrene (480 mg/kg), phenanthrene (514 mg/kg), fluoranthene (537 mg/kg), chrysene (232 mg/kg), etc. Some of the highest metal concentrations

observed in this location included lead (153 mg/kg), zinc (152 mg/kg), barium (37.7 mg/kg), and nickel (36.4 mg/kg), etc. The only VOC compounds identified in this location included trichloroethylene (23 μg/kg), tetrachloroethylene (11.6 μg/kg), 1,1,1-trichloroethane (9.7 μg/kg), and 1,1-dichloroethane (10 μg/kg). Generally lower SVOC and VOC concentrations were observed in the other locations samples.

Elevated TPH concentrations were observed at WT-SD-47 (1,160 mg/kg) and WT-SD-09 (4,340 mg/kg and 3,940 mg/kg in the duplicate). Relatively elevated metal concentrations were also observed at this location (zinc 772 mg/kg and 689 mg/kg in the duplicate, nickel 595 mg/kg and 593 mg/kg in the duplicate, lead 714 mg/kg and 691 mg/kg in the duplicate, chromium 490 mg/kg and 497 mg/kg in the duplicate).

It should be noted that no sediment was encountered in upstream accessible locations along the Willow Brook conduit to allow sample collection. Several manholes along the subsurface conduit were opened to confirm no sediment had accumulated within the conduit. Historical measurements have indicated non-detectable PCB levels in sediment samples collected from upstream brook locations, prior to the conduit.

Based on the results obtained, additional investigations were determined to be necessary to better characterize the vertical extent of the contamination within Willow Brook and Willow Brook Pond and to identify potential nearby sources of contamination.

Phase II: *Report on Supplemental PCB Investigation for Willow Brook and Willow Brook Pond*, prepared by LEA, dated April 1998. The purpose of this report was to present the findings of the supplemental PCB investigation conducted on Willow Brook and Willow Brook Pond. The supplemental soil and sediment sampling was performed to identify potential nearby sources of contamination and to provide information of the vertical extent of the contamination within Willow Brook and Willow Brook Pond. An overview of the investigation of the potential source areas and the delineation of Willow Brook and Willow Brook Pond sediments is as follows:

Southwestern bank of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic sludge drying beds located to the south of Willow Brook Pond was a potential source. Four soil borings were also installed at the southwestern bank of Willow Brook Pond downgradient of the historic sludge drying beds. The borings were advanced to a depth of 20 to 24 feet from the western bank of the pond. Low total PCB concentrations (up to about 2 ppm) were detected in the borings installed along the southwestern bank of Willow Brook Pond. These concentrations did not appear to be indicative of a source of PCB contamination.

Area of Former Oil Basin area, within the western section of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the pond area was a potential source. The existing oil-water separator is currently operating in this area. Four soil borings were installed in the vicinity of the area of Former Oil Basin, the small embayment west of the Process Water Facility and south of the lower section of Willow Brook Pond. Two of these borings were installed on top of the bank immediately to the south of the area of Former Oil Basin using a Geoprobe® and advanced to a depth of 20 to 24 feet. The other two were installed by hand to a depth of 2 to 8 feet in the immediate proximity of the existing oil/water separator. PCBs were detected in the soils collected from the four soil borings; however, the highest total PCB concentrations were of the order of 1.3 ppm. These concentrations do not appear to be indicative of a source of contamination.

Former Oil-Water Separator, located historically in the area between the two sections of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the

Pond area was a potential source. Five soil borings were installed in the vicinity of the Former Oil-Water Separator in between the two sections of Willow Brook Pond to identify potential historic sources of PCB contamination. The soil borings were installed using a Geoprobe® to a depth of approximately 20 feet. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for analysis from each boring. Elevated total PCB concentrations were observed in the soil samples from this location. The total PCB concentration observed in this area ranged up to 128 ppm (location WT-SB-88) at a depth of 10 to 12 feet. Free oil was also observed in this location. However, the oil was not extracted from the soil matrix for analysis. The highest PCB concentrations were observed at a depth of approximately 8 to 12 feet below ground surface corresponding approximately to the depth of the water and sediment within the pond, and the approximate level of the water table in the area. These concentrations and findings from this area are indicative of a probable source. It should be noted that the contamination might have originated from multiple sources.

Sediment Sampling: In-depth sampling was also performed within the eastern and western water body of Willow Brook Pond, and along Willow Brook in the vicinity of the wetlands area, and in the wetland area within UTC/P&W's property. These samples were collected to develop at-depth profiling information. It should be noted that only surface sediment samples were collected during the initial Phase I investigation. A 5-foot core was used for collection of the sediment and underlying soil samples during Phase II. Generally, one sediment and two soil samples of the underlying soil were selected from each sampling location. Detected total PCB concentrations within the two sections of Willow Brook Pond (east and west) ranged in concentrations up to 258 ppm in the upper 0- to 2-foot interval. The highest concentration was observed in location WT-SD-72 near the pond's effluent point. Approximately 73.5 ppm of total PCBs were detected at a depth interval of 2 to 4 feet in location WT-SD-78, located at the eastern portion of Willow Brook Pond. Significantly lower and/or non-detectable levels were observed at greater depths. PCB concentrations remained at detectable levels at certain locations at depths up to 8 or 12 feet. Total organic carbon (TOC) concentrations up to 162,000 mg/kg were detected in sediment samples within Willow Brook Pond (location WT-SD-75 at a depth of 0 to 2 feet).

The total PCB concentrations detected in Willow Brook in the vicinity of the wetlands area and within the wetlands for surface samples (0 to 6 inches) ranged in concentration from 44 ppm up to 299 ppm (location WT-SD-92). The total PCB concentrations observed in the at-depth samples (1.5 to 2.0 feet) were significantly lower ranging from 2.6 ppm to 5.7 ppm.

Additional investigations were then proposed, focusing on the areas where the highest levels of PCB contamination were identified to further investigate and define the extent of contamination.

Phase III: *Report on PCB Investigation for Willow Brook and Willow Brook Pond,* prepared by LEA, dated April 1999. The purpose of this report was to present the findings of the third phase of PCB investigations in Willow Brook and Willow Brook Pond. During this phase, soil samples were collected from soil borings and monitoring wells installed in the vicinity of Willow Brook Pond. In addition, surface sediment and soil samples to depths of up to 6 feet were collected along the banks of Willow Brook. Soil/sediment samples were collected from the wetland area at Willow Arms and from other adjacent residential properties along the portion of Willow Brook, which lies downstream of Willow Brook Pond and to the east of Main Street. Groundwater sampling was also performed in monitoring wells installed at the perimeter of Willow Brook Pond.

Willow Brook Pond Perimeter Sampling: Twelve soil borings and eight monitoring wells were installed in the vicinity of Willow Brook Pond to assess the lateral extent of the contamination. The borings and monitoring wells were installed using a Geoprobe® to a depth of approximately 20 feet. Hand borings to

an approximate depth of 12 feet were installed in locations inaccessible by the Geoprobe®. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for PCB analysis from each boring, including the most contaminated one, based on visual observations, and random ones corresponding approximately to the depth of contamination obtained during the previous investigation. Total PCB concentrations of 50.87 ppm were observed to the east of the eastern water body at Willow Brook Pond, along the reinforced concrete pipe that conveys flow from Willow Brook into Willow Brook Pond. Relatively elevated PCB concentrations up to 14.33 ppm were observed in the area of the Former Oil-Water Separator between the two sections of Willow Brook Pond. This is consistent with previous findings and provides delineation of contamination in this area. Elevated concentrations of semi-volatile organic compounds (SVOCs) and select metals have been observed at some locations. The elevated compounds are consistent and appear to be co-located with the elevated PCB concentrations.

PCBs may have seeped into nearby soils at certain locations, for example at location WT-PZ--140 to the north of the larger water body of Willow Brook Pond (3.82 ppm). However, concentrations detected at depth are generally much lower or below detectable levels. The contamination was confirmed to be primarily contained within Willow Brook Pond.

Wetlands and Stream Bank Sampling: Soil/sediment samples were collected from several abutting residential properties along the segment of Willow Brook between Willow Brook Pond and Main Street. The samples were collected at different elevations along the bank of the brook to assess the lateral extent of contamination. Samples were also collected from the wetlands area at the Willow Arms property and from the adjacent portion of UTC/P&W's property. Surface soil/sediment samples were collected in a total of 28 locations. In seven of these locations, hand auger borings were advanced to approximately 6 feet to assess the vertical extent of contamination. Relatively elevated PCB concentrations (up to 596.2 ppm) were observed within the wetland area. Relatively elevated SVOC and select metals concentrations were also observed within this area, and, as stated before, are consistent and co-located with elevated PCB concentrations. The total PCB concentrations typically decrease to less than 1 ppm at a depth of 4 to 6 feet below grade. Similar concentrations were observed in the wetland area within UTC/P&W property. Total PCB concentrations up to 21.77 ppm were detected from sediment within Willow Brook in the off-site properties (downstream of the wetland area). The PCB concentrations observed drop substantially at higher elevations along the bank of Willow Brook, indicating that the contamination is confined within the brook and the wetland. PCB concentrations decrease to less than 1 ppm prior to Main Street.

Groundwater Sampling: Groundwater samples were collected by LEA personnel from the installed monitoring wells on December 4, 1998. Samples were collected using a peristaltic pump and dedicated polyethylene tubing. Of the eight monitoring wells installed, PCBs were only detected at two locations. PCBs were detected in groundwater from monitoring wells WT-PZ-136 [8.5 parts per billion (ppb)] and WT-PZ-139 (0.73 ppb). These wells are in the vicinity of locations where the highest PCB concentrations in soil have been detected.

Surface Water Sampling: Surface water samples were collected from two locations at Willow Brook Pond (at the pumps from the larger water body prior to entering the facility for non-contact cooling water use and at the dam) and from Willow Brook (downstream of Willow Brook Pond at the intersection with Main Street). No PCBs were detected in any of the surface water samples collected.

1.4 Nature and Extent of Contamination

1.4.1 Soil and Sediment

Overall and with consideration of the data collected to date, PCB concentrations are generally distributed in the brook and pond sediments gradually decreasing in concentration in the downgradient direction. This decrease trends from > 100 ppm in the pond and wetland areas to a concentration of < 1 ppm at Main Street. PCBs were also found in the soils between the two ponds, where the former oil/water separator was located. The vertical extent of PCB impacts has been defined by the sampling conducted, generally achieving non-detect or concentrations < 1 ppm at depths ranging from 4 to 6 feet below grade in the wetland area and 14 to 16 feet below grade in the soil between the upper and lower Willow Brook Pond (in the vicinity of the former oil-water separator). Soil samples collected along and up the banks of the brook and ponds define the horizontal limits of PCB to non-detect or concentrations of < 1 ppm. Figures 1-2 and 1-3 depict the extent of PCB impact in the Willow Brook and Willow Brook Pond area. Within the pond and brook the PCBs are commingled with SVOCs and select metals.

1.4.2 Groundwater

Groundwater samples collected during the remedial investigation identified only two locations where PCB concentrations were above detection limits (WT-PZ-136 at 8.5 ppb and WT-PZ-139 at 0.73 ppb). Well WT-PZ-136 is located in the immediate vicinity of the former oil/water separator and locations of high PCB content in soil. Well WT-PZ-139 is adjacent to an area of elevated PCB in soils. It is expected that removal of soil and source material in these areas will address PCB in groundwater. As these areas and the previously sampled monitoring wells will be removed during RA, post-excavation groundwater monitoring will be conducted to confirm no impacts to groundwater remain following excavation. This monitoring will be conducted through the installation of new monitoring wells in the area.

1.4.3 Surface Water

Surface water sampling from Willow Brook and Willow Brook Pond was performed on February 6, 1998. Samples were collected from Willow Brook Pond at the pumps pumping from the larger water body and dam and from Willow Brook downstream of Willow Brook Pond at Main Street. No PCBs were detected in any of the surface water samples collected.

2.0 STATEMENT OF WORK

The remediation plan for Willow Brook and Willow Brook Pond project as defined in Section 1.0, involves the excavation and offsite disposal of soil and sediment containing total PCB concentrations in excess of 25 ppm. The remediation plan for the wetland area located north of Willow Brook involves the excavation and offsite disposal of soil and sediment containing PCB concentrations in excess of the Residential Direct Exposure Criteria. Following excavation and removal of the impacted soil and sediment within Willow Brook and Willow Brook Pond, a cap consisting of an organic rich soil layer, a gravel layer and a stone layer will be placed within the limits of Willow Brook and Willow Brook Pond. The dam structure between Willow Brook Pond and the open channel section of Willow Brook will remain intact. The area will be restored to much the same configuration as exists today with two ponds (upper and lower Willow Brook Ponds) and an open channel (Willow Brook) from the downstream end of the pond to the cross culvert at Main Street. The existing wetland downstream of the pond will also be restored. Details regarding site restoration and capping are further discussed in Section 2.3.

As noted previously, soil and sediment within Willow Brook and Willow Brook Pond are also impacted by SVOCs, metals, and petroleum hydrocarbons. During the removal of PCB contaminated soil and sediment, a large percentage of the soils and sediment impacted by these constituents will also be removed. Remediation of other constituents of concern found in the remediation areas will be completed in accordance with the Remediation Standard Regulation (RSR), 22a-133k-1 through 3 of the Regulations of Connecticut State Agencies (RCSA). The remediation goals for the ancillary constituents are presented in tabular format in Appendix A and B to 22a-133k-2, more specifically the Industrial/Commercial criteria in Appendix A, the GB Mobility Criteria in Appendix B and/or alternative criteria in accordance with those specific provisions. In any event, any remaining contamination will be capped in accordance with the variance provisions in the RSR as noted previously. Following remediation, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire project area to preclude access to Willow Brook and Willow Brook Pond.

The proposed 25 ppm total PCBs action level within Willow Brook and Willow Brook Pond assumes future use of the remediation area as an open pond to be flanked by green space. However, as noted above, a perimeter fence will be installed to preclude free access to the remediated area. In the event that redevelopment of this area involves a bike path or roadway, the area directly beneath those uses will be remediated to a total PCB concentration of less than the Residential Direct Exposure Criteria. A release of the aforementioned Environmental Land Use Restriction by the Commissioner of the Department of Environmental Protection would be necessary before any redevelopment activities are initiated. Such release would necessitate the preparation of a detailed remediation and restoration plan, which would be consistent with the future proposed use of the subject area or part thereof. Furthermore, should redevelopment of the area necessitate remediation to less than the Residential Direct Exposure Criteria, appropriate barriers (i.e. fencing or railings) would be installed between the capped areas and the areas remediated to less than the Residential Direct Exposure Criteria.

2.1 General

This section details the work to be completed during the project. The section begins with a discussion of pre-construction activities including the application for necessary Federal, State of Connecticut and Town of East Hartford permits to complete the work, and the design of the project. This is followed by a

discussion of the construction activities including site preparation, the demolition and removal of existing structures, contaminated soil and sediment excavation and offsite disposal, wetlands restoration, site restoration activities, implementation of institutional controls, and record keeping and reporting. The last part of this section details post-construction activities. This includes a discussion on the preparation of a post-remediation report detailing the remediation activities and a post-remediation groundwater monitoring program.

2.2 Pre-Construction Activities

This section contains a description of those activities that will be completed prior to the initiation of PCB removal activities at the site. The pre-construction activities are presented in three general categories: project permits, engineering design, and health and safety plan.

2.2.1 Project Permits and Approvals

Prior to the initiation of construction activities and the completion of design activities, it will be necessary to obtain permits from a variety of regulatory agencies maintaining jurisdiction over the work. The agencies include the Army Corps of Engineers, the State of Connecticut Department of Environmental Protection, and the Town of East Hartford Inland Wetlands, and Planning and Zoning Commissions.

US Army Corps of Engineers

The work of this project involves the excavation of nearly 12,500 cubic yards of contaminated soil and sediment from within Willow Brook and Willow Brook Pond. The majority of the excavation activities occur within the two ponds, within the wetlands west of the ponds, or immediately adjacent to these areas. The construction activities will result in the disturbance of greater than 1-acre of wetlands within and immediately abutting the work. A permit from the Army Corps of Engineers is necessary prior to performing a construction activity that impacts greater than 1-acre of inland wetlands. In consideration of the fact that the project will result in the disturbance of greater than 1-acre of inlands wetlands, the permit from the Army Corps of Engineers will be sought through the individual permit process. The permit application was filed on February 14, 2001 and is currently under review. As part of this permit application, a public notice was issued. In response to the notice, the Army Corps of Engineers has not received any substantive comments.

Connecticut Department of Environmental Protection

Prior to initiation of the construction activities, it will also be necessary to obtain a permit from the CTDEP Inland Water Resources Division. This permit will address the need to obtain a water quality certification for the excavation/placement of fill within the flood plain and wetlands pursuant to Section 401 of the Clean Water Act. The permit application was filed on February 14, 2001 and is currently under review. Comments from the DEP on the application have been received and addressed in a revised submission. As part of this permit application, a public notice was issued. In response to the notice, the CTDEP Inland Water Resources Division has not received any substantive comments. .

The application to the IWRD was prepared and submitted on forms approved by the DEP and included: a permit application transmittal form; the permit application for programs administered by the IWRD; the technical documentation form; an executive summary; a USGS site location map; a listing of all adjacent property owners;; a soil scientists report; an engineering/hydrogeologic report; flood management

consistency worksheets; an environmental report; an alternatives assessment; a flood contingency plan; and plans and drawings detailing the work.

In addition to the above pre-construction permit, it will also be necessary to register for the General Permit for the Discharge of Storm Water and Dewatering Wastewaters Associated With Construction Activities and the General Permit for the Discharge of Groundwater Remediation Wastewater. The CTDEP Bureau of Water Management issues both General Permits. Registration packages will be submitted to the CTDEP prior to initiation of construction activities. In addition, a Storm Water Pollution Control Plan (a requirement of the storm water general permit) will be prepared prior to the initiation of construction activities.

In addition to the above permits, it will also be necessary to secure an approval for the use of an engineered control to remediate soil and sediment within the project area. The engineered control consists of the pond bottom/sediment, stream channel, and composite caps to be installed following excavation activities within the project area. The request was submitted to the CTDEP on January 5, 2001 in accordance with Section 22a-133k-2(f)(2)(B) of the Regulations of Connecticut State Agencies. The request was a detailed report and plan which was prepared to satisfy the requirements of the above referenced regulatory section and to document that the cost of excavation and offsite disposal of the polluted soil at the site is significantly greater than the cost of installing and maintaining an engineered control and conducting groundwater monitoring. The request further documented that the significantly greater cost outweighs the risk to human health and the environment if the engineered control fails to prevent the mobilization of, or human exposure to the remaining polluted soils. The request is currently under review by the CTDEP. The use of an engineered control is also subject to a public comment process. The public notice of the intended use of the engineered control was advertised on April 28, 2001. To date, no substantive comments have been received.

Town of East Hartford

Prior to the initiation of construction activities, it will be necessary to obtain three permits from the Town of East Hartford. These permits will be issued by the Inland Wetlands, and Planning and Zoning Commissions. The Inland Wetlands Commission permit will be necessary prior to the performance of construction activities within wetlands or within specified distances from a wetland. The Inland Wetlands Commission issued an approval for the project following a public hearing on the application on April 24, 2001.

The Planning and Zoning Commission permits will be in the form of a Major Flood Hazard Permit and a Soil Erosion and Sedimentation Control Permit. The Major Flood Hazard Permit will be necessary prior to performing construction activities within a flood hazard area of the Town of East Hartford. This application was submitted to the Town of East Hartford on May 7, 2001 and is expected to be approved in June 2001. The Soil Erosion and Sedimentation Control Permit must be obtained prior to initiating a construction project, which includes disruption to greater than ½ acre of land in the Town of East Hartford. This application was submitted on May 29, 2001 and is expected to be approved during June 2001. It should be noted, an Excavation Permit will not be necessary, as a special exception has been sought as the construction activities are being undertaken as part of a remediation project.

2.2.2 Engineering and Design

Prior to the implementation of the construction activities at the site, design drawings and technical specifications necessary to support permitting activities will be prepared to depict each phase of the

project. The construction drawings will be used in support of applications to obtain necessary permits as well as to direct the efforts during the construction activities. The technical specifications will be of adequate detail to ensure that each phase of construction is performed in accordance with the terms and conditions of any permits obtained prior to the initiation of construction, this Remedial Action Plan, and other applicable local, state and/or federal requirements. The project is being performed as a design-build effort. As such, detailed design plans and specifications beyond that which is necessary to support the permitting efforts and to establish the performance criteria for the remediation project, are not necessary. The drawings and figures contained herein represent the current status of engineering design for the project. Additional engineering design is not anticipated, other than the anticipated minor field alterations necessitated by changed conditions.

2.2.3 Health and Safety Plan

A Health and Safety Plan (HASP) will be prepared prior to the initiation of construction activities. The HASP will detail safety organization, procedures, and personal protective equipment that are based on an analysis of potential site-specific hazards. The HASP, will meet the requirements of 29 CFR 1910 and 29 CFR 1926 (which includes 29 CFR 1910.120 and 29 CFR 1926.65). The HASP will include, but will not be limited to, the following components:

- Identification of key personnel - All on-site personnel involved with the construction activities at the site will be required to maintain Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Training (29 CFR 1910.120 and 29 CFR 1926.65) and the corresponding 8-hour refresher course update
- Training – A description of health and safety training requirements for supervisory and on-site personnel will be presented. Training requirements will include attending an initial site orientation prior to performing on-site activities
- Medical Surveillance – A description of appropriate medical examinations required for supervisory and on-site personnel.
- Site Hazards – A description of chemical, physical, and climatological hazards associated with the project.
- Work Zones – A description of the work zones that will be established during construction activities.
- Personnel Safety Equipment and Protective Clothing – A description of personnel protective equipment and protective clothing to be used and available on site.
- Equipment Cleaning – The methods and procedures for decontamination of personnel, materials, and equipment will be described.
- Confined Space Entry – A listing of confined spaces and description of procedures for confined space entry in accordance with Permit Required Confined Space Entry (29 CFR 1910.146).
- Excavation Safety – A description of excavation and trenching safety procedures as specified in 29 CFR 1926 Subpart P.
- Standard Operating Procedures and Safety Programs as required by applicable portions of 29 CFR 1910 and 29 CFR 1926.

2.3 Construction Activities

The proposed construction activities involve:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;
- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below and the footprint of the process water facility) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;
- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and
- The implementation of two institutional controls consisting of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

The following parts of this section describe in general each of the anticipated construction activities necessary to complete the remediation.

2.3.1 Site Preparation

Drawing 2-1 presents the general site preparation details associated with this project. The following is a general description of anticipated site preparation activities.

Erosion Control

Appropriate soil erosion and sedimentation control methods (e.g., silt fence, straw bale dikes, absorbent booms, etc. as depicted in Figure 2-1) will be installed to mitigate the transport of suspended solids or sediments downstream. A soil erosion and sediment control plan is a component of applications for local, state and federal permits. Due to the magnitude of excavation to accomplish the removal of contaminated soil and sediment, excavation activities may be suspended during periods of heavy precipitation.

Clearing and Grubbing

The area in the immediate vicinity of Willow Brook and Willow Brook Pond is covered with a variety of vegetation, including the wetland areas (see Drawing 2-1). Vegetation ranges from mowed grass to

mature trees. To gain access to perform the planned excavation activities, clearing and grubbing will be required. Cutting, processing, and appropriate disposal of heavy vegetation will be a component of the project. It is anticipated that stumps from trees located in areas known or suspected to be impacted by PCBs or other constituents will be disposed of at an offsite facility as PCB remediation waste. The remainder of the woody debris will be shipped offsite for volume reduction and/or disposal as a solid waste in accordance with the State of Connecticut Solid Waste Management Regulations.

Decontamination Facilities

Contractor equipment that has been in contact with contaminated soil and sediment will require decontamination prior performing work in an uncontaminated area or demobilization from the site. A decontamination pad or pads will be strategically located at the site adjacent to excavations and vehicle loading areas. Potential locations for decontamination facilities are shown on Drawing 2-1. The decontamination pad or pads will generally be constructed of a wood frame or similar materials, lined with heavy plastic, and include a layer of open stone. Equipment that has come into contact with contaminated soil and sediment will be cleaned with a pressure washer, scrub brushes and organic solvent using a double wash/rinse process in accordance with Subpart S of 40 CFR Part 761 over the decontamination pad.

Durable field sampling equipment (e.g., stainless steel trowels, plastic scoops, shovels, etc.) used to implement the Field Sampling and Analysis Plan will be decontaminated prior to each sample location to mitigate the potential for cross-contamination of samples collected for laboratory analysis. Decontamination will be performed in accordance with Standard Operating Procedures provided as Appendix B and in accordance with 40 CFR Part 761.79(c).

Wash water and detergents used in the decontamination process will be disposed of following pretreatment through a mobile water treatment system (described in more detail later in this document) to the sanitary sewer in accordance with the terms and conditions of the CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater. The terms and conditions of this General Permit require removal of PCBs to a concentration of 1 μg/L, which is more restrictive than §761.79 (c).

Site Security

Limiting access to the site during construction will be accomplished thorough the use of both existing and permanent fencing (refer to Drawing 2-1 and Figure 2-2), along the north side of Willow Brook and Willow Brook Pond, and temporary construction fencing to be installed along Willow Street. The fencing will be supplemented by the use of security personnel to ensure that unauthorized persons do not access the construction site during remediation activities.

2.3.2 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Drawing 1-1). A list and description of the primary structures to be demolished and removed are as follows:

- Five buildings and components associated with the process water facility; and
- The former underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Area Preparation

Prior to demolition, a complete survey of the structures and their components will be performed. The survey is necessary to determine decommissioning, demolition, and disposal requirements. UTC/P&W will be responsible for shutdown and removal of components they intend to reuse from the process water facility.

Process Water Buildings

Demolition of the process water buildings will extend to a depth necessary to achieve the project objectives of removal of soil and sediment containing total PCBs in excess of the Commercial/Industrial Direct Exposure Criteria that are located within 4 feet of the ground surface and in excess of the GB Pollutant Mobility Criteria that are located above the seasonal high water table. Other related structures, such as pilings, erosion structures, etc., will also be demolished and removed to a depth necessary to achieve the project objectives. Pipes and utilities connected to these buildings will be abandoned or removed during the demolition activities or during the soil and sediment removal phase of the project. Utilities designated for in-place abandonment will be will be analytically assessed and decontaminated if necessary. Utilities located within an area of soil remediation shall be excavated and disposed of as bulk remediation waste.

A Civil War marker/gravestone is located to the east of the main water processing building. This feature shall be protected during all aspects of the work.

Former Oil/Water Separator

A buried oil/water separator is located between the upper and lower sections of Willow Brook Pond. This structure and surrounding soils are contaminated with PCBs. The oil/water separator, its contents, and the soil containing greater than 25 ppm PCBs surrounding the structure will be completely removed and disposed of at an offsite location during the project. If a light-non-aqueous phase liquid (LNAPL) is identified during excavation, the remediation of will proceed until the LNAPL is removed in accordance with Section 22a-449(d)-106(f) of the Regulations of Connecticut State Agencies. However, it is anticipated that the presence of LNAPL is coincident with soils containing greater than 25 ppm PCBs and the removal of the LNAPL would be completed during excavation of those soils. Prior to removal of the structure, the oil/water separator will be exposed and any liquids will be removed, characterized, and disposed of at an offsite location.

Available analytical data are sufficient to delineate the three-dimensional extent of soil impacted by PCBs in the vicinity of the oil/water separator. However, the data are not adequate for the purposes of establishing the lateral limits of the composite cap to be installed in this area to address soils impacted by other constituents. As a result, prior to implementing the remediation in this area, soil borings will be advanced to a depth of 15 feet using the Geoprobe®. Soil samples will be collected from each Geoprobe®soil boring and analyzed for PCBs and constituents other than PCBs. The intent of the sampling will be to delineate the three-dimensional extent of other soils requiring remediation for other constituents pursuant to the RSRs. It is anticipated that soil samples will be analyzed for mass and SPLP metals (RCRA 8 plus copper, nickel and zinc), cyanide, VOCs, SVOCs, and TPH. The location of each soil boring is discussed in Section 4.0.

Demolition Debris Management

Further evaluation of the affected structures and components will be performed to determine disposal requirements prior to demolition. Appropriate samples will be collected and submitted for laboratory analysis to characterize the waste for disposal. Any demolition debris characterized as bulk PCB remediation waste shall be disposed of at a chemical waste landfill approved under 40 CFR 761.75The sampling procedures and protocols are further discussed in Section 4.0, Field Sampling and Analysis Plan. It is anticipated that all material removed in the demolition process will be disposed of off site. An expected waste stream summary is presented in Section 4.0.

Soil Sampling and Analysis

Sampling and analysis of certain soils below and adjacent to the subject buildings and structures will be required to confirm horizontal and vertical limits, disposal and handling requirements. Soil confirmatory samples will be collected and analyzed in accordance with the Field Sampling and Analysis Plan presented in Section 4.0. The excavated and staged soil will be sampled for disposal characterization. The soil disposal characterization samples will also be collected in accordance with the Field Sampling and Analysis Plan. All confirmatory and disposal characterization samples will be analyzed in accordance with the Quality Assurance Project Plan in Section 5.0.

2.3.3 Contaminated Soil and Sediment Excavation and Offsite Disposal

This section presents a summary description of the planned soil and sediment excavation and offsite disposal activities. As noted, it is anticipated that approximately 12,500 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. The proposed by-pass channel was incorporated into this project primarily to facilitate in-situ dewatering and to mitigate potential logistical complications associated with other water handling options. Based on the available historic stream channel bathymetry and utility invert data, the by-pass channel is expected to effectively relieve the groundwater table to an elevation below 21.00 in the pond areas. A field determination will be made based on the percent solids observed in the in-situ material, to excavate the material and direct-load the haul vehicles for off-site disposal, or to excavate the material and stage it in a temporary staging area for further gravity dewatering. The staged material would again be evaluated after a 24-hour period to assess the percent solids. If the percent solids are unacceptable for over-the-road transport, lime will be added to the material to further stabilize it and to achieve compliance with shipping requirements.

If it is determined that material staging in stockpiles is necessary to facilitate the offsite disposal of the contaminated soil and sediment, a material staging and stockpile area will be constructed. The material staging and stockpile area construction and operation is discussed in greater detail below.

Contaminated soil and sediment will be characterized for disposal based on the "as-found" concentration of PCBs. Additional analysis will be performed on stockpile grab samples as needed to satisfy the disposal vendor. The waste will be disposed of based upon the more restrictive analytical data regardless of the as-found concentrations (e.g. if in-situ characterization documents < 50 ppm PCBs and the stockpile data suggests > 50 ppm, the waste disposal profile used for this particular load would be based on the stockpile data). Stockpile analytical data would not be used to reduce any disposal restrictions on the material.

Stream Flow During Construction

The construction project involves the excavation of submerged sediments from within Willow Brook and Willow Brook Pond. Remediation will begin at the upstream pond and progress downstream. To accomplish the excavation, it will be necessary to temporarily redirect flow within Willow Brook.

During construction, all flow entering the PCB remediation work area from the upstream conduit of Willow Brook will be bypassed by the construction of a channel capable of conveying a 100 year flood as defined by the Flood Insurance Study prepared for the Town of East Hartford in January of 1979. The bypass channel will be constructed on the south side of the Willow Brook and Willow Brook Ponds as depicted in Drawing 2-2 and as detailed in Figure 2-3 through 2-5. Provisions will be made to direct local drainage that enters the work area directly from storm sewers on United Technologies Corporation, Pratt & Whitney property on the south side of the work area into the bypass channel. Storm water discharges from municipal and privately owned storm sewers that enter the work area from the north will either be conveyed or pumped around active work areas. During a 500-year flood, the hydraulic gradient above the work area would be higher than the conduit, and the backwater would cause some catch basins to be surcharged above the surface elevation of the inlets upstream of the conduit outlet. Provision has been made to seal the catch basins within the temporary staging and stockpile areas upgradient of the conduit outlet and to block surface flow from entering either the work area or the storage areas.

Dewatering

In addition to water diversion, it is also likely that construction dewatering will be necessary to facilitate the removal of soil and sediment containing greater than 25 ppm total PCBs. Conventional sump or well-point techniques will be employed to allow for spot dewatering of excavation areas. All dewatering wastewater will be containerized, treated as necessary, sampled, then discharged to the Town of East Hartford Water Pollution Control Facility through a sanitary sewer under a general permit, issued by the DEP, for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer. The collected water will be pumped to a settling tank within which solids will be separated. Water will be decanted from the settling tank, treated in an onsite mobile water treatment system through a wet-phase carbon adsorption system then discharged. All related monitoring and record keeping shall be implemented as mandated by this general permit. A copy of this general permit is provided as Appendix C.

Excavation Methods

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Drawing 2-3. Based on the prior investigations, it is anticipated that an average of 2 to 3 feet of sediment will be removed from the pond and brook, respectively and up to 4 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the former oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bulldozers, and loaders. It likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

Once the target soils and sediment have been removed and verified, the excavation will continue in the next remediation area and the placement of the geotextile, soil and stone cap (See Section 2.3.4) can proceed. Should the confirmatory samples indicate that the 25 ppm total PCB limit has not been achieved within the pond and brook or the Residential Direct Exposure Criteria for PCBs within the wetland area,

additional excavation will be performed. Excavation will continue until all soil and sediment containing PCBs at concentrations in excess of 25 ppm within the pond and brook and the Residential Direct Exposure Criteria for PCBs within the wetland are removed.

Soil/Sediment Sampling and Analysis

Sampling and analysis of certain soils/sediments will be required to confirm horizontal and vertical limits, disposal and handling requirements. Soil and sediment confirmatory samples will be collected in accordance with the Field Sampling and Analysis Plan presented in Section 4.0. The excavated and staged soil and sediment will be sampled for disposal characterization. The soil and sediment disposal characterization samples will also be collected in accordance with the Field Sampling and Analysis Plan. All confirmatory and disposal characterization samples will be analyzed in accordance with the Quality Assurance Project Plan in Section 5.0.

Soil/Sediment Staging

During the soil and sediment removal activities the excavated soil and sediment may need to be temporarily relocated into staging areas adjacent to the excavation area for gravity dewatering and lime stabilization as detailed above. The staging areas will consist of a perimeter berm and will be lined with polyethylene and pavement to contain all soils and liquids. Soil and sediment placed within the staging areas shall be covered with a low permeability sheet to limit exposure to precipitation. All water within the staging areas will be collected in a pre-formed sump located at an intentionally defined low spot within the staging area(s). The collected water will be pumped to a settling tank within which solids will be separated. Water will be decanted from the settling tank, treated in an onsite water treatment system through a wet-phase carbon adsorption system then discharged to the Town of East Hartford Water Pollution Control Facility. Sampling, as necessary to comply with the terms and conditions of the general permit for discharge and the Town's discharge requirement will be performed. Prior to initiating the discharge to the sanitary sewer, the treated water will be sampled to ensure that the PCB concentration is less than 1 ug/l and all other constituents comply with the terms and conditions of the general permit.

Stabilization

The excavated soil and sediment shall be staged for dewatering by gravity within a staging area in order to meet applicable requirements for disposal (i.e., no free liquids). It is anticipated that the soil and sediment will be further stabilized utilizing up to six percent lime by weight, only if necessary. Lime will be evenly incorporated into the excavated soil and sediment via mechanical mixing. This stabilization process is intended to facilitate the legal shipping of the contaminated material over-the-road to a permitted offsite disposal facility.

Off-Site Disposal

It is anticipated that all soil and sediment excavated as part of this project will be shipped to an offsite facility for disposal. The offsite disposal includes handling, storing, containerizing, transporting (including providing and preparing manifests, bills of lading, etc.) and disposing of excavated soil and sediment. The excavated soil and sediment will be transported via a licensed waste hauler to a permitted chemical or solid waste disposal facility dependant on the waste characterization. The estimated in-place volume of soil and sediment requiring offsite disposal is 12,500 cubic yards.

Dust-Control

Included as Appendix D is a project-specific Dust Control Plan. This plan establishes the activities that will be performed to minimize the potential exposure to unacceptable levels of airborne contaminants during the work.

2.3.4 Pond/Stream Channel Cap, Engineered Control, Wetland Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The planned restoration activities are described in detail below and depicted on Drawings 2-4 and 2-5 with related details and sections presented in Figures 2-6 through 2-8. The site restoration involves the installation of 3 types of caps/engineered controls over soil and sediments remaining following excavation and removal of those containing total PCBs at concentrations greater than 25 ppm. The cap details were derived based on the anticipated stream flow velocities and considered the ultimate use of the area as a combined wetland, pond, and stream channel. The base of each cap consists of a non-woven geotextile, a 9-inch layer of organic rich soil, and a non-woven geotextile. This layer is referred to below as an organic-rich layer. This organic-rich layer is included as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. The caps are described below and are depicted on Figures 2-6 through 2-8.

- Within Willow Brook Pond, a 36-inch soil and stone cap is proposed (refer to Drawing 2-4 and Figure 2-6). The cap will consist of a 9-inch organic rich layer, 21 inches of process gravel, and a 6-inch layer of 4-inch stone. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.
- Within Willow Brook (downstream of the dam), a 36-inch soil and stone cap is proposed (refer to Drawing 2-4 and Figure 2-7). The cap will consist of a 9-inch organic rich layer, a 15-inch layer of modified rip-rap and a 12-inch layer of cobbles, gravel and coarse sand. The 15-inch layer of modified rip-rap extends the width of the channel bottom and transitions into a 24-inch layer of intermediate rip-rap on the side slopes of the channel banks. The 24-inch layer of modified rip-rap extends up the channel banks to the elevation of the 10 year flood. The rip-rap channel lining has been designed to withstand the erosive forces anticipated in the stream channel following completion of the construction project.
- The area of the underground oil/water separator will be provided with a composite cap (refer to Drawing 2-4 and Figure 2-8). The composite cap will consist of a 40-mil flexible membrane liner, a geotextile drainage layer, 30-inches of granular backfill, and a 6-inch loam and seed layer.
- In addition to the above, the wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of granular fill, and 12-inches of wetland soil. The wetland will be planted with native wetland plants (refer to Drawing 2-4 and Figure 2-9).

In response to a request by the Department of Environmental Protection (DEP) staff, the Willow Brook stream channel will be slightly modified between the dam that impounds Willow Brook Pond and Main Street to reduce the slope of the banks to control potential erosion and to modify the character of the channel bottom to create a low flow channel with pools and eddies. The limits of these improvements are shown on Drawing 2-5.

2.3.5 Site Restoration

Following the completion of the excavation and offsite disposal of contaminated soil and sediment, all areas disturbed by construction will be restored. The restoration of the waterway and wetland were previously described. It is anticipated that restoration activities for area outside the waterway and wetland will consist of the installation of paved parking areas or grassed areas. Planned final site restoration is presented in Drawing 2-4.

The future site use options may consist of the following:

- Additional automobile and/or truck parking; and
- Relocation/rerouting of Willow Street to the northern portion of the property as indicated on Figure 2-10.

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 2-5 and Drawing 2-4).

In the event that redevelopment of this area involves a bike path or roadway, the area directly beneath those uses will be remediated to a total PCB concentration of less than the Residential Direct Exposure Criteria. A release of the Environmental Land Use Restriction by the Commissioner of the Department of Environmental Protection would be necessary before any redevelopment activities are initiated. Such release would necessitate the preparation of a detailed remediation and restoration plan, which would be consistent with the future proposed use of the subject area or part thereof. Furthermore, appropriate barriers (i.e. fencing or railings) would be installed between the capped areas and the areas remediated to a concentration less than the Residential Direct Exposure Criteria.

2.3.6 Record Keeping and Reporting

The following records will be maintained during construction to document the remedial activities:

1. The delineation of the final horizontal and vertical limits of the soil and sediment removal activities;
2. A photographic record of construction progress;
3. Records of all quality assurance/quality control (QA/QC) testing performed;
4. A record of all field screening and confirmatory sampling and analytical results, including sampling methods, locations and depths, frequency, and analytical results;
5. Results of all waste disposal characterization samples of excavated materials;
6. Results of all samples of treated effluent from the temporary on-site wastewater treatment system;
7. A record of all daily activities; quantities of materials removed, generated, used, and disposed of; and document manpower, material, and equipment used;
8. A record of all materials and equipment delivered to the site; and
9. Copies of all hazardous waste manifests, non-hazardous waste bills of lading, and certificates of disposal for wastes generated during the project.

2.4 Post-Construction Activities

The following is a general description of the post-construction activities. It is anticipated that the post construction activities will include the preparation of a report documenting the remediation of the site and the implementation of a post-remediation groundwater monitoring program.

2.4.1 Post-Remediation Reports

A post remediation report will be prepared for submission to the appropriate regulatory agencies. The report will contain a detailed description of remediation activities, confirmatory samples, offsite disposal documentation, appropriate figures and drawings, and analytical data tables presenting results of confirmatory samples. The post remediation report will be prepared to provide a full accounting of all activities performed and documentation necessary to support the conclusion that the remedial activities met the objectives of this Remedial Action Work Plan. The report will be submitted to the CTDEP and EPA for review and ultimate approval. A separate report will be generated to satisfy the project closeout reporting requirements of the wetlands restoration efforts. The project closeout report is a likely condition of a permit or approval issued by the Army Corps of Engineers.

2.4.2 Post Remediation Groundwater Monitoring Program

Following completion of remedial activities, it will be necessary to perform post remediation groundwater monitoring of groundwater in the vicinity of Willow Brook and Willow Brook Pond. A Post-Remediation Groundwater Monitoring Program has been developed and submitted to the CTDEP and EPA. The Post-Remediation Groundwater Monitoring Program specifies groundwater monitoring wells to be sampled, field collection and analytical methods, quality assurance/quality control procedures, program duration, and reporting requirements. It is anticipated that post-remediation groundwater monitoring will be performed on a quarterly basis for a period of not less than two years.

3.0 PROJECT SCHEDULE

The anticipated completion dates for major project activities are as follows:

• Permits from US Army Corps of Engineers, CTDEP and East Hartford	June 2001
• Site Remediation Construction Period	December 2001
• Site Restoration/Establishment of Vegetation	June 2002
• Post Remediation Report, filing ELURs and Groundwater Monitoring Plan	June 2002

A detailed project schedule is included as Figure 3-1.

4.0 FIELD SAMPLING AND ANALYSIS PLAN

4.1 Introduction

4.1.1 General

This plan addresses the field procedures, samples to be collected, sample type, sample location and the sample collection methods to be used during implementation of the remedial activities outlined in the RAWP. The Quality Assurance Project plan (QAPP), is presented in Section 5.0.

4.1.2 Objectives of the Sampling and Analysis Plan

The overall objective of the sampling and analysis program is to provide analytical data that verify the achievement of the remediation goals for the site. The sampling program has been developed in consultation with the requirements presented in 40 CFR Part 761 Section 761.61 (c), 40 CFR Part 761 Subpart O, and the documents entitled *Verification of PCB Spill Cleanup By Sampling and Analysis*, EPA August 1985 and *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup*, EPA May 1986. The objective of this risk managed remediation program is to remove PCB-impacted soil exhibiting concentrations in excess of 25 ppm and place a 3-foot cap over the residual contamination areas (i.e., those areas that exhibit PCB concentrations less than 25 ppm). The proposed caps were described in previous sections. The portion of the wetlands to the north of the Willow Brook stream channel will be excavated to a PCB concentration less than the Residential Direct Exposure Criteria. Based on the objectives of the remediation program, the following specific objectives have been established for the sampling and analysis program:

- Confirm that PCB concentrations remaining in soil/sediment at the limits of the excavation are consistent with the Remedial Action (RA) objectives; and
- Determine the handling and disposal requirements for the soil/sediment and miscellaneous materials generated during implementation of the RA.

4.1.3 Overview of the Sampling and Analysis Program

Analytical results associated with samples collected as part of the RA activities will be used to document that the objectives of the RA have been satisfied. Samples that will be collected as part of the RA will consist of the following:

- Post-excavation soil/sediment samples to confirm the successful implementation of the RA and document residual contamination concentrations;
- Post PCB excavation soil sampling to confirm the limits of soil requiring remediation pursuant to the RSR (as a result of other constituent concentrations) in the vicinity of the former oil/water separator and the wetland area;
- Concrete disposal characterization samples;
- Soil/sediment disposal characterization samples for verification of constituent concentrations ; and

- Miscellaneous material samples for the assessment of disposal options and/or treatment performance (e.g., the temporary wastewater treatment system) associated with the implementation of the RA.

The location of the characterization samples performed and PCB isoconcentration contours are shown on Figures 1-2 and 1-3 for Willow Brook and Willow Brook Pond, respectively. The proposed sampling grid for the confirmatory samples to be collected is shown schematically in Figure 4-1. The proposed layout for the confirmatory sampling is presented on Drawing 4-1. In addition, disposal characterization samples will be collected from excavated materials associated with the RA.

4.2 Remedial Action Field Sampling

4.2.1 General

Details associated with implementing the Field Sampling Program (FSP) are presented in this section. The following information concerning the FSP is also provided:

- Proposed sample grid, sample identification numbers, and sample type;
- Procedures for sampling and for measuring field parameters; and
- A summary of the data to be generated from each sampling effort, including field and analytical parameters.

Detailed information regarding the RA field sampling including the number/type of environmental samples and quality control samples to be collected, sample intervals, analytical parameters, sample containers, preservation, and holding times are presented in tables located at the end of this section. A description of these tables is provided below:

Table No.	Title	Contents
4-1	Confirmatory Sample Summary	Presents the sample media, anticipated number of samples to be collected from the excavations, the sampling frequency, anticipated sample depth, and laboratory analytical parameters.
4-2	Quality Control Analyses Summary	Indicates the number and type of quality assurance/quality control (QA/QC) samples, which will be required.
4-3	Sample Containers, Preservation, and Holding Times For Soil/Sediment and Water Samples	Indicates the appropriate sample containers, preservation methods, and holding times for the samples to be collected.

All sampling activities will be performed in accordance with the Loureiro Engineering Associates, Inc. Standard Operating Procedures provided in Appendix B.

4.2.2 Post-Excavation Confirmatory Sampling

Post-excavation confirmatory sampling of soil/sediment will be conducted in the areas to be excavated (Drawing 2-3) to confirm that residual PCB concentrations do not exceed the RA objectives at the limits of the excavations (25 ppm PCBs in all areas to be capped, the Commercial Industrial and GB Pollutant Mobility Criteria in inaccessible soil locations within and immediately adjacent to the process water buildings, and the Residential Direct Exposure Criteria for PCBs in the wetland area to the north of the stream channel). The proposed layout for the confirmatory sampling is presented on Drawing 4-1. Confirmatory soil sampling will be performed throughout the project as necessary to document the adequacy of the remedial measures as proposed.

PCB Confirmatory Soil Sampling – Engineered Control Areas

Post-excavation confirmatory soil/sediment samples for PCBs will be collected from the bottom and sidewalls of the excavated areas which will be located beneath the engineered controls within Willow Brook. Willow Brook Pond, and the oil-water separator area as defined above at a frequency of one sample per 400 square feet, which equates to a 20-foot grid spacing. Grab samples will be obtained within each grid node. A maximum of four grab samples from adjacent grid nodes will be composited into one sample in the field for PCB analysis in the laboratory. This analysis will represent the respective 1,600 +/- square foot area as shown in Figure 4-1.

The grid will be conservatively applied to a two-dimensional diagram of the entire three-dimensional remediation area to maximize the total number of sample locations. The sampling points will proceed in every direction to the extent sufficient to result in a comprehensive two-dimensional grid completely overlaying the excavation area. Judgmental samples would be added as appropriate based upon field observations and as needed to adequately represent the sidewalls (where present) and floor area of each remediation area. Based on the available analytical data and related proposed limits of the remedial excavation, Drawing 4-1 (Potential Confirmatory Sample Locations) was prepared to demonstrate the expected layout of the grid with additional judgmental samples spotted as appropriate.

Evaluation of the composite data for PCBs would be based upon a direct comparison of the sample data to the 1 ppm and 25 ppm criteria. More specifically, any result for a composite sample below 1 ppm in a 1-ppm target area located beneath an engineered control and 25 ppm in a 25-ppm target area located beneath the engineered control would result in the conclusion that remediation in those areas has been completed.

PCB Confirmatory Soil Sampling – Non-Engineered Control Areas

Non-engineered control areas within the limits of the project include the wetland west of the dam, the footprint of the process water facility and ancillary structures to the process water facility, and the single area east of the eastern limits of the upper section of Willow Brook Pond (the vicinity of WT-SB-132). Post-excavation confirmatory soil/sediment grab samples for PCBs will be collected from the bottom and sidewalls of these excavated areas as shown in Drawing 4-1. The data from the individual grab samples will be evaluated pursuant to the RSR to confirm the completion of remediation in these areas.

Confirmatory Soil Sampling for Constituents Other than PCBs

As defined by the available analytical data, there are other constituents of concern that are noted in soil and sediment within the project area. These other constituents include metals, VOCs, SVOCs, TPH and

cyanide. The remediation is designed to address these constituents as well as PCBs. Remediation of other constituents of concern found in the remediation areas will be completed in accordance with the RSR. In addition, an engineered control (EC) will be installed within the limits of the project area (with the exception of the wetland area which will be remediated to less than the Residential Direct Exposure Criteria for PCBs, a small area in the vicinity of WT-SB-132, and the footprint of the process water facility which will be remediated in accordance with the Commercial/Industrial Direct Exposure Criteria and in excess of the GB Pollutant Mobility Criteria that are located above the seasonal high water table as previously described) in accordance with the variance provision in the RSR thereby allowing soils exceeding the tabular criteria to be left in place.

As discussed earlier in this section, two specific areas of the site will need to be evaluated for PCBs as well as other constituents of concern, i.e. in the vicinity of the former oil/water separator and within the wetland area. In order to document the adequacy of the lateral extent of the remediation within the wetland area, soil grab samples will be obtained from the sidewalls of the excavations at varying depths of not less than 1-sample per 3-vertical feet every 20-feet (e.g. a 5- foot deep excavation that has a 60-foot long sidewall would have 3- sidewall samples at 2-feet below original grade and 2-sidewall samples at 4-feet below original grade at alternating depths on 10-foot centers). This sampling pattern will be enhanced with judgmental samples as needed based on field observations. This pattern would be implemented on the northern, eastern and western sidewalls of the wetland remediation area. Since the wetland area will be restored without a cap, floor sampling for constituents of concern other than PCBs will be necessary. Floor sampling will be accomplished by obtaining one grab sample at the center point of the four adjacent grid nodes defined for PCB sampling. This analysis will represent the respective 1,600 +/- square foot area as shown in Figure 4-1.

For the oil/water separator area, the excavation will proceed until the results of the previously described PCB confirmatory sampling verify removal of all soil and sediment containing greater than 25 ppm PCBs. The limits of the composite cap to be installed over this area will be defined through additional soil sampling and analysis discussed in Section 2.0. The initial sampling locations are shown on Drawing 4-1. Additional soil borings would be added, as necessary, to delineate the three-dimensional extent of soils impacted by constituents other than PCBs (i.e. metals, cyanide, VOCs, SVOCs, and TPH). It is anticipated that soils requiring remediation for constituents other than PCBs extends beyond the lateral limits of soil impacted by greater than 25 ppm PCBs. As a result, following excavation of soils greater than 25 ppm PCBs, soils from the upper three-feet outside the lateral limits of the PCB excavation, but within the limits defined as requiring remediation for other constituents pursuant to the RSRs, will be stripped and used to backfill the PCB excavation. Confirmatory sidewall grab sampling as described above will be implemented to ensure all soils requiring remediation pursuant to the RSR will be located beneath the composite cap.

The analytical data derived from these analyses for other constituents would be compared to the appropriate criteria presented in the RSR. As noted above, exceedances would be addressed by extension of the cap or further remediation, as appropriate.

Sample Collection

Procedures for collecting post-excavation PCB confirmatory soil/sediment samples are presented as follows:

- Soil/sediment will be collected from each of the discrete sampling locations through the use of a calibrated disposable syringe. One syringe will be used for each composite sample. The individual grab samples will be used to form a single composite sample in the field.
- The aliquots will be composited and mixed thoroughly in the laboratory-supplied glassware.
- At the laboratory, a final sample, of sufficient weight and volume will be collected from the composite, dried at low temperature or in a desiccator at ambient temperature, extracted and analyzed to represent the post-excavated confirmatory soil/sediment sample.
- A second portion of the sample will be weighed out at the same time as the portion to be used for analytical determination. This portion will be weighed, oven-dried and used to calculate the percent dry weight of the sample. The oven-dried aliquot will not be extracted or used for analytical determination.

Procedures for collecting vertical and lateral limit confirmatory soil samples (constituents other than PCBs) are presented as follows:

- Soil will be collected from each of the discrete sampling locations. The individual grab samples will not be used to form a composite sample.
- A sample, of sufficient weight and volume will be obtained from the sample container, extracted and analyzed to represent the post-excavated confirmatory soil present.
- Samples for VOC analysis will be collected in accordance with SW-846 Method 5035.
- A second portion of the sample will be weighed out at the same time as the portion to be used for analytical determination. This portion will be weighed, oven-dried and used to calculate the percent dry weight of the sample. The oven-dried aliquot will not be extracted or used for analytical determination.

Soil/sediment samples shall be collected using disposable sampling equipment or decontaminated spatulas, split-spoon samplers, augers or an equivalent. All disposable components of a sampling device will be disposed of prior to sample collection and all fixed components of a sampling device will be decontaminated prior to sample collection. The materials and procedures to collect post-excavation confirmatory soil/sediment samples are presented below.

- Appropriate health and safety equipment;
- Plastic sheeting;
- Tape measure (50 feet or greater);
- Appropriate soil sample containers;
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Field forms and labels;
- Chain-of-custody forms; and
- Site map with post-excavation confirmatory soil/sediment locations.

Each component of the sampling device will be decontaminated or replaced with a new, dedicated, or disposable component prior to collecting soil/sediment samples for laboratory analysis. The sampling equipment will be decontaminated as previously discussed.

A portion of each confirmatory soil sample will be used for visual characterization. In addition, field analysis will be conducted to determine if PCB concentrations are above or below the RA objective of 25 ppm. The field analysis will be performed using screening tests, as for example, rapid immunoassay

screen test kits. The PCB field test kits are a semi-quantitative screening method that determines whether the total PCB concentration is above or below the specified threshold values by comparison with a standard. Rapid immunoassay screen tests will not be used to determine final compliance with the RA objectives, rather they will be used as a means to direct the need for further excavation prior to embarking on final confirmatory sampling and analysis at a fixed laboratory in accordance with the procedures outlined above. The manufacturer will provide standard operating procedures for PCB field test kits. Final confirmatory samples will be submitted to the laboratory for analysis for PCBs (USEPA SW-846 Method 8082A revised Jan. 1998).

QA/QC soil/sediment samples will also be collected as described in Section 4.5.2 and in the QAPP presented in Section 5.0. Trip blanks, equipment blanks, duplicate samples and performance evaluation samples will be submitted for analysis. Table 4-1 presents the number of soil/sediment samples to be collected, and Table 4-2 presents the associated QA/QC soil sampling frequencies. Samples will be placed in appropriate laboratory supplied sample containers, preserved as described in Section 4.4.1, and labeled as described in Section 4.4.2. The samples will be handled, packaged, and shipped under appropriate chain-of-custody procedures as presented in Section 4.4.3.

4.2.3 Disposal Characterization Sampling

Contaminated soil and sediment will be characterized for disposal based on the "as-found" concentration of PCBs in accordance with 40 CFR 761.61. This data will establish the basis for segregation within the staging areas. Additional analysis will be performed on stockpile grab samples as needed to satisfy the disposal vendor. Additional analytes beyond PCBs will include metals, VOCs, SVOCs, TPH, or cyanide as appropriate for thorough characterization. The waste will be disposed of based upon the more restrictive analytical data regardless of the as-found concentrations (e.g. if in-situ characterization documents < 50 ppm PCBs and the stockpile data suggests > 50 ppm, the waste disposal profile used for this particular load would be based on the stockpile data). Stockpile analytical data would not be used to reduce any disposal restrictions on the material.

A minimum of two and a maximum of four separate waste streams are expected. The minimum two waste streams are PCB remediation waste (PCBs > 50 mg/kg) and PCB contaminated waste (PCBs < 50 mg/kg). The additional two waste streams would include the above minimum two but with the addition of other underlying hazardous constituents. Supplemental analysis (for PCBs as well as other constituents of concern) will be performed for disposal vendor satisfaction and for disposal characterization of the concrete debris from demolition of the process water facility and the former oil/water separator. Supplemental analysis for disposal vendor satisfaction will be performed from stockpile grab samples using a random node sampling technique. Disposal characterization sampling of concrete debris will be performed at a rate of approximately 1 sample per 500 tons of concrete debris or at a more frequent rate as directed by the disposal vendor.

4.2.4 Miscellaneous Sampling

In addition to the sampling activities described above, additional sampling may be performed to determine handling and disposal requirements. These samples may include effluent samples from the temporary wastewater treatment system and debris from the demolition of the existing process water facility. A description of the sampling and analysis to be conducted for each of these materials is presented below.

Effluent Samples from the Temporary Wastewater Treatment System

Surface water or groundwater that enters the active remedial excavations and water generated from soil/sediment dewatering activities will be pumped to on-site storage tanks and treated on site at a temporary wastewater treatment system. During normal operation of the temporary wastewater treatment system, effluent samples will be collected and analyzed for specific parameters as required by the discharge permit. Effluent samples will be collected and analyzed in accordance to the frequency specified by the permit to confirm that discharge permit limits are achieved.

Demolition of the Existing Water Process Facility

As part of the RA, the existing process water facility will be demolished. Further evaluation of the building system and building components will be performed to determine disposal requirements; these requirements will be reviewed in the RD.

4.3 Sample Designation System

4.3.1 Sample Codes

A six-digit designation code and sample date will provide each sample with a unique sample identification number. This alphanumeric system will apply to all samples collected and submitted to the designated laboratory for analysis. The designation codes that will be used for the samples collected, as part of the RA, are presented below:

Sample Type	Sample Location Designation
Confirmatory Soil/Sediment Samples	• A prefix indicating that the sample was collected in the Waste Treatment area (WT-) • A designation (CS) indicating that the sample is a confirmatory sample; • A consecutive number indicating the sample collected.
Disposal Characterization Soil/Sediment Sample	• A prefix indicating that the sample was collected in the Waste Treatment area (WT-) • A designation (DC-) indicating that the sample is a disposal characterization sample; • A consecutive number indicating the sample collected.
Temporary Wastewater Treatment System Effluent Samples	• A prefix indicating that the sample was collected in the Waste Treatment area (WT-) • Samples of the effluent water from the treatment system will contain a the designation (EW) followed by a consecutive sample number.

Blind sample numbers will be assigned to the samples submitted to the laboratory for QA/QC purposes. The blind sample numbers will be associated with the sample location designations only in the field forms.

4.4 Sample Handling and Documentation

4.4.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for samples collected as part of the RA are shown in Table 4-3. The analytical laboratory will supply appropriate sample containers, sample labels, and preservatives.

An example of a sample label, custody seal, field sampling record and chain–of–custody form are included in Figures 4-2 through 4-5, respectively.

4.4.2 Packing, Handling, and Shipping Requirements

Sample custody seals and packing materials for filled sample containers will also be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler with ice and packed to eliminate the possibility of container breakage.

All samples will be packaged by the field personnel and transported as low concentration environmental samples. The packaged samples will be shipped either by carrier or hand delivered to the laboratory within 36 hours of sample collection.

4.4.3 Documentation

Field personnel will provide documentation for all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record, which allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the fieldwork will be retained in the project file.

Various forms of documentation to be maintained throughout the RA include:

- Daily Production Documentation – Daily field forms containing a record of all field sampling activities.
- Sampling Information – Detailed notes will be made concerning the sample location, physical observations, sample depths, and weather conditions.
- Chain-of-Custody – Chain-of-custody forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Chain-of-custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by one of the field personnel designated to be responsible for sample custody.
- Field Equipment Calibration, and Maintenance Logs – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment.

4.4.4 Electronic Database

All data including field and analytical data collected will be maintained in a site-specific electronic database. The database already contains all characterization data obtained during the Willow Brook and Willow Brook Pond investigations to date. All data entered in the database will be verified for accuracy.

4.5 Management of Sampling-Related Materials and Wastes

The handling of sampling related materials and wastes is discussed below.

4.5.1 Disposable Equipment and Debris

Disposable equipment and debris, such as health and safety equipment, plastic sheeting, sampling equipment, and other equipment and/or sampling debris not reused during the RA will be collected in plastic bags during sampling and disposed of as bulk PCB remediation waste and would be included in the soil loads in accordance with the miscellaneous H&S waste provisions permitted under a standard disposal profile.

4.5.2 Decontamination Rinsate

Decontamination rinsate (< 50 mg/kg PCB) will be containerized at a controlled, centralized location in an appropriate temporary storage container or in labeled 55-gallon drums. Upon completion of the field sampling activities, the rinsate will be treated to comply with the maximum allowable concentrations stipulated in the General Permit for the Discharge of Groundwater Remediation Wastewater prior to discharge to the sanitary sewer..

4.6 Field Quality Assurance/Quality Control

This section summarizes the Quality Assurance/Quality Control (QA/QC) requirements for sampling activities associated with the RA at the site.

4.6.1 Field Instrument Calibration and Preventative Maintenance

Field personnel will document the calibration and maintenance of all applicable field equipment in the appropriate field forms.

4.6.2 QA/QC Sample Collection

QA/QC samples will be collected at a frequency of one every 20 samples and submitted to the laboratory for analysis. The number of QA/QC field samples to be collected is provided in Table 4-2. The type of QA/QC samples to be collected during the RA includes trip blanks, equipment blanks, duplicate samples, aqueous performance evaluation (PE) samples, and matrix spike/matrix spike duplicate (MS/MSD) samples. Guidance on the collection of the QA/QC samples is presented below:

Trip Blanks

Trip blanks will be collected at a frequency of one every 20 samples or one per cooler per day to ensure that the samples are not contaminated by VOCs while in transit to the laboratory. The equipment blanks will be prepared by the laboratory and delivered along with the sample glassware. No trip blanks will be collected in sample batches that do not include analysis for VOCs.

Equipment Blanks

Equipment blanks are collected as a check that the decontamination procedure has been adequately performed and that cross-contamination of samples will not occur due to the sampling equipment. Equipment blanks will be prepared in the field by pouring laboratory supplied analyte-free water into or over decontaminated sampling equipment and then directly into the laboratory supplied sample bottles. One equipment blank will be collected for each representative type of equipment used (i.e., spoons, bowls, split-spoon sampler, etc.) for every 20 samples collected and/or at a minimum of once per week.

Duplicate Samples

Duplicate samples will be sent for laboratory analysis to evaluate the reproducibility of the sampling technique used. Duplicate samples will be collected at a frequency of one every 20 samples collected.

Performance Evaluation Samples

Performance evaluation samples will be sent for laboratory analysis to ensure that environmental data collection results in the delivery of analytical data of known and documented quality, suitable for its use. Aqueous PE samples for each suite of analytes (PCBs, metals, VOCs, SVOCs, TPH, and cyanide as applicable) will be collected at a frequency of one every 20 samples collected. The analytical results of the PE samples will be evaluated following USEPA Region I Performance Evaluation Sample Guidance – Attachment H, July 1996. The PE samples will be counted as field samples in the 20-sample SDG total.

5.0 QUALITY ASSURANCE PROJECT PLAN

5.1 Introduction

5.1.1 General

This Quality Assurance Project Plan (QAPP) has been prepared in accordance with the USEPA referenced document SW-846 and presents analytical methods and procedures which will be used during implementation of the Remedial Action (RA0, as outlined in the Remedial Action Work Plan, (RAWP).

5.1.2 Objectives of the Quality Assurance Project Plan

The objective of the QAPP is to present the quality assurance/quality control (QA/QC) procedures to be implemented during the RA. The QAPP ensures that the data generated is of sufficient quality and quantity to allow confirmation that the RA objectives for the site are achieved. The sampling objectives of the QAPP are as follows:

- Confirm that residual PCB soil/sediment concentrations (at the horizontal and vertical limits of the excavation) satisfy the objectives of the RA;
- Determine handling and disposal requirements for the soil/sediments generated during the RA; and,
- Determine handling and disposal requirements for the miscellaneous materials generated during the RA.

5.1.3 Remedial Action Data Quality Objectives

To obtain data necessary to meet the objectives previously stated, the following categories of field sampling will be conducted as part of the RA:

- Post-excavation confirmatory soil/sediment samples to confirm the successful implementation of the RA and document residual contamination concentrations.
- Soil/sediment disposal characterization samples for assessment of disposal options; and
- Miscellaneous material samples for the assessment of disposal options and/or treatment performance (e.g., the temporary wastewater treatment system) associated with the implementation of the RA.

Preliminary Data Quality Objectives (DQOs) were identified to ensure that the data generated during field sampling will be of adequate quality and sufficient quantity to form a sound basis for decision making purposes relative to the above objectives. DQOs have been specified for each data collection activity.

DQO summaries for the RA activities are presented in the following section. The summary consists of stated DQOs relative to the following items:

- Data Uses;
- Data Types;
- Data Quality;
- Data Quantity;

- Sampling and Analytical Methods; and
- Data Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters (PARCC Parameters).

The categories of analytical data discussed in the following sections with regard to data quality are defined as follows:

Screening Data: Screening data will be used to provide a quick assessment of site characteristics or conditions. This objective for data quality is available for data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This includes field measurements such as immunoassay test kit results. This data will be reviewed and verified for accuracy and completeness as the field forms are processed by the LEA task manager.

Disposal Characterization Data: This includes all disposal characterization data, debris sampling and routine wastewater sampling prior to discharge. This data will be generated by a state-certified laboratory using EPA-approved analytical methods. The data will be reviewed for accuracy and data verification will be performed. This data will also be entered in the site-specific database. No data validation will be performed.

Confirmatory Data: Confirmatory data will be generated from a state-certified analytical laboratory using EPA-approved analytical methods. The data will reviewed for accuracy and data verification will be performed. A Tier II data validation will be performed on the confirmatory data obtained in accordance with EPA Region I data validation guidelines. This data will also be entered in the site-specific database.

5.1.4 Post-Excavation Confirmatory Soil/Sediment Sampling

Data Uses

Post-excavation confirmatory soil/sediment sampling will be conducted to confirm that residual concentrations of PCBs, metals, VOCs, SVOCs, TPH, and cyanide (if applicable) present at the limits of excavations in the excavated areas are below the RA objectives.

Data Types

Confirmatory soil/sediment sampling will include the collection and analysis of samples for PCBs, metals, VOCs, SVOCs, TPH, and cyanide (if applicable). Table 4-1of the QAPP presents the anticipated number of confirmatory soil/sediment samples to be collected and the laboratory analysis to be performed. Visual observation, and field screening of soil/sediment samples using PCB immunoassay field test kits will also be conducted to select soil/sediment samples for laboratory analysis.

Data Quality

Sample analysis for PCBs metals, VOCs, SVOCs, and cyanide (if applicable) will be conducted in accordance with the methods referenced in the USEPA document SW-846. TPH analysis will be conducted in accordance with "*Analysis of Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection* (ERI, 1999). Alternatively, if requested by EPA, TPH analysis will be conducted by SW-846 Method 418.1 The final determination of the TPH method will occur after consultation with EPA and DEP and prior to commencement of work. In

addition, field screening of soil/sediment samples will be performed using PCB immunoassay field test kits in accordance with the Standard Operating Procedures (SOPs) have been provided by the manufacturer and are included in Appendix B. The results will be presented using a Tier II laboratory data quality package and final electronic deliverables.

QA/QC samples will be performed for the confirmatory soil/sediment samples collected. No QA/QC samples will be performed for the screening immunoassay data. The number and type of QA/QC soil/sediment samples to be analyzed are summarized in Table 4-2.

Data Quantity

The location, number and type of analysis of post-excavation confirmatory soil/sediment samples to be analyzed from the excavation area will be determined based on a 20-ft grid as discussed in the previous section. The samples collected will be analyzed for PCBs, metals, VOCs, SVOCs, and cyanide in select areas.

Sampling and Analysis Methods

The Field Sampling Plan contains a description of the post-excavation confirmatory, disposal characterization and additional miscellaneous sampling procedures to be employed during the RA. The recommended project-specific laboratory analytical methods and reporting limits are listed in Table 5-1 of this QAPP. The final project-specific laboratory analytical methods and reporting limits will be supplied by the selected analytical laboratory prior to commencing work.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Recommended precision and accuracy quality control limits for chemical constituents that are used during data review to assess analytical performance, are included in Tables 5-2 and 5-3. Final precision and accuracy quality control limits will be generated by the selected analytical laboratory though internal control limits. These limits will be provided to LEA prior to commencing work. Data comparability will be achieved through the use of standard CTDEP/USEPA approved methods. Data completeness will be assessed at the conclusion of the RA.

5.1.5 Disposal Characterization Sampling

Data Uses

Disposal characterization sampling will be conducted to determine handling requirements for soil/sediment excavated during the RA.

Data Type

The disposal characterization sampling will include the collection of soil/sediment samples for field screening for PCBs using an immunoassay field test kit.

Data Quality

Laboratory analysis for PCBs will be performed in accordance with the methods referenced in USEPA SW 846. The results will be presented using a standard laboratory report format and final electronic deliverables. Field screening of soil/sediment samples may be performed using field test kits in accordance with SOPs provided by the manufacturer.

Data Quantity

Typically, one composite disposal characterization sample will be collected for every 500 CY of soil/sediment removed from a RA excavation area as directed by LEA. LEA may elect to perform disposal characterization sampling at an alternate frequency based on review of previous investigation data to aid in the evaluation of disposal options. QA/QC disposal characterization samples will not be submitted for laboratory analysis.

Sampling and Analytical Methods

The Field Sampling Plan presents a description of the disposal characterization soil/sediment sampling procedures to be employed during the RA. The recommended laboratory methods to be utilized are presented on Table 5-1 of this QAPP. Final laboratory methods to be utilized will be provided by the selected analytical laboratory prior to commencing work.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits for chemical constituents analyzed as part of the characterization sampling will not undergo data review. Data comparability will be achieved through the use of standard CTDEP/USEPA approved methods. Data completeness will be assessed at the conclusion of the RA.

5.1.6 Miscellaneous Sampling

Data Uses

Miscellaneous sampling will be conducted to generate data to determine handling requirements for the following material, which will be generated during implementation of the RA:

- Effluent from the temporary wastewater treatment system; and
- Building components from demolition of the existing on-site process water facility.

Data Types

The miscellaneous sampling will include the collection and analysis of samples for laboratory analysis as described below:

- Surface water and/or groundwater which enters the active excavation area and water generated from soil/sediment dewatering activities (as applicable) will be pumped to an on-site temporary wastewater treatment system. Effluent samples from the temporary wastewater treatment system will be submitted for laboratory analysis, as described below, to confirm that limits for discharge to the local sanitary sewer system are achieved.
- Samples of identified existing process water facility components will be submitted for laboratory analysis to determine disposal requirements during the demolition process.

Data Quality

Sample analysis for miscellaneous samples will be conducted in accordance with USEPA standard methods. TPH analysis will be conducted in accordance with "*Analysis of Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection* (ERI, 1999). Alternatively, if requested by EPA, TPH analysis will be conducted by SW-846 Method 418.1 The final determination of the TPH method will occur after consultation with EPA and DEP and prior to commencement of work. Results for the miscellaneous samples will be presented in a standard laboratory report.

Data Quantity

The number of miscellaneous samples to be collected as part of the RA is presented below:

- Samples of the effluent water from the temporary on-site wastewater treatment system will be submitted based upon the requirements of the discharge permit; and

- The number of samples from the demolition of the process water facility will be determined during the RA effort.

Sampling and Analytical Methods

Field instruments used during the program will be calibrated daily to confirm appropriate analyses, as applicable. A summary of potential field equipment and calibration data is included in Table 5-4. Samples of building components will be submitted for laboratory analysis for PCBs, metals, VOCs, SVOCs, TPH, and other analytes as required by disposal vendors using EPA-approved methods. Samples effluent from the temporary water treatment system will be analyzed for those parameters specified in the discharge authorization.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits will not be reviewed for miscellaneous samples submitted for laboratory analysis as part of the RA.

Data representativeness is addressed by the sample quantities and/or locations identified in the Field Sampling Plan. Data comparability will be achieved through the use of standard USEPA/CTDEP approved methods. Data completeness will be assessed at the conclusion of the RA.

5.2 Project Organization and Responsibilities

5.2.1 Project Organization

The RA will require integration of personnel from the organizations identified below, referred to as the project team. A detailed description of the responsibilities of each members of the project team is presented below.

5.2.2 Overall Project Management

LEA, on behalf of UTC/P&W, has overall responsibility for the RA at the site. LEA will perform the confirmatory soil/sediment sampling, disposal characterization sampling and miscellaneous sampling described in the Field Sampling Plan. In addition, LEA will be responsible for evaluating resultant sampling data and preparing required data submittals. UTC/P&W will provide project direction and oversight.

5.2.3 Team Member Responsibilities

This section of the QAPP discusses the responsibilities and duties of the project team members.

UTC/P&W

UTC/P&W Project Manager responsibilities and duties include:

- Overall direction of the RA;
- Direction of LEA; and
- Review of LEA work products, including data, memoranda, letters, reports, and all documents transmitted to the USEPA and CTDEP.
- Assure corrective actions are taken for deficiencies cited during audits of sampling/analytical activities.

LEA

LEA's responsibilities and duties include:

- Oversight of remedial work activities and products; and
- Coordination with UTC/P&W, USEPA and CTDEP.

More specifically, LEA personnel will have the following responsibilities:

LEA Project Manager

Responsibilities and duties include:

- Management and coordination of all aspects of the project as defined in the RAWP with an emphasis on adhering to the objectives of the RA; and
- Coordination of office and field activities with P&W/UTC.

LEA Task Manager

Task Manager (Project Engineer/Geologist), as set forth in Section 5.2.3 will manage the ongoing sampling and analysis activities associated with the RA. Responsibilities and duties of each Task Manager include:

- Manage day to day remedial sampling activities;
- Develop, establish, and maintain files on remedial sampling activities;
- Review data from the remedial sampling activities;
- Assure corrective actions are taken for deficiencies cited during audits of remedial sampling activities;

- Overall QA/QC of the portions of the RA;
- Review all field records and logs;
- Instruct personnel working on remedial sampling activities;
- Coordinate field and laboratory schedules pertaining to remedial sampling activities;
- Ensure in coordination with the Quality Assurance Manager the preparation of QA/QC samples including performance evaluation samples;
- Request sample bottles from the laboratory;
- Review the field instrumentation, maintenance, and calibration to meet quality objectives;
- Prepare sections of reports pertaining to relevant RA; and
- Maintain field and laboratory files of field forms and logs, data reductions and calculations.

LEA Field Sampling Personnel

The field sampling personnel's responsibilities and duties include:

- Prepare sample labels and field paperwork
- Perform field procedures associated with the collection of samples as set forth in the FSP;
- Perform field analyses and collect QA samples;
- Calibrate, operate, and maintain field instrumentation equipment;
- Reduce field data;
- Maintain sample custody; and
- Complete field records and logs and provide copies to the LEA Task Manager.

Quality Assurance Manager (QAM)

The QAM's responsibilities and duties include:

- Review laboratory data packages;
- Coordinate field QA/QC activities with task managers, included audits of sampling activities, concentrating on field analytical measurements and practices to meet data quality objectives;
- Review audit reports; and
- Prepare interim QA/QC compliance reports.
- The QAM will be independent of the unit generating the data.

5.2.4 Analytical Laboratory

Selected Analytical Laboratory

The selected analytical laboratory's general responsibilities and duties include:

- Perform sample analyses and associated laboratory QA/QC procedures;
- Supply sampling containers, shipping packages, and preservatives;
- Maintain laboratory custody of sample; and
- Strictly adhere to all protocols in the QAPP.

Laboratory Project Manager

The Laboratory Project Manager's responsibilities and duties include:

- Serve as primary communication contact between LEA and the laboratory technical staff;
- Monitor work loads and ensure availability of resources;
- Oversee preparation of analytical reports;
- Provide data validation packages as requested, and
- Supervise in house chain-of-custody.

Laboratory Quality Assurance Manager

The Laboratory QAM's responsibilities and duties include:

- Supervise the group which reviews and inspects all project related laboratory activities; and
- Conduct audits of all laboratory activities.

Laboratory Sample Custodian

The Laboratory Sample Custodian's responsibilities and duties include:

- Receive all samples; and
- Maintain custody of the samples and all documentation.

Laboratory Data Reviewer

The Laboratory Data Reviewer's responsibilities and duties include:

- Verify final analytical data prior to transmittal to LEA.

5.3 Quality Assurance Objective for Measurement of Data

5.3.1 General

This section identifies the parameters that will be measured in the field and parameters that will be analyzed in the laboratory as part of the RA sampling. This section also identifies the quality assurance parameters objectives for field measurement/laboratory analysis.

5.3.2 Field Parameters and Methods

Selected soil/sediment samples collected during the RA may be screened using PCB field test kits.

5.3.4 Laboratory Parameters and Methods

As described in the Field Sampling Plan, laboratory analyses will be performed during the RA to determine concentrations of the following:

- PCBs, metals, VOCs, SVOCs, TPH, and cyanide in confirmatory soil/sediment samples;
- PCBs, metals, VOCs, SVOCs, and cyanide in disposal characterization samples; Additional analyses may be performed to satisfy disposal vendor requirements.

- Specific analyses as required by the applicable permit(s) for samples of the effluent water from the temporary on-site wastewater treatment system; and
- Miscellaneous samples to be determined for disposal of demolition debris from the existing process water facility.

QA/QC analyses will be performed for analyses of PCBs, metals, VOCs, SVOCs, and cyanide as set forth on Table 4-2. Table 5-1 presents the recommended reporting limits for each of the analytes. The final reporting limits will be supplied by the selected laboratory prior to commencing work. The reporting limits will be at a concentration consistent with the appropriate criteria of the State of Connecticut Remedial Standard Regulations or lowest appropriate reporting limit for each compound, whichever is lower.

5.3.5 Quality Assurance Objectives

The overall quality assurance objective for the RA sampling and analysis program is to develop and implement procedures for sampling, preservation, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventative maintenance, and corrective actions, such that valid data will be generated. The measurement performance criteria will be communicated to the laboratory by the LEA Project Manager in order to ensure that the data users' quality objectives are linked to verifiable measurement performance criteria. These procedures are presented in the following sections of the QAPP. Specific QC checks are also discussed in the following sections.

Quality assurance objective are generally defined in terms of five parameters:

- Representativeness;
- Comparability;
- Completeness;
- Precision; and
- Accuracy.

Each of the parameters mentioned above are discussed below. Specific objectives for the RA sampling and analysis program are set forth in other sections of this QAPP.

5.3.6 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represents site conditions, and is dependent on sampling and the variability of environmental media at the site. The sampling program has been designed to assess the presence of the chemical constituents at the time of sampling. The FSP presents the rationale for sample quantities and location. The FSP and this QAPP presents field sampling methodologies and laboratory analytical methodologies, respectively.

5.3.7 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability throughout the RA will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP and the FSP through the use of established QA/QC procedures, and the utilization of appropriately trained personnel.

5.3.8 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 5.11 of this QAPP.

5.3.9 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objective of the SAP. To maximize precision, specific sampling and analytical procedures will be followed. All sampling and analysis work for this RA will adhere to the established protocols presented in the QAPP and Field Sampling Plan. Checks for analytical precision may include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates and field duplicates. Checks for field measurement precision may include obtaining duplicate field measurements.

5.3.10 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments (see Table 5-). In addition, reference standards, matrix spikes, blank spikes, and surrogate standards may be used to assess the accuracy of the analytical data.

5.4 Sampling Procedures

Post-excavation confirmatory soil/sediment samples, disposal characterization samples and miscellaneous samples will be collected as described in the FSP. In the event of a variance in the field sampling procedures, a case narrative will be included in the field notes. The narrative will describe the nature of the variance in procedure, the reason for the variance, any effect the action may have on the data, and any corrective action taken. The LEA Project Manager will be notified immediately of any variance taken in field and/or laboratory procedures.

Sample containers will be ordered from the laboratory to ensure a sufficient number are in inventory at least 3 days prior to sampling. The number of containers will be in excess of the expected number of samples collected to prevent a shortage due to breakage. Chain-of-custody forms and custody seals (if necessary) will be kept in inventory in a similar manner.

5.5 Sample and Document Custody

5.5.1 General

This section identifies the field and laboratory procedures for the handling and documentation of samples collected as part of the RA. The field and laboratory sample handling and documentation procedures are presented below.

5.5.2 Field Procedures

The objective of field procedures for sample custody is to assure that samples are not tampered with from the time of sample collection through time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so the samples cannot be tampered with.

5.5.3 Laboratory Procedures

This subsection presents information related to laboratory sample custody, sample receipt and storage, sample analysis, laboratory documentation, and laboratory project files.

Sample Custody

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of custody form will accompany samples requiring laboratory analysis. Samples will be kept secured in the laboratory until all stages of analysis are complete.

Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field chain of custody and sign as recipient. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, LEA will be notified. The laboratory sample custodian will be responsible for logging in the samples, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis.

Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets, which contain all pertinent information for analysis. The analyst will sign and date the laboratory chain of custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, performance evaluation samples, trip blanks, and equipment blanks are considered field samples for the purposes SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of five calendar days (less, when five-day holding times for extraction must be met), and must be processed through the laboratory (preparation, analysis and reporting) as a group. Every SDG will include a minimum of one site-specific matrix spike/matrix spike duplicate (MS/MSD or MS/Dup) pair, which shall be received by the laboratory as part of the SDG assignment.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will ensure that the quality control samples for an SDG are applicable to the field samples of the same SDG, and that the best possible comparisons may be made.

In case of a failure in the analytical system, the laboratory will be responsible for the necessary corrective action as described by the laboratory SOP or the analytical method. Any questionable laboratory data

will be subjected to data validation as described in Region I, EPA-New England Data Validation Functional Guidelines For Evaluating Environmental Analyses, Rev. December 1996. As noted above, data validation packages will be requested for all confirmatory sampling data.

In the event of a variance in the laboratory analysis procedures, a case narrative will be included in the laboratory data package. The narrative will describe the nature of the variance in procedure, the reason for the variance, any effect the action may have on the data, and any corrective action taken. The LEA Project Manager will be notified immediately of any variance taken in field and/or laboratory procedures.

Laboratory Project Files

The laboratory will establish a file for all pertinent analytical data generated during the RA. The file will include the chain of custody forms, raw data, chromatograms (required for all constituents analyzed by chromatography), and sample preparation information. The laboratory will retain all project files and data packages for a period of five years.

Laboratory Documentation

Workbooks, bench sheets, instrument logbooks, and instrument printouts are used to trace the history of the samples through the analytical process, and document and relate important aspects of the work, including the associated quality controls. As such, all logbooks, bench sheets, instrument logs, and instrument printouts are part of the permanent record of the laboratory.

Each page or entry is dated and initialed by the analyst at the time of entry. Errors in entry are crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by writing directly over the erroneous entry, and initialed and dated by the individual making the correction.

Laboratory notebooks are periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP.

Computer and Hard Copy Storage

Gas Chromatograph/Mass Spectrometry (GC/MS) raw data files are maintained on computer disk for five years, hard copy GC chromatograms are maintained in files for a minimum of five years, or as dictated by the policy of the selected laboratory.

Sample Storage Following Analysis

The laboratory maintains samples for a minimum of one month after the final report is delivered to LEA, or for a duration equal to the sample holding time. After this period, the samples shall be transferred to P&W/UTC for disposal in accordance with applicable rules and regulations.

5.6 Calibration Procedures and Frequency

5.6.1 Field Equipment Maintenance and Calibration Procedures and Frequency

Any field equipment will be thoroughly inspected on a daily basis. Any equipment deficiencies will be noted and remedied prior to leaving for the site. Any equipment found not in good working order will be repaired or replaced as necessary. No equipment shall return to field use unless found to be in good working order after repair. The LEA Equipment Manager will be responsible for assuring replacement equipment is available in case of equipment malfunction. In the event of equipment malfunction, replacement equipment in good working order will be transported to the site.

Any critical spare parts for field equipment will be in stock prior to the start of the project. After the project begins, the inventory of spare parts will be replenished as needed by the Equipment Manager. Specific procedures for performing and documenting calibration and maintenance for the field equipment for total organic vapors are provided in the FSP. Field equipment, frequency of calibration, and calibration standards are provided in Table 5-4. Maintenance will be performed according to the instrument instruction manual. Any critical spare parts for field equipment will be in stock prior to the start of the project. After the project begins, the inventory of spare parts will be replenished as needed by the Equipment Manager.

Calibration standards for the pH meter, conductivity meter, and turbidity meter are purchased as solutions certified by the manufacturer.

5.6.2 Laboratory Equipment Calibration Procedures and Frequency

Instrumentation calibration will follow the specifications provided by the SOPs for the analytical methods used as outlined in USEPA SW846.

5.7 Analytical Procedures

5.7.1 Field Analytical Procedures

Field analytical procedures may include field screening for PCBs using a field test kits. Specific field measurement quality in terms of precision and accuracy are presented in Table 5-5.

5.7.2 Laboratory Analytical Procedures

Specific requirements related to each sample medium to be analyzed and details of the methods to be used for this project are presented in the subsections below. The methods to be include the following:

- Standard USEPA methods will be used for the laboratory analysis of PCB's and the required analyses for the RA material disposal and permit requirements.
- CTDEP approved methods and updates will be used for laboratory analysis where applicable.

The anticipated turnaround times for receipt of analytical results for samples are summarized in the table below.

Sample Type	Turnaround Time
Post-excavation soil/sediment samples	24 hours to 2 weeks
Disposal characterization samples	24 hours to 2 weeks
Effluent samples from wastewater treatment	24 hours to 2 weeks

system	
Water treatment building demolition	1 week to 2 weeks

5.7.3 General Analytical Requirements

The number of environmental and QC samples to be analyzed are summarized in Tables 4.1 and 4-2. The analytical parameters, recommended methods and recommended reporting limits are presented in Table 5-1. Final methods and reporting limits will be provided by the analytical laboratory prior to commencing work.

5.7.4 Remedial Action Sample Matrices

Soil/Sediment, and Solids

Soil/sediment and solids analytical results will be determined on a dry weight analysis as specified in the appropriate sample extraction method. The results will be reported in the units presented in Table 5-1. Moisture content will be reported separately. Recommended QC limits for soil/sediment samples to be analyzed for PCBs, metals, VOCs, SVOCs and cyanide (at select locations) are presented in Table 5-2. The final limits will be established using the selected analytical laboratory's internal control limits.

Water

Water from the temporary wastewater treatment system in this category that will be analyzed. Analytical results for the water analysis will be reported in the units identified in Table 5-1.

Analytical Requirements

The primary sources for methods used to analyze soil/sediment are provided in the USEPA documents. LEA will assess data usability of PCBs. The primary sources for methods used to analyze water samples associated with the on-site temporary wastewater treatment system are provided in 40 CFR 136.

Tables summarizing QC limits required to evaluate analytical performance are provided as follows:

Table	Title
5-2	Soil Analysis Quality Control Limits
5-3	Water Analyses Quality Control Limits

5.8 Data Reduction, Review, and Reporting

After field and laboratory data are obtained, the data will be subject to the following:

- Reduction or manipulation mathematically or otherwise into meaningful and useful forms;
- Review;
- Organization, interpretation, and reporting; and
- External data review.

The subsections below present descriptions of the data reduction, review, and reporting activities that will be conducted in the field and laboratory as part of the RA sampling and analysis program.

5.8.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field forms. The LEA Task Manager will review such data for adherence to the FSP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and as necessary, incorporated into the data evaluation process. Data reduction will be performed for the confirmatory soil/sediment sampling and the disposal characterization soil sampling associated with determining PCB concentrations using a field test kits.

5.8.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by field personnel and reviewed for accuracy by the LEA Task Manager and the QAM. All logs and documents will be checked for:

- General Completeness;
- Readability;
- Usage of appropriate procedures;
- Appropriate instrument calibration and maintenance;
- Reasonableness in comparison to present and past data collected;
- Correct sample locations; and
- Corrected calculations and interpretations.

5.8.3 Laboratory Data Reduction

The calculations used for data reduction are specified in each of the analytical methods referenced previously. Whenever possible, analytical data is transferred directly from the instrument to a computerized data system. Raw data is entered into permanently bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses (as for example, PCBs, VOCs) are based on response factors. Quantitation is performed using internal or external standards.

5.8.4 Laboratory Data Review

All data will be subject to review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The QAM will review a random sample of a minimum 5 percent of the final data reports, and laboratory director will review a cross-section of the final data reports.

If discrepancies exist in the analytical results, then corrective action is taken as discussed in Section 5.11.

5.8.5 Laboratory Data Reporting

The laboratory is responsible for preparing standard laboratory reports for all samples analyzed.
Data will be tabulated by sample and method, with reference to both field and laboratory identifications. In addition, the laboratory will provide documentation backup (laboratory calculation sheets, chain of custody, etc.)

5.9 Field and Laboratory Quality Control Checks

5.9.1 General

Both field and laboratory quality control checks will be implemented during the RA. If a failure in the established sampling protocol occurs before the sample is collected, the field personnel shall use professional judgment to determine the location of an appropriate replacement sample. This alternative sample location will be documented in the field forms, and the information as to the reason for and location of the alternative sampling will be reported to the LEA Project Manager or designated person. If a failure in the established sampling protocol occurs after sample submission (for example, if part of the complete sample set is found to be inadmissible), the Project Manager will determine the location of replacement samples and collection methodology. The proposed field and laboratory control checks are discussed below.

5.9.2 Field Quality

Field quality control checks will include obtaining duplicate field measurements, using analyte-free water for the preparation of sample blanks, using clean sample containers, collecting duplicate samples, and preparing rinse blanks, as further described in the subsections below.

5.9.3 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements.

5.9.4 Sample Containers

Certified-clean sample containers will be supplied by analytical laboratory. Certificates of analysis will be filed in the project file.

5.9.5 Field Duplicates

Field duplicates will be collected for soil/sediment samples to verify the reproducibility of the sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, soil and soil/sediment sample field duplicates will be analyzed at a frequency of one every 20 samples for chemical constituents. Table 4-2 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix. Acceptable field duplicate precision for soil samples must be less than 50%. Data that do not meet the criteria will be qualified according to USEPA Region I, Data Validation Guidelines, revised December 1996.

5.9.6 Equipment Blanks

Equipment blanks are used to monitor the cleanliness of sampling equipment and the effectiveness of the decontamination procedures. Equipment blanks will be prepared and submitted for analysis at a frequency of one every 20 samples. Equipment blanks will be prepared by filling sample containers with analyte free water, which has been routed through a cleaned sampling device. If dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be required. Table 4-2 provides the estimated number of equipment blanks for environmental samples to be collected. The criterion for equipment blanks is such that no target compound should be present at or above the

laboratory quantitation limit. Data that do not meet the criteria will be qualified using the 5X action rule according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.7 Method Blanks

Sources of contamination in the analytical process, whether specific analytes or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for potential contamination attributable to glassware, reagents, instrumentation, or other sources, which could affect the sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples. The criterion for method blanks is such that no target compound should be present at or above the laboratory quantitation limit. Data that do not meet the criteria will be qualified using the 5X action rule (10X rule for common laboratory contaminants) according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.8 Matrix Spike/Matrix Spike Duplicates

MS/MSD will be used to measure the accuracy of organic analyte recovery from sample matrices. All MS/MSD will be site specific. For PCBs, metals, VOCs, SVOCs, and cyanide matrix spike/matrix spike duplicate pairs will be analyzed at a frequency of one every 20 samples.

The percent recovery (%R) and the relative percent difference (RPD) will be evaluated for MS/MSD data and compared with the acceptance criteria as stated in the appropriate EPA analytical method. When MS recoveries and RPDs are outside QC limits, associated MS blank and surrogate recoveries will be evaluated to attempt to verify the reason for deviation and determine the effects on the reported sample results. In addition, the percent relative standard deviation (%RSD) will be calculated for the unspiked sample, the MS and the MSD and will be considered a triplicate in determining overall precision of the analytical method. The unspiked sample results will be qualified according to the to USEPA Region I Data Validation Guidelines, Revisions December 1996 for any data that is outside acceptable control limits. Table 4-2 presents the estimated number of MS/MSD analyses for each applicable matrix and parameter.

5.9.9 Surrogates

Surrogates are compounds, which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by GC/MS and GC methods and is added to the sample prior to extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a spike specific basis.

If surrogate recoveries exceed specified QC limits, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. Recoveries for surrogate compounds in samples, QC samples and blanks must be within the QC acceptance criteria as specified in the appropriate EPA analytical method. Samples with surrogate compounds outside acceptance will be qualified according to USEPA Region I Data Validation Guidelines, Revisions December 1996. Surrogate compounds will be selected utilizing the guidance provided in the analytical methods summarized in Table 5-2.

5.9.10 Calibration Standards

Compliance requirements for initial calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Calibration check standards will be analyzed as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If the results of the calibration check standard exceeds specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be re-analyzed

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the recommended analytical methods summarized in Table 5-1 or other appropriate method defined prior to commencing work. Calibration data will be evaluated based on USEPA Region I Data Validation Guidelines, Revisions December 1996. Data that does not meet acceptance criteria will be qualified accordingly.

5.9.11 Internal Standards

Instrument performance, stability and laboratory precision throughout an analytical sequence is monitored by the addition of internal standard compounds. Internal standard areas and retention times are monitored for organic analysis performed by GC/MS methods. Method specific internal standard compounds are spiked into all field samples, calibration standards and QC samples after preparation and prior to analysis. If the internal standard areas in one or more samples exceed the specified tolerances, then the instrument will be recalibrated and all affected samples reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods summarized in Table 5-1 and other methods deemed appropriate by the selected analytical laboratory prior to commencing work. Sample results with internal standard areas and/or retention time data outside control limits will be qualified based on USEPA Region I Data Validation Guidelines, Revisions December 1996

5.9.12 Reference Standards

Reference standards are standards of known concentration, and independent in origin from the calibration standards. Reference standards, are generally available through the USEPA, the National Bureau of Standards, or are specified in analytical methods. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series.

5.9.13 Performance Evaluation Program

Performance Evaluation Audit

Data for performance evaluation samples will be generated to provide information on the overall accuracy and bias of the analytical method and on laboratory performance. UTC/P&W will conduct a performance evaluation (PE) audit as part of the program following "USEPA Region I Performance Evaluation Program Guidance," July 1996 Revision. Based upon the criteria presented in Attachment H of the USEPA Region 1 PE program guidance document, only aqueous PE samples will be submitted for this program. An overview of the proposed PE audit program is as follows:

- LEA will coordinate PE sample acquisition with the selected vendor prior to initiating the RA program;

- Sample acquisition, handling, and analyses will be in general accordance with USEPA Region 1 guidance criteria; and
- It is estimated that a total of four PE soil samples will be submitted as part of the program.

All samples in a sample delivery group will be validated based upon a comparison between the vendor-certified performance evaluation (PE) results and the laboratory's reported results. PE samples will be evaluated for false negatives, false positives, and inaccurate target compound quantitation. The PE samples provide information on the magnitude and direction of quantitative bias for the laboratory method. Results that are outside the vendor-certified acceptance limits will be qualified according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.10 Performance and System Audits

5.10.1 General

This section describes the performance and system audits that will be completed in the field and the laboratory during implementation of RA.

5.10.2 Audits

Field performance and systems audits that will be completed during this project are described in the subsection below. The results of all audits and reviews, along with recommendations for corrective action, will be given to the LEA Project Manager as soon as possible in order to assess the need for any corrective action.

Readiness Reviews

Readiness reviews will be conducted prior to commencing each phase of the project on an as-needed basis to ensure all components required for each phase are in place.

Surveillance

Surveillance of remedial activities will be conducted by the LEA Task Manager or other field personnel on-site on a daily basis. Activities should be documented in the field notes. Any deviations from the FSP or QAPP should be reported to the Project Manager as soon as possible.

Technical System Audit

A Technical System Audit (TSA) shall be performed by the LEA Project Manager or person designated by the Project Manager shortly after commencing remedial activities. The purpose of the TSA is to ensure that facilities, personnel, training, procedures and record keeping are in accordance with the QAPP. Performing this early in the project provides opportunity for corrective action.

Audit of Data Quality

An audit of data quality will be performed by the management team prior to final reporting. This will serve to reveal how the data were handled, what judgments were made, and whether uncorrected mistakes were made.

5.10.3 Performance Audits

The LEA Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibration to verify that measurements are taken according to established protocols. The QAM will review all field reports and communicate concerns to the Project Manager and/or Task Managers.

5.10.4 Internal System Audits

A field internal system audit is a qualitative evaluation of all components of field QA/QC. The system audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed.

5.10.5 Laboratory Audits

The analytical laboratory will perform internal audits consistent with applicable regulations. LEA reserves the right to conduct an on site audit of the laboratory prior to start of analyses for the project.

5.11 Data Assessment Procedures

The analytical data generated during the RA will be evaluated with respect to precision, accuracy, and completeness and compared to the data quality objectives set forth in this QAPP. A summary of recommended QC limits required to evaluate analytical performance is provided in Tables 5-2 and 5-3. Final QC limits will be established using the selected analytical laboratory's internal control limits.

Following the collection of field sampling and analytical data, various statistical analyses can be performed to determine the data usability and sensitivity of the data.

Data usability can be checked through standard data validation procedures, and statistical cross validation procedures. These procedures involve predicting a data value for one point, based on results from other points. The difference between the measured and predicted number can indicate an invalid result.
An assessment of data sufficiency involves the determination of whether the confidence intervals values are rigorous enough to satisfy regulatory or engineering requirements.

5.11.1 Data Precision Assessment Procedures

Field precision will be controlled through the use of experienced field personnel, properly calibrated instruments, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision analyses will be monitored through the use of matrix spike/matrix spike duplicate sample analyses and performance evaluation samples. The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{A+B/2} \times 100$$

Where:

A = Analytical results from first duplicate measurement

B = Analytical results from second duplicate measurement.

5.11.2 Data Accuracy Assessment Procedures

The accuracy of field precision will be controlled by experienced field personnel, properly calibrated field instruments, and adherence to established protocols. The accuracy of field instruments will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spike, surrogate spikes, PE samples, and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\text{Percent Recovery} = \frac{(A-X)}{B} \times 100$$

Where:

A = Value measured in spiked sample
X = Value measured in original sample
B = True value of amount added to sample or true value of standard.

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Recommended accuracy objectives for matrix spike recoveries are found in Tables 5-2 and 5-3. Final accuracy objectives for matrix spike recoveries will be determined by the selected analytical laboratory's internal control limits.

5.11.3 Data Completeness Assessment Procedures

Completeness of field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated:

$$\text{Completeness} = \frac{\text{Number of Valid Results}}{\text{Total Number of Results Generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90%. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

5.11.4 Internal Reporting

The QAM will review analytical concerns identified by the data review with the laboratory. Supporting data (i.e. historic data, related field or laboratory data) will be reviewed to assist in determining data quality, as appropriate. The QAM will incorporate results of assessments of data usability into a summary that will be submitted to the Project Manager and appropriate Task Managers.

5.11.5 RA Reporting

The summary report prepared by LEA will contain a QA/QC section summarizing the quality of data collected and/or used as appropriate to the project data quality objectives, which are discussed in this

QAPP. The QAM will prepare the QA/QC summaries using reporting and memoranda documenting the data assessment and review.

5.11.6 Data Validation

A standardized data validation review process for judging the analytical quality and usefulness of data will be performed in accordance with the procedures set forth in the most current editions of the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses. Technical judgment on the validity of the laboratory results will be provided to determine the overall usability and legal defensibility. All confirmatory sample data obtained will be validated. Individual sample results will be accepted, rejected, or qualified. Validation decisions will be communicated to the end-user through a written data validation memorandum and all qualifiers applied to the individual sample results will be incorporated into the analytical database.

The following items will be reviewed when applicable:

- Data Completeness;
- Custody Documentation;
- Preservation and Holding Times;
- Instrument Performance;
- Initial and Continuing Calibration;
- Blanks;
- Field Duplicate Precision;
- Surrogate Compounds and Recoveries;
- Internal Standard Compounds, Recoveries and Retention Times;
- Matrix Spike Recoveries/Duplicate Correlations;
- Control Spike/Laboratory Control Spike;
- Performance Evaluation Assessment;
- Instrument Detection Limits (IDLs);
- ICP Interference Check Sample;
- Furnace Atomic Absorption Analysis;
- ICP Serial Dilution;
- Method Compliance; and
- Sample Result Verification.
- Overall Evaluation of Data

Project requirements are for full validation of 20% of the field samples within each data package.

5.12 Reports to Management.

Daily reports on remedial activities (verbal or written) will be given from field personnel to the LEA Project Manager or person designated by the Project Manager.

Laboratory reports will be given to the Project Manager as received.

Memorandums regarding data validation will be provided to the Project Manager after complete review of the laboratory data package by the data validation staff.

TABLES

Table 4-1

Willow Brook and Willow Brook Pond
East Hartford, Connecticut

Field Sampling Plan
Confirmatory Sampling Summary

Sample Type	Sample Media	Anticipated Number of Samples	Laboratory Analytical Methods (USEPA)
Confirmatory	Soil/Sediment	108	SW846-8082, Rev. December 1996(PCB)
Confirmatory	Soil/Sediment	74	SW-846-8260B Rev. December 1996 (VOC) SW-846-8270C Rev. December 1995 (SVOC) SW-846-1312 Rev. September 1994 (SPLP) SW-846-6010B Rev. December 1996 (ICP Metals) SW-846-7010 Rev. January 1998 (GFAA Metals) SW-846-7471A Rev. January 1998 (Mercury–Cold Vapor) SW-846-9012A Rev. December 1996 (Cyanide) TPH: EPA 418.1 or CT-ETPH*
Disposal/ Characterization (Possible Methods Required By Disposal Facility)	Soil/Sediment	24	SW846-8082, Rev. December 1996(PCB) SW-846-8260B Rev. December 1996 (VOC) SW-846-8270C Rev. December 1995 (SVOC) SW-846-1312 Rev. September 1994 (SPLP) SW-846-6010B Rev. December 1996 (ICP Metals) SW-846-7010 Rev. January 1998 (GFAA Metals) SW-846-7471A Rev. January 1998 (Mercury–Cold Vapor) SW-846-9012A Rev. December 1996 (Cyanide) TPH: EPA 418.1 or CT-ETPH*
Temporary Wastewater Treatment System Effluent	Wastewater	As Required By Permit	VOC: EPA-601 and 602 plus xylenes or EPA624 MTBE: EPA-602 or EPA-624 TPH: EPA 418.1 or CT-ETPH* Metals: EPA-200.7, 239.1 or 239.2 BNA: EPA-625 PAH: EPA-610 PCBs: EPA-608 Cyanide: EPA-335.1; 335.2

Notes:

1. Bottom samples are collected at a frequency of 1 sample per every 400 square feet of excavation bottom.
2. Samples are collected from an interval of 0 to 6 inches below post-remediation surface.
3. PCB = Polychlorinated Biphenyls; SVOC = Semi-Volatile Organic Compounds; VOC = Volatile Organic Compounds; SPLP = Synthetic Precipitate Leachate Procedure; ICP = Inductively Coupled Plasma; TPH = Total Petroleum Hydrocarbons; MTBE = Methyl tertiary butyl ether; BNA = Base Neutral and Acid Extractables; PAH = Polynuclear Hydrocarbons; GFAA = Graphite Furnace Atomic Absorption Spectrometry
4. USEPA = United States Environmental Protection Agency
5. * CT-ETPH is performed by non-EPA method (*Analysis of Extractable Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detector* (ERI, 1999)).
6. Final TPH method will be determined after consultation with appropriate regulatory authorities and before start of work.

7.

Table 4-1

Willow Brook and Willow Brook Pond
East Hartford, Connecticut

Field Sampling Plan
Detailed Confirmatory Sampling Summary
by Remediation Area

AREA	Composite Samples		Grab Samples	
	PCB # Aliquots	PCB # Composites	PCB	Other Parameters
Wetland Area	44	11	46	46
Lower Willow Brook Pond Area	109	30		16
Oil Water Separator Area	8	2	12	12
Upper Willow Brook Pond Area	22	7		
SUB-TOTAL		50	58	
TOTAL	Total PCB Aliquots 183	Total PCB samples 108		Total Other Parameters 74

Notes:
1. Other Parameters: refer to analytical methods as described in Table 4-1, Confirmatory Sampling Summary for details.
2. One PCB aliquots sample will be collected per 400 square foot node. Approximately 4 aliquots will be combined to form 1 composite sample which represents a 1600 square foot area. In some cases, less than four samples may be composited but never will more than four samples be composited.
3. A total of 232 aliquots will be combined for a total of 69 PCB composite confirmatory samples.
4. A total 121 PCB confirmatory samples will consist of 69 composites and 52 grab samples.

Table 4-1

Willow Brook and Willow Brook Pond
East Hartford, Connecticut

Field Sampling Plan
Extraction Method Summary

Analytical Method	Matrix	Extraction Method (as applicable)
SW-846 Method 8082	Soil / Sediment	3545, 3550B, 3540C, 3541
SW-846 Method 8270C	Soil / Sediment	3550B, 3540C, 3541, 3545, 3545, 3560, 3561
SW-846 Method 8260B	Soil / Sediment	5030B, 5035
CT-ETPH	Soil / Sediment	3545, 3550B, 3540C, 3510C, 352C0
SW-846 6010B	Soil / Sediment	3050B, mercury 7471A, TCLP 1311, SPLP 1312

Table 4-3
Required Containers, Preservatives, and Analysis
Holding Times for Solid, Aqueous, and Vapor Samples

Fraction	Soil/Solid Sample Bottle	Preservative	Holding Time
TCL Volatiles	2-40 ml glass screw cap vials with Teflon septa	5 ml $NaHSO_4$, Cool to 4 C.	14 days
TCL Semivolatiles	1-16 oz. glass w/Teflon lined enclosure.	Cool to 4 C.	14 days till extraction/40 days to inject extract
TCL Organochlorine Pesticides/PCBs	from same 16 oz. above	Cool to 4 C.	14 days till extraction/40 days to inject extract
chloride, sulfate, ammonia, COD alkalinity	from same 16 oz. above	Cool to 4 C.	28 days 14 days
nitrate, nitrite, o-phosphate, BOD	from same 16 oz. above	Cool to 4 C.	48 hours
hexavalent chromium	from same 16 oz. above	Cool to 4 C.	48 hours
TAL metals plus Tin	from same 16 oz. above	Cool to 4 C.	28 days Hg & 180 days all other metals
Cyanides	from same 4 oz. above	Cool to 4 C.	14 days
Dioxins	1-4 oz. glass w/Teflon lined enclosure.	Cool to 4 C.	30 days till extraction/45 days to complete analysis
TOC	from same 16 oz. above	Cool to 4 C.	28 days
Total Petroleum Hydrocarbons (CT-ETPH)	from same 16 oz. above	Cool to 4 C.	14 days till extraction/40 days to inject extract
TPH (418.1)	from same 16 oz. above	Cool to 4 C.	28 days
Trip Blank, Field Blank or Aqueous Sample			
TCL Volatiles	2-40 ml glass screw cap vials with Teflon septa	HCl to pH <2, Cool to 4 C.	14 days
TCL Semivolatiles	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
TCL Organochlorine Pesticides/PCBs	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
TAL Metals plus Tin	1-1 liter HDP	HNO to pH<2	28 days Hg & 180 days all other metals
Cyanides	1-1 liter HDP	NaOH to pH >12, Cool to 4 C.	14 days
Dioxins	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	30 days extraction/45 days to complete analysis
Chloride, sulfate TDS, TSS alkalinity	1-1 liter HDP	Cool to 4 C.	28 days 7 days 14 days
nitrate, nitrite, o-phosphate, BOD	1-1 liter HDP	Cool to 4 C.	48 hours
hexavalent chromium	1-500 ml HDP	Cool to 4 C.	24 hours
ammonia, COD	1-1 liter clear glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
TOC	1-125 ml glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
Total Petroleum Hydrocarbons (CT-ETPH)	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
Total Petroleum Hydrocarbons (418.1)	2-1 liter amber glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
Fraction	**Air Sample Container/Media**	**Preservative**	**Holding Time**
TCL Volatiles	SUMMA Canister	None	14 days
TCL Semivolatiles	XAD-2/PUF Cartridges	Cool to 4 C	14 days extraction/40 days to inject
TAL Metals plus Tin	Quartz Filter	None	28 days Hg & 180 days all other metals
Total Suspended Particulate Matter	Quartz Filter	None	14 days

NOTES:

1 - Depending on how sample analyses are distributed between the laboratories, additional sample bottles may be required.

2 - Holding times are from the date of sample collection.

3 - CT-ETPH - "Analysis of Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection"

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
67-64-1	Acetone	36-132	15	36-132	33-138	40	33-138
71-43-2	Benzene	50-150	15	50-150	42-167	40	42-167
75-27-4	Bromodichloromethane	19-146	15	19-146	45-453	40	45-453
75-25-2	Bromoform	29-141	15	29-141	42-153	40	42-153
74-83-9	Methyl bromide	13-174	15	13-174	34-164	40	34-164
78-93-3	Methyl ethyl ketone	35-153	15	35-153	46-146	40	46-146
75-15-0	Carbon disulfide	14-171	15	14-171	39-153	40	39-153
56-23-5	Carbon tetrachloride	52-151	15	52-151	42-168	40	42-168
108-90-7	Chlorobenzene	54-149	15	54-149	43-164	40	43-164
75-00-3	Chloroethane	16-167	15	16-167	31-160	40	31-160
67-66-3	Chloroform	56-152	15	56-152	46-160	40	46-160
74-87-3	Methyl chloride	30-170	15	30-170	25-175	40	25-175
124-48-1	Chlorodibromomethane	33-150	15	33-150	44-151	40	44-151
75-34-3	1,1-Dichloroethene	36-166	15	36-166	44-164	40	44-164
107-06-2	1,2-Dichloroethene	52-149	15	52-149	46-160	40	46-160
75-35-4	1,1-Dichloroethane	22-181	15	22-181	52-166	40	52-166
540-59-0	1,2-Dichloroethane (total)	53-149	15	53-149	43-167	40	43-167
78-87-5	1,2-Dichloropropane	36-164	15	36-164	46-163	40	46-163
10061-01-5	cis-1,3-Dichloropropene	47-140	15	47-140	45-153	40	45-153
10061-02-6	trans-1,3-dichloropropene	27-143	15	27-143	35-19	40	35-19
100-41-4	Ethylbenzene	54-157	15	54-157	45-172	40	45-172
591-78-6	Methyl butyl ketone	34-141	15	34-141	55-134	40	55-134
75-09-2	Methylene chloride	52-156	15	52-156	41-181	40	41-181
108-10-1	Methyl isobutyl ketone	45-119	15	45-119	54-128	40	54-128
100-42-5	Styrene	44-153	15	44-153	76-132	40	76-132
79-34-5	1,1,2,2-Tetrachloroethane	40-139	15	40-139	43-148	40	43-148
127-18-4	Tetrachloroethene	51-165	15	51-165	43-183	40	43-183
108-88-3	Toluene	49-156	15	49-156	44-170	40	44-170
71-55-6	1,1,1-Trichloroethane	1-144	15	1-144	45-166	40	45-166
79-00-5	1,1,2-Trichloroethane	48-142	15	48-142	44-156	40	44-156
79-01-6	Trichloroethene	36-159	15	36-159	42-169	40	42-169
75-01-4	Vinyl chloride	38-168	15	38-168	31-176	40	31-176
1330-20-7	Xylenes (total)	52-150	15	52-150	42-162	40	42-162

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
95-50-1	1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA
541-73-1	1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
106-46-7	1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA
87-68-3	Hexachlorobutadiene	NA	NA	NA	NA	NA	NA
83-32-9	Acenaphthene	58-108	20	58-108	46-117	40	46-117
208-96-8	Acenaphthylene	50-112	20	50-112	43-116	40	43-116
120-12-7	Anthracene	59-104	20	59-104	41-121	40	41-121
56-55-3	Benzo[a]anthracene	61-111	20	61-111	48-124	40	48-124
205-99-2	Benzo[b]fluoranthene	55-114	20	55-114	40-134	40	40-134
207-08-9	Benzo[k]fluoranthene	50-126	20	50-126	41-134	40	41-134
191-24-2	Benzo[ghi]perylene	57-137	20	57-137	35-147	40	35-147
50-32-8	Benzo[a]pyrene	48-123	20	48-123	42-137	40	42-137
111-91-1	bis(2-Chloroehtoxy)methane	47-109	20	47-109	41-117	40	41-117
111-44-4	bis(2-Chloroethyl)ether	53-102	20	53-102	39-116	40	39-116
108-60-1	bis(2-Chloroisopropyl)ether	42-117	20	42-117	65-108	40	65-108
117-81-7	bis(2-Ethylhexyl)phthalate	55-122	20	55-122	45-132	40	45-132
101-55-3	4-Bromophenyl phenyl ether	60-106	20	60-106	46-123	40	46-123
85-68-7	Butyl benzyl phthalate	49-119	20	49-119	48-135	40	48-135
106-47-8	4-Chloroaniline	49-99	20	49-99	D.L.-123	40	D.L.-123
59-50-7	4-Chloro-3-methylphenol	58-111	20	58-111	48-117	40	48-117
91-58-7	2-Chloronaphthalene	55-105	20	55-105	45-117	40	45-117
95-57-8	2-Chlorophenol	56-101	20	56-101	43-114	40	43-114
7005-72-3	4-Chlorophenyl phenyl ether	54-108	20	54-108	49-117	40	49-117
218-01-9	Chrysene	58-115	20	58-115	48-12+6	40	48-12+6
132-64-9	Dibenzofuran	55-113	20	55-113	67-103	40	67-103
84-74-2	Di-n-butyl phthalate	54-115	20	54-115	43-126	40	43-126
53-70-3	Dibenz[a,h]anthracene	50-146	20	50-146	45-154	40	45-154
95-50-1	1,2-Dichlorobenzene	47-98	20	47-98	39-112	40	39-112
541-73-1	1,3-Dichlorobenzene	43-94	20	43-94	37-112	40	37-112
106-46-7	1,4-Dichlorobenzene	43-94	20	43-94	39-110	40	39-110
91-94-1	3,3-Dichlorobenzidine	52-112	20	52-112	19-117	40	19-117

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
120-83-2	2,4-Dichlorophenol	56-105	20	56-105	46-117	40	46-117
84-66-2	Diethyl phthalate	48-115	20	48-115	49-127	40	49-127
105-67-9	2,4-Dimethylphenol	52-94	20	52-94	33-113	40	33-113
131-11-3	Dimethyl phthalate	25-106	20	25-106	49-123	40	49-123
534-52-1	4,6-Dinitro-2-methylphenol	53-117	20	53-117	28-147	40	28-147
51-28-5	2,4-Dinitrophenol	43-131	20	43-131	9-167	40	9-167
121-14-2	2,4-Dinitrotoluene	56-118	20	56-118	48-126	40	48-126
606-20-2	2,6-Dinitrotoluene	56-106	20	56-106	47-122	40	47-122
117-84-0	Di-n-octyl phthalate	44-140	20	44-140	35-150	40	35-150
206-44-0	Fluoranthene	53-115	20	53-115	44-121	40	44-121
86-73-7	Fluorene	51-113	20	51-113	46-115	40	46-115
118-74-1	Hexachlorobenzene	63-108	20	63-108	44-126	40	44-126
87-68-3	Hexachlorobutadiene	30-85	20	30-85	41-117	40	41-117
77-47-4	Hexachlorocyclopentadiene	D.L.-132	20	D.L.-132	D.L.-125	40	D.L.-125
67-72-1	Hexachloroethane	35-83	20	35-83	39-110	40	39-110
193-39-5	Indeno(1,2,3-cd)pyrene	48-141	20	48-141	44-151	40	44-151
78-59-1	Isophorone	54-106	20	54-106	41-115	40	41-115
91-57-6	2-Methylnaphthalene	49-104	20	49-104	61-99	40	61-99
95-48-7	2-Methylphenol	47-87	20	47-87	58-114	40	58-114
91-20-3	Naphthalene	50-108	20	50-108	41-115	40	41-115
88-74-4	2-Nitroaniline	59-112	20	59-112	74-102	40	74-102
99-09-2	3-Nitroaniline	50-114	20	50-114	47-105	40	47-105
100-01-6	4-Nitroaniline	54-126	20	54-126	37-108	40	37-108
98-95-3	Nitrobenzene	54-106	20	54-106	42-116	40	42-116
88-75-5	2-Nitrophenol	65-112	20	65-112	44-122	40	44-122
100-02-7	4-Nitrophenol	17-68	20	17-68	42-146	40	42-146
86-30-6	N-Nitrosodiphenylamine	33-70	20	33-70	39-125	40	39-125
621-64-7	N-Nitrosodipropylamine	51-112	20	51-112	40-120	40	40-120
87-86-5	Pentachlorophenol	29-135	20	29-135	18-161	40	18-161
85-01-8	Phenanthrene	60-109	20	60-109	43-121	40	43-121
108-95-2	Phenol	28-58	20	28-58	36-121	40	36-121
129-00-0	Pyrene	58-118	20	58-118	46-130	40	46-130

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
120-82-1	1,2,4-Trichlorobenzene	45-100	20	45-100	42-114	40	42-114
95-95-4	2,4,5-Trichlorophenol	62-118	20	62-118	69-115	40	69-115
88-06-2	2,4,6-Trichlorophenol	50-108	20	50-108	46-118	40	46-118
86-74-8	Carbazole	40-137	20	40-137	35-133	40	35-133
309-00-2	Aldrin	59-120	20	59-120	62-120	40	62-120
319-84-6	alpha-BHC	69-120	20	69-120	59-120	40	59-120
319-85-7	beta-BHC	72-115	20	72-115	72-115	40	72-115
319-86-8	delta-BHC	62-120	20	62-120	68-110	40	68-110
58-89-9	gamma-BHC/Lindane	79-120	20	79-120	63-120	40	63-120
72-54-8	4,4-DDD	71-115	20	71-115	65-120	40	65-120
72-55-9	4,4-DDE	69-105	20	69-105	63-120	40	63-120
50-29-3	4,4-DDT	74-120	20	74-120	59-121	40	59-121
60-57-1	Dieldrin	77-120	20	77-120	55-123	40	55-123
959-98-8	Endosulfan I	72-110	20	72-110	57-120	40	57-120
33213-65-9	Endosulfan II	76-120	20	76-120	64-120	40	64-120
1031-07-8	Endosulfan sulfate	63-120	20	63-120	62-120	40	62-120
72-20-8	Endrin	73-120	20	73-120	64-124	40	64-124
7421-93-4	Endrin aldehyde	70-121	20	70-121	31-120	40	31-120
76-44-8	Heptachlor	64-120	20	64-120	45-120	40	45-120
1024-57-3	Heptachlor epoxide	80-120	20	80-120	71-126	40	71-126
72-43-5	Methoxychlor	76-120	20	76-120	39-129	40	39-129
8001-35-2	Toxaphene	NA	NA	NA	NA	NA	NA
12674-11-2	Aroclor-1016	NA	NA	NA	NA	NA	NA
11104-28-2	Aroclor-1221	NA	NA	NA	NA	NA	NA
11141-16-5	Aroclor-1232	NA	NA	NA	NA	NA	NA
53469-21-9	Aroclor-1242	75-120	20	75-120	69-115	40	69-115
12672-29-6	Aroclor-1248	NA	NA	NA	NA	NA	NA
11097-69-1	Aroclor-1254	NA	NA	NA	NA	NA	NA
11096-82-5	Aroclor-1260	77-120	20	77-120	71-119	40	71-119
5103-71-9	alpha-Chlordane	60-140	20	60-140	60-140	40	60-140
5103-74-2	gamma-Chlordane	60-140	20	60-140	60-140	40	60-140

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
53494-70-5	Endrin ketone	60-140	20	60-140	60-140	40	60-140
1-33-1	Total-TCDD	NA	NA	NA	NA	NA	NA
1746-01-6	2378-TCDD	60-140	50	57-128	60-140	50	55-136
1-33-2	Total-TCDF	NA	NA	NA	NA	NA	NA
51207-31-9	2378-TCDF	60-140	50	62-129	60-140	50	72-118
1-28-9	Total PeCDD	NA	NA	NA	NA	NA	NA
40321-76-4	12378-PeCDD	60-140	50	80-125	60-140	50	67-139
1-29-0	Total PeCDF	NA	NA	NA	NA	NA	NA
57117-41-6	123478-PeCDF	NA	NA	NA	NA	NA	NA
57117-31-4	123678-PeCDF	60-140	50	51-132	60-140	50	54-129
1-20-0	Total HeCDD	NA	NA	NA	NA	NA	NA
39227-28-6	123478-HeCDD	60-140	50	64-27	60-140	50	57-132
57653-85-7	123678-HeCDD	NA	NA	NA	NA	NA	NA
19408-74-3	123789-HeCDD	NA	NA	NA	NA	NA	NA
1-20-1	Total HeCDF	NA	NA	NA	NA	NA	NA
70648-26-9	123478-HeCDF	60-140	50	50-146	60-140	50	50-150
57117-44-9	123678-HeCDF	NA	NA	NA	NA	NA	NA
72918-21-9	123789-HeCDF	NA	NA	NA	NA	NA	NA
60851-34-5	234678-HeCDF	NA	NA	NA	NA	NA	NA
1-01-9	Total HpCDD	NA	NA	NA	NA	NA	NA
35822-46-9	1234678-HpCDD	60-140	50	60-131	60-140	50	50-138
1-02-0	Total HpCDF	NA	NA	NA	NA	NA	NA
67562-39-4	1234678-HpCDF	60-140	50	50-150	60-140	50	50-150
55673-89-7	11234789-HpCDF	NA	NA	NA	NA	NA	NA
3268-87-9	OCDD	60-140	50	50-147	60-140	50	50-149
39001-1-2	OCDF	60-140	50	50-150	60-140	50	50-150
7440-36-0	Antimony	75-125	20	75-125	75-125	20	75-125
7440-38-2	Arsenic	75-125	20	75-125	75-125	20	75-125
7440-39-3	Barium	75-125	20	75-125	75-125	20	75-125
7440-41-7	Beryllium	75-125	20	75-125	75-125	20	75-125

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
7440-43-9	Cadmium	75-125	20	75-125	75-125	20	75-125
7440-47-3	Chromium	75-125	20	75-125	75-125	20	75-125
7440-48-4	Cobalt	75-125	20	75-125	75-125	20	75-125
7440-50-8	Copper	75-125	20	75-125	75-125	20	75-125
7439-92-1	Lead	75-125	20	75-125	75-125	20	75-125
7439-97-6	Mercury	75-125	20	75-125	75-125	20	75-125
7440-02-0	Nickel	75-125	20	75-125	75-125	20	75-125
7782-49-2	Selenium	75-125	20	75-125	75-125	20	75-125
7440-22-4	Silver	75-125	20	75-125	75-125	20	75-125
7440-28-0	Thallium	75-125	20	75-125	75-125	20	75-125
7440-31-5	Tin	75-125	20	75-125	75-125	20	75-125
7440-62-2	Vanadium	75-125	20	75-125	75-125	20	75-125
7440-66-6	Zinc	75-125	20	75-125	75-125	20	75-125
7429-90-5	Aluminum	75-125	20	75-125	75-125	20	75-125
7440-70-2	Calcium	75-125	20	75-125	75-125	20	75-125
7439-89-6	Iron	75-125	20	75-125	75-125	20	75-125
7439-95-4	Magnesium	75-125	20	75-125	75-125	20	75-125
7439-96-5	Manganese	75-125	20	75-125	75-125	20	75-125
7440-09-7	Potassium	75-125	20	75-125	75-125	20	75-125
7440-23-5	Sodium	75-125	20	75-125	75-125	20	75-125
SA0001	Alkalinity (to pH 8.3)	75-125	20	75-125	75-125	20	75-130
SA0002	Total Alkalinity (to pH 4.5)	75-125	20	75-125	75-125	20	75-130
SA0003	Ammonia	75-125	20	75-125	75-125	20	75-130
SA0004	BOD	75-125	20	75-125	75-125	20	75-130
SA0006	Chloride	75-125	20	75-125	75-125	20	75-130
SA0007	COD	75-125	20	75-125	75-125	20	75-130
SA0008	Cyanide, Total	75-125	20	75-125	75-125	20	75-130
SA0011	Hexavalent Chromium	75-125	20	75-125	75-125	20	75-130
SA0012	Nitrate/Nitrite	75-125	20	75-125	75-125	20	75-130
SA0014	Orthophosphate	75-125	20	75-125	75-125	20	75-130
SA0018	Total Dissolved Solids	75-125	20	75-125	75-125	20	75-130

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
SA0019	Total Organic Carbon	75-125	20	75-125	75-125	20	75-130
SA0023	Total Sulfate	75-125	20	75-125	75-125	20	75-130
SA0024	Total Suspended Solids	75-125	20	75-125	75-125	20	75-130

NOTES:
(1) Fractions: VOA - Volatile Organic Analytes; DAI - Direct Aqueous Injection; SV - Semivolatile Organics; OCP - Organochlorine Pesticides
OP - Organophosphorus Pesticides; H - Herbicides; DIOX/F - Dioxins/Furans; M - Metals; WC - Wet Chemistry; RAD - Radiological
(2) Fictitious CAS numbers created to represent the co-eluting isomers 3-methylphenol and 4-methylphenol.
(3) SVOC limits were rounded to whole numbers to reflect the accuracy of the laboratory (5/5/01).
TBD - PQL to be determined
SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods," third edition.
EPA - "Methods for Chemical Analysis of Water and Wastes," EPA 600-4/79-020.
(4) These are recommended values for recovery and RPD. The selected analytical laboratory's internal control limits will serve as the final limits for the project.

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
67-64-1	Acetone	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
75-05-8	Acetonitrile	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
107-02-8	Acrolein	VOA	SW846-8260B	5.0	ug/l	100.0	ug/kg
107-13-1	Acrylonitrile	VOA	SW846-8260B	0.5	ug/l	10.0	ug/kg
107-05-1	Allyl chloride	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
71-43-2	Benzene	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
75-27-4	Bromodichloromethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-25-2	Bromoform	VOA	SW846-8260B	4.0	ug/l	5.0	ug/kg
74-83-9	Methyl bromide (bromomethane)	VOA	SW846-8260B	10.0	ug/l	10.0	ug/kg
78-93-3	Methyl ethyl ketone (2-Butanone)	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
75-15-0	Carbon disulfide	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
56-23-5	Carbon tetrachloride	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
108-90-7	Chlorobenzene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-00-3	Chloroethane	VOA	SW846-8260B	10.0	ug/l	10.0	ug/kg
67-66-3	Chloroform	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
126-99-8	Chloroprene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
74-87-3	Methyl chloride (Chloromethane)	VOA	SW846-8260B	10.0	ug/l	10.0	ug/kg
124-48-1	Dibromochloromethane	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
96-12-8	1,2-Dibromo-3-chloropropane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
74-95-3	Dibromomethane (methylene bromide)	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
106-93-4	Ethylene dibromide (EDB)	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
110-57-6	trans-1,4-Dichloro-2-butene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-71-8	Dichlorodifluoromethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-34-3	1,1-Dichloroethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
107-06-2	1,2-Dichloroethane	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
75-35-4	1,1-Dichloroethene	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
156-59-2	cis-1,2-Dichloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
156-60-5	trans-1,2-Dichloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
78-87-5	1,2-Dichloropropane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
542-75-6	1,3-Dichloropropene (total)	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
123-91-1	1,4-Dioxane	VOA	SW846-8260B	150.0	ug/l	150.0	ug/kg
100-41-4	Ethylbenzene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
97-63-2	Ethyl methacrylate	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
591-78-6	2-Hexanone	VOA	SW846-8260B	50.0	ug/l	50.0	ug/kg
78-83-1	Isobutyl alcohol	VOA	SW846-8260B	50.0	ug/l	50.0	ug/kg
126-98-7	Methacrylonitrile	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-09-2	Methylene chloride	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
74-88-4	Methyl iodide	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
80-62-6	Methyl methacrylate	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
108-10-1	4-Methyl-2-pentanone	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
1634-04-4	Methyl-tert-butyl ether	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
107-12-0	Propionitrile	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
100-42-5	Styrene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
630-20-6	1,1,1,2-Tetrachloroethane	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
79-34-5	1,1,2,2-Tetrachloroethane	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
127-18-4	Tetrachloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
108-88-3	Toluene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
71-55-6	1,1,1-Trichloroethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
79-00-5	1,1,2-Trichloroethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
79-01-6	Trichloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-69-4	Trichlorofluoromethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
108-05-4	Vinyl acetate	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
96-18-4	1,2,3-Trichloropropane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-01-4	Vinyl chloride	VOA	SW846-8260B	2.0	ug/l	10.0	ug/kg
1330-20-7	Xylenes (total)	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
83-32-9	Acenaphthene	SV	SW846-8270C	10	ug/l	330	ug/kg
208-96-8	Acenaphthylene	SV	SW846-8270C	0.3	ug/l	330	ug/kg
98-86-2	Acetophenone	SV	SW846-8270C	10	ug/l	330	ug/kg
53-96-3	2-Acetylaminofluorene	SV	SW846-8270C	10	ug/l	330	ug/kg
92-67-1	4-Aminobiphenyl	SV	SW846-8270C	10	ug/l	330	ug/kg
62-53-3	Analine	SV	SW846-8270C	10	ug/l	330	ug/kg
120-12-7	Anthracene	SV	SW846-8270C	10	ug/l	330	ug/kg
140-57-8	Aramite	SV	SW846-8270C	10	ug/l	330	ug/kg
56-55-3	Benzo[a]anthracene	SV	SW846-8270C	0.6	ug/l	330	ug/kg
205-99-2	Benzo[b]fluoranthene	SV	SW846-8270C	0.08	ug/l	330	ug/kg
207-08-9	Benzo[k]fluoranthene	SV	SW846-8270C	0.3	ug/l	330	ug/kg
191-24-2	Benzo[ghi]perylene	SV	SW846-8270C	10	ug/l	330	ug/kg
50-32-8	Benzo[a]pyrene	SV	SW846-8270C	0.2	ug/l	330	ug/kg
100-51-6	Benzyl alcohol	SV	SW846-8270C	20	ug/l	670	ug/kg
111-91-1	bis(2-Chloroethoxy) methane	SV	SW846-8270C	10	ug/l	330	ug/kg
111-44-4	bis(2-Chloroethyl)ether	SV	SW846-8270C	10	ug/l	330	ug/kg
108-60-1	2,2'-oxybis(1-chloro-Propane)	SV	SW846-8270C	10	ug/l	330	ug/kg
117-81-7	bis(2-Ethylhexyl)phthalate	SV	SW846-8270C	2	ug/l	330	ug/kg
101-55-3	4-Bromophenyl phenyl ether	SV	SW846-8270C	10	ug/l	330	ug/kg
85-68-7	Butyl benzyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
86-74-8	Carbazole	SV	SW846-8270C	10	ug/l	330	ug/kg
106-47-8	4-Chloroaniline	SV	SW846-8270C	20	ug/l	670	ug/kg
59-50-7	4-Chloro-3-methyl phenol	SV	SW846-8270C	20	ug/l	670	ug/kg
91-58-7	2-Chloronaphthalene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-57-8	2-Chlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
7005-72-3	4-Chlorophenyl phenyl ether	SV	SW846-8270C	10	ug/l	330	ug/kg
218-01-9	Chrysene	SV	SW846-8270C	10	ug/l	330	ug/kg
132-64-9	Dibenzofuran	SV	SW846-8270C	10	ug/l	330	ug/kg
84-74-2	Di-n-butyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
117-84-0	Di-n-octyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
53-70-3	Dibenz[a,h]anthracene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-50-1	1,2-Dichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
541-73-1	1,3-Dichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
106-46-7	1,4-Dichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
91-94-1	3,3-Dichlorobenzidine	SV	SW846-8270C	20	ug/l	670	ug/kg
120-83-2	2,4-Dichlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
84-66-2	Diethyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
297-97-2	0,0-Diethyl-0-2-pyrazinyl	SV	SW846-8270C	10	ug/l	330	ug/kg
60-51-5	Dimethoate	SV	SW846-8270C	10	ug/l	330	ug/kg
60-11-7	p-(Dimethylamino)azobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
57-97-6	7,12-Dimethylbenz(a)anthracene	SV	SW846-8270C	10	ug/l	330	ug/kg
122-09-8	alpha,alpha,-Dimethylphenethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
119-93-7	3,3-Dimethylbenzidine	SV	SW846-8270C	10	ug/l	330	ug/kg
105-67-9	2,4-Dimethylphenol	SV	SW846-8270C	10	ug/l	330	ug/kg
131-11-3	Dimethyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
99-65-0	1,3-Dinitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg

Table 5-1

RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
534-52-1	4,6-Dinitro-2-methylphenol	SV	SW846-8270C	50	ug/l	830	ug/kg
51-28-5	2,4-Dinitrophenol	SV	SW846-8270C	50	ug/l	830	ug/kg
121-14-2	2,4-Dinitrotoluene	SV	SW846-8270C	10	ug/l	330	ug/kg
606-20-2	2,6-Dinitrotoluene	SV	SW846-8270C	10	ug/l	330	ug/kg
117-84-0	Di-n-octyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
88-85-7	Dinoseb	SV	SW846-8270C	10	ug/l	330	ug/kg
122-39-4	Diphenylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
298-04-4	Disulfoton	SV	SW846-8270C	10	ug/l	330	ug/kg
65-50-0	Ethyl methanesulfonate	SV	SW846-8270C	10	ug/l	330	ug/kg
52-85-7	Famphur	SV	SW846-8270C	10	ug/l	330	ug/kg
206-44-0	Fluoranthene	SV	SW846-8270C	10	ug/l	330	ug/kg
86-73-7	Fluorene	SV	SW846-8270C	10	ug/l	330	ug/kg
118-74-1	Hexachlorobenzene	SV	SW846-8270C	0.077	ug/l	330	ug/kg
87-68-3	Hexachlorobutadiene	SV	SW846-8270C	10	ug/l	330	ug/kg
77-47-4	Hexachlorocyclopentadiene	SV	SW846-8270C	10	ug/l	330	ug/kg
67-72-1	Hexachloroethane	SV	SW846-8270C	3	ug/l	330	ug/kg
70-30-4	Hexachlorophene	SV	SW846-8270C	10	ug/l	330	ug/kg
1888-71-7	Hexachloropropene	SV	SW846-8270C	10	ug/l	330	ug/kg
193-39-5	Indeno(1,2,3-cd)pyrene	SV	SW846-8270C	10	ug/l	330	ug/kg
78-59-1	Isophorone	SV	SW846-8270C	10	ug/l	330	ug/kg
120-58-1	Isosafrole	SV	SW846-8270C	10	ug/l	330	ug/kg
91-80-5	Methapyrilene	SV	SW846-8270C	10	ug/l	330	ug/kg
56-49-5	3-Methylcholanthrene	SV	SW846-8270C	10	ug/l	330	ug/kg
66-27-3	Methyl methanesulfonate	SV	SW846-8270C	10	ug/l	330	ug/kg
91-57-6	2-Methylnaphthalene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-48-7	2-Methylphenol (o-Cresol)	SV	SW846-8270C	10	ug/l	330	ug/kg
108-39-4	3-Methylphenol ((m-Cresol)	SV	SW846-8270C	10	ug/l	330	ug/kg
106-44-5	4-Methylphenol (p-Cresol)	SV	SW846-8270C	10	ug/l	330	ug/kg
298-00-0	Methyl parathion	SV	SW846-8270C	10	ug/l	330	ug/kg
91-20-3	Naphthalene	SV	SW846-8270C	10	ug/l	330	ug/kg
130-15-4	1,4-Naphthoquinone	SV	SW846-8270C	10	ug/l	330	ug/kg
134-32-7	1-Naphthylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
91-59-8	2-Naphthylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
88-74-4	2-Nitroaniline	SV	SW846-8270C	50	ug/l	830	ug/kg
99-09-2	3-Nitroaniline	SV	SW846-8270C	50	ug/l	830	ug/kg
100-01-6	4-Nitroaniline	SV	SW846-8270C	50	ug/l	830	ug/kg
98-95-3	Nitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
56-57-5	4-Nitoquinoline-1-oxide	SV	SW846-8270C	10	ug/l	330	ug/kg
88-75-5	2-Nitrophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
100-02-7	4-Nitrophenol	SV	SW846-8270C	50	ug/l	830	ug/kg
55-18-5	N-Nitrosodiethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
62-75-9	N-Nitrosodimethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
86-30-6	N-Nitrosodiphenylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
621-64-7	N-Nitrosodi-n-propylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
924-16-3	N-Nitrosodi-n-butylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
10595-95-6	N-Nitrosomethylethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
59-89-2	N-Nitrosomorpholine	SV	SW846-8270C	10	ug/l	330	ug/kg
100-75-4	N-Nitrosopiperidenemethylethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
930-55-2	N-Nitrosopyrrolidine	SV	SW846-8270C	10	ug/l	330	ug/kg
99-55-8	5-Nitro-0-toluidine	SV	SW846-8270C	10	ug/l	330	ug/kg
56-38-2	Parathion	SV	SW846-8270C	10	ug/l	330	ug/kg

Table 5-1

RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
608-93-5	Pentachlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
76-01-7	Pentachloroethane	SV	SW846-8270C	10	ug/l	330	ug/kg
82-68-8	Pentachloronitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
87-86-5	Pentachlorophenol	SV	SW846-8270C	1	ug/l	830	ug/kg
62-44-2	Phenacetin	SV	SW846-8270C	10	ug/l	330	ug/kg
85-01-8	Phenanthrene	SV	SW846-8270C	0.077	ug/l	330	ug/kg
108-95-2	Phenol	SV	SW846-8270C	10	ug/l	330	ug/kg
106-50-3	p-Phenylenediamine	SV	SW846-8270C	10	ug/l	330	ug/kg
298-02-2	Phorate	SV	SW846-8270C	10	ug/l	330	ug/kg
109-06-8	2-Picoline	SV	SW846-8270C	10	ug/l	330	ug/kg
23950-58-5	Pronamide	SV	SW846-8270C	10	ug/l	330	ug/kg
129-00-0	Pyrene	SV	SW846-8270C	10	ug/l	330	ug/kg
110-86-1	Pyridine	SV	SW846-8270C	10	ug/l	330	ug/kg
94-59-7	Safrole	SV	SW846-8270C	10	ug/l	330	ug/kg
3689-24-5	Sulfotepp	SV	SW846-8270C	10	ug/l	330	ug/kg
95-94-3	1,2,4,5-Tetrachlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
58-90-2	2,3,4,6-Tetrachlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
95-53-4	0-Toluidine	SV	SW846-8270C	10	ug/l	330	ug/kg
120-82-1	1,2,4-Trichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-95-4	2,4,5-Trichlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
88-06-2	2,4,6-Trichlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
126-68-1	0,0,0-Triethylphosphorothiote	SV	SW846-8270C	10	ug/l	330	ug/kg
99-35-4	1,3,5-Trinitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
15972-60-8	Alachlor	OCP	SW846-8082	2	ug/l	230.0	ug/kg
116-06-3	Aldicarb	OCP	SW846-8082	3	ug/l	1000.0	ug/kg
309-00-2	Aldrin	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
1912-24-9	Atrazine	OCP	SW846-8082	3	ug/l	200.0	ug/kg
319-84-6	alpha-BHC	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
319-85-7	beta-BHC	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
319-86-8	delta-BHC	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
58-89-9	gamma-BHC/Lindane	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
57-74-9	Chlordane	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
94-75-7	2,4-D	OCP	SW846-8082	70	ug/l	1400.0	ug/kg
72-54-8	4,4-DDD	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
72-55-9	4,4-DDE	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
50-29-3	4,4-DDT	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
60-57-1	Dieldrin	OCP	SW846-8082	0.002	ug/l	3.3	ug/kg
959-98-8	Endosulfan I	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
33213-65-9	Endosulfan II	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
1031-07-8	Endosulfan sulfate	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
72-20-8	Endrin	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
7421-93-4	Endrin aldehyde	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
53494-70-5	Endrin ketone	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
76-44-8	Heptachlor	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
1024-57-3	Heptachlor epoxide	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
72-43-5	Methoxychlor	OCP	SW846-8082	0.5	ug/l	17.0	ug/kg
122-34-9	Simazine	OCP	SW846-8082	4	ug/l	800.0	ug/kg
8001-35-2	Toxaphene	OCP	SW846-8082	1.0	ug/l	170	ug/kg
12674-11-2	Aroclor-1016	OCP	SW846-8082	0.5	ug/l	33	ug/kg

Table 5-1

RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
11104-28-2	Aroclor-1221	OCP	SW846-8082	0.5	ug/l	67	ug/kg
11141-16-5	Aroclor-1232	OCP	SW846-8082	0.5	ug/l	33	ug/kg
53469-21-9	Aroclor-1242	OCP	SW846-8082	0.5	ug/l	33	ug/kg
12672-29-6	Aroclor-1248	OCP	SW846-8082	0.5	ug/l	33	ug/kg
11097-69-1	Aroclor-1254	OCP	SW846-8082	0.5	ug/l	33	ug/kg
11096-82-5	Aroclor-1260	OCP	SW846-8082	0.5	ug/l	33	ug/kg
7440-36-0	Antimony	M	SW846-6010B	6	ug/l	12	mg/kg
7440-38-2	Arsenic	M	SW846-7000A	4	ug/l	1	mg/kg
7440-39-3	Barium	M	SW846-6010B	200	ug/l	15	mg/kg
7440-41-7	Beryllium	M	SW846-6010B/7000A	4	ug/l	0.08	mg/kg
7440-43-9	Cadmium	M	SW846-7000A	5	ug/l	0.1	mg/kg
7440-47-3	Chromium (total)	M	SW846-6010B	10	ug/l	1	mg/kg
7440-48-4	Cobalt	M	SW846-6010B	50	ug/l	8	mg/kg
7440-50-8	Copper	M	SW846-6010B	25	ug/l	6	mg/kg
7439-92-1	Lead	M	SW846-7000A	3	ug/l	0.3	mg/kg
7439-97-6	Mercury	M	SW846-7470A/7471A	0.2	ug/l	0.15	mg/kg
7440-02-0	Nickel	M	SW846-6010B	40	ug/l	0.9	mg/kg
7782-49-2	Selenium	M	SW846-6010B/7000A	5	ug/l	0.8	mg/kg
7440-22-4	Silver	M	SW846-6010B	10	ug/l	3	mg/kg
7440-28-0	Thallium	M	SW846-7000A	5	ug/l	3	mg/kg
7440-31-5	Tin	M	SW846-6010B	250	ug/l	20	mg/kg
7440-62-2	Vanadium	M	SW846-6010B	50	ug/l	1	mg/kg
7440-66-6	Zinc	M	SW846-6010B	20	ug/l	15	mg/kg
7429-90-5	Aluminum	M	SW846-6010B	200	ug/l	46	mg/kg
7440-70-2	Calcium	M	SW846-6010B	5000	ug/l	76	mg/kg
7439-89-6	Iron	M	SW846-6010B	100	ug/l	30	mg/kg
7439-95-4	Magnesium	M	SW846-6010B	5000	ug/l	38	mg/kg
7439-96-5	Manganese	M	SW846-6010B	15	ug/l	3	mg/kg
7440-09-7	Potassium	M	SW846-6010B	5000	ug/l	76	mg/kg
7440-23-5	Sodium	M	SW846-6010B	5000	ug/l	76	mg/kg
7440-36-0	Antimony - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.006	mg/l
7440-38-2	Arsenic - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.05	mg/l
7440-39-3	Barium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	1	mg/l
7440-41-7	Beryllium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.004	mg/l
7440-43-9	Cadmium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.005	mg/l
7440-47-3	Chromium (total) - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.05	mg/l
7440-50-8	Copper - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	1.3	mg/l
7439-92-1	Lead - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.015	mg/l
7439-97-6	Mercury - SPLP/TCLP	M	1311/1312-7470A	N/A	N/A	0.002	mg/l
7440-02-0	Nickel - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.1	mg/l
7782-49-2	Selenium - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.05	mg/l
7440-22-4	Silver - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.036	mg/l
7440-28-0	Thallium SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.005	mg/l
7440-62-2	Vanadium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.05	mg/l
7440-66-6	Zinc - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	5	mg/l
5289290-40-1	Total Petroleum Hydrocarbons	Phy	CT-ETPH	0.5	mg/l	50	mg/kg
5289290-40-0	Total Petroleum Hydrocarbons	Phy	EPA 418.1	0.5	mg/l	50	mg/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
SA0001	Alkalinity (to pH 8.3)	WC	EPA 310.1	1	mg/l	5	mg/kg
SA0002	Total Alkalinity (to pH 4.5)	WC	EPA 310.1	1	mg/l	5	mg/kg
SA0003	Ammonia	WC	EPA 350.2	1	mg/l	20	mg/kg
SA0004	BOD	WC	EPA 405.1	2	mg/l	200	mg/kg
SA0006	Chloride	WC	EPA 300.0	0.2	mg/l	2	mg/kg
SA0007	COD	WC	EPA 410.2	7	mg/l	1250	mg/kg
SA0008	Cyanide, Total	WC	SW846 9012A	0.005	mg/l	0.1	mg/kg
SA0011	Hexavalent Chromium	WC	SW846 7196A	0.01	mg/l	4	mg/kg
SA0012	Nitrate/Nitrite	WC	EPA 300.0	0.1/0.1	mg/l	1.0/1.0	mg/kg
SA0014	Orthophosphate	WC	EPA 365.3	0.01	mg/l	1	mg/kg
SA0018	Total Dissolved Solids	WC	EPA 160.1	30	mg/l	NA	mg/kg
SA0019	Total Organic Carbon	WC	EPA 415.1/Kahn	1	mg/l	5	mg/kg
SA0023	Total Sulfate	WC	EPA 300.0	0.5	mg/l	5	mg/kg
SA0024	Total Suspended Solids	WC	EPA 160.2	9	mg/l	NA	mg/kg

NOTES:

(1) Fractions: VOA (Volatile Organic, DAI (Direct Aqueous Injection), SV (Semivolatile Organic), OCP (Organochlorine Pesticide), OP (Organophospohorus Pesticide, H (Herbicide), Diox/F (Dioxin/Furan), M (Metal), Phy (Physical), and WC (Wet Chemistry Parameter)

(2) Fictitious CAS number created to represent the coeluting isomers 3-methylphenol and 4-methylphenol.

(3) The following VOA compounds are considered poor purging compounds and the above stated detection limits may be difficult for most labs to achieve: acetone, acetonitrile, acrolein, MEK, carbon disulfide, t-1,4-dichloro-2-butene, 1,4-dioxane, 2-hexanone isopropyl alcohol, methacrylonitrile, MIBK. This may be of issue particularly if these compounds are contituents of concern.

(4) These are recommended quantitation limits. The final Practical Quantitation Limits will be at a concentration to comply with the appropriate Connecticut Remedial Standard Regulations criteria or the selected laboratory's lowest reporting limit, whichever is lower.

SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods," third edition.

EPA - "Methods for Chemical Analysis of Water and Wastes," EPA 600 4/79-020

CT-ETPH - "Analysis of Extractable Petroleum hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame nization Detector"

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
TCL Volatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<5X the QL or methylene chloride, and <QL for all other compounds	<5X the QL or methylene chloride, and <QL for all other compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	4-Bromofluorobenzene Dibromofluoromethane Toluene-d8 Dichloroethane-d4	86-115% 86-118% 88-110% 80-120%	74-121% 80-120% 81-117% 80-120%
TCL Semivolatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<QL for all compounds	<QL for all compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
	Surrogate Spike Recoveries	Nitrobenzene-d5	35-114%	23-120%
		2-Fluorobiphenyl	43-116%	30-115%
		p-Terphenyl-d14	33-141%	18-137%
		Phenol-d6	10-94%	24-113%
		Phenol-d5	10-115%	24-113%
		2-Fluorophenol	21-100%	25-121%
		2,4,6-Tribromophenol	10-123%	19-121%
		4,4-Dibromobiphenyl (Spiked onto cartridge before it is sent to the field.)	NA	NA

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
TCL Pesticides/ PCB Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<QL for all compounds	<QL for all compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	Tetrachloror-meta-xylene decachlorobiphenyl	60-150% 60-150%	60-150% 60-150%
TAL Metals plus Tin	Lab blank, trip blank, or field blank	All TCL Compounds	<PRDL for all compounds	<PRDL for all compounds
	Laboratory Duplicate Precission	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Metals	Table 5-3	Table 5-3
All Wet Chemistry Parameters	Lab blank, trip blank, or field blank	All Parameters	<QL for all compounds	<QL for all compounds
	Laboratory Duplicate Precision	All Parameters	Table 5-3	Table 5-3
	Matrix Spike Recovery	All Parameters	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Parameters	Table 5-3	Table 5-3

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
Dioxins/ Dibenzoflurans	Lab blank, trip blank, or field blank	All Compounds	<5X the QL or methylene chloride, and <QL for all other compounds	<5X the QL or methylene chloride, and <QL for all other compounds
	Matrix Spike Duplicate Precision	All Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Compounds	Table 5-3	Table 5-3
	Recovery Standard Recovery	C13-1,2,3,4-TCDD	>40%	>40%

Notes:

QL = Quantitation limit; PRDL = Project required detection Limit; TCL = TargetCompound List; NA= Not Applicable

VOC and SVOC surrogate recoveries updated to reflect most current method specifications on 5/5/01

The compounds and control limits are recommended only. The final compounds and associated control limits will be supplied by selected analytical laboratory from internally generated control charts.

APPENDICES

Appendix A

Summary of Historical Analytical Results

Appendix B

Standard Operating Procedures

Appendix C

CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater to the Sanitary Sewer

Appendix D

Willow Brook/Willow Brook Pond
Dust Control Plan

DUST CONTROL PLAN
FOR
UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
WILLOW BROOK AND WILLOW BROOK POND
EAST HARTFORD, CT

May 2001

Prepared for

UNITED TECHNOLOGIES CORPORATION
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Table of Contents

		Page
1.	**INTRODUCTION**	**1-1**
2.	**OPERATIONAL CONTROLS**	**2-1**
2.1	Methods to Reduce Dust Creation	2-1
2.2	Methods to Control Dust	2-1
3.	**MONITORING**	**3-1**
4.	**NOTIFICATION AND CORRECTIVE ACTION PROCEDURES**	**4-1**

Attachments

Attachment A Dust and Wind Monitoring Daily Log Sheet

1. INTRODUCTION

This Dust Control Plan has been developed to outline the operational controls, monitoring requirements, and notification procedures to be implemented during the performance of the Willow Brook/Willow Brook Pond polychlorinated biphenyl (PCB) remediation project at the Pratt & Whitney (P&W) facility in East Hartford, Connecticut. As the project involves the excavation of wet soil and sediment, the generation of dust as a result of excavation and material handling activities is not anticipated to be a significant concern. This plan is organized to present the operational controls to be implemented during the project to minimize the generation of dust, to control the dust that is generated, to define monitoring requirements to ensure that abutting residents and P&W facility workers are not exposed to airborne particulate matter beyond applicable threshold levels, and to establish notification procedures and corrective actions to be implemented in the event applicable particulate thresholds are exceeded.

The action level for particulate matter in air (dust) established for this project is 150 $\mu g/m^3$ in air based on a time-weighted-average over a single 1-hour period.

2. OPERATIONAL CONTROLS

The following describes the proposed measures to be implemented during the construction activities associated with the remediation of Willow Brook and Willow Brook Pond. LEA-Cianci, Inc. (LCI) will implement remediation activities under the direct supervision of Loureiro Engineering Associates, Inc. (LEA)

2.1 Methods to Reduce Dust Creation

The following are the methods to be employed to minimize the potential for dust generation:

1. All vehicle transport routes will be maintained through the use of a mechanical sweeper;
2. All entrance and exit points from areas of excavation will be provided with an anti-tracking pad of crushed stone;
3. Transportation and disposal vendor vehicles leaving the site will be pressure washed to remove particulate matter;
4. All stockpiled materials awaiting offsite disposal will be staged within designated stockpile areas;
5. All stockpiled material from by-pass channel excavation will either be covered or dust suppressants (Section 2.2) will be applied;
6. Stockpile areas will be constructed with wind screens along the western, eastern and northern limits (predominant wind direction during the construction period is from the south and southwest);
7. Stockpiled material will either be covered or dust suppressants (Section 2.2) will be applied.

2.2 Methods to Control Dust

LCI will provide either or both of the following means to perform active dust control throughout the planned remediation activities. One method will be through the use of a full-time water truck to apply water on an as-needed basis to all active work areas. The second method will be through a truck-mounted mechanical broadcast spreader to apply chemical dust suppressants (calcium chloride or sodium chloride) to active work areas. The two methods may be implemented either alone or in conjunction with one another on an as needed basis to ensure the

150 $\mu g/m^3$ standard for the project is not exceeded. Active work areas include all areas being excavated or restored, all vehicle transport routes, and all staging and stockpiling areas for contaminated soil or backfill materials for the construction of the engineered controls.

3. MONITORING

Dust monitoring and wind direction monitoring will be performed on a daily basis during the following period:

- Dust and wind direction monitoring to commence upon initiation of demolition, excavation, or soil and sediment handling activities (material handling activities);
- Dust and wind direction monitoring to be discontinued upon completion of placement of all earthen materials associated with caps.

Wind direction monitoring will be performed through the use of a windsock to be strategically located within the limits of the project area (depicted as the Limits of Construction on Drawing 1-1 of the Remedial Action Work Plan). Real-time dust monitoring will be performed by affixing the particulate monitoring device at a location downwind of excavation activities at the site when: 1) precipitation has not occurred during the previous 24 hours; and 2) when work is being performed at the site. The individual responsible for performing the dust monitoring will manually record the maximum and time-weighted concentration at a frequency of not greater than once per hour during periods of material handling activities at the site.

Notification procedures and corrective actions are described in Section 4.0. The portable particulate monitor will be a direct read personal monitor and will be calibrated and maintained in accordance with the manufacturer recommended intervals. The dust monitor will be capable of monitoring particulate matter less than 10 microns in size, capable of storing individual readings for a single 24-hour period, and will be provided with a digital readout of maximum and time-weighted-average concentrations for a 1-hour period. At a minimum, the particulate monitor will be calibrated prior to each use. A daily log sheet for dust and wind monitoring is provided as Appendix A.

4. NOTIFICATION AND CORRECTIVE ACTION PROCEDURES

This section presents procedures to be implemented in the event daily monitoring indicates an exceedance of the 150 $\mu g/m^3$ time-weighted average standard for the project at any one individual location along the downwind perimeter of the project area. As a result, the procedures provided below are those that are necessary to correct the activities identified as resulting in the exceedance.

If during the hourly inspection and recording of particulate levels it is noted that the running time-weighted-average concentration of particulate matter exceeds 150 μ g/m^3 standard for the project, perform the following:

1. Remove the dust monitor from the sampling location and proceed to an upwind location and obtain a background measurement. If the working site particulate matter measurement is less than 100 $\mu g/m^3$ above the background level, return the monitor to the original monitoring location and continue with hourly readings. If the working site particulate matter measurement is greater than 100 $\mu g/m^3$ above the background level, perform the following tasks.

2. Immediately notify the onsite LCI Superintendent of the result via two-way radio or telephone;

3. Perform a visual inspection of the work area and identify the suspect activities generating dust;

4. Immediately proceed to the location of the suspected activities and inform workers to cease operations if operations are the cause of dust;

5. Immediately arrange for application of dust suppression materials as identified in Section 2.2;

6. Recommence project activities and repeat sampling at the original downwind sampling location where the exceedance was noted; and

7. Repeat steps 3 though 6 , if necessary, until the particulate reading is less than the 150 $\mu g/m^3$ standard over a one-hour period.

Attachment A

Dust and Wind Monitoring
Daily Log Sheet

Willow Brook and Willow Brook Pond
PCB Remediation Project
Dust and Wind Monitoring Daily Log Sheet

Date: _____
Wind Direction: _____ Time: _____ a.m./p.m.

Dust Monitoring Inspector Name: _____

Inspector Signature:

Location Description (ex. 250 feet east of field office)	Time (ex. 10.15 am)	Reading (mg/m^3)

Dust Monitor Calibration Record:

Performed By: _____
Date: _____
Time: _____
Standard: _____
Instrument Reading: _____

Corrective Actions:

If during the hourly inspection and recording of particulate levels it is noted that the running time-weighted-average concentration of particulate matter exceeds 150 μ g/m^3 standard for the project, perform the following:

1. Remove the dust monitor from the sampling location and proceed to an upwind location and obtain a background measurement. If the working site particulate matter measurement is less than 100 $\mu g/m^3$ above the background level return the monitor to the original monitoring location and continue with hourly readings. If the working site particulat matter measurement is greater than 100 $\mu g/m^3$ above the background level, perform the following tasks.
2. Immediately notify the onsite LCI Superintendent of the result via two-way radio or telephone;
3. Perform a visual inspection of the work area and identify the suspect activities generating dust;
4. Immediately proceed to the location of the suspected activities and inform workers to cease operations if operations are the cause of dust;
5. Immediately arrange for application of dust suppression materials as identified in Section 2.2;
6. Recommence project activities and repeat sampling at the original downwind sampling location where the exceedance was noted; and
7. Repeat steps 3 though 6 , if necessary, until the particulate reading is less than the 150 $\mu g/m^3$ standard over a one-hour period.

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Description of Oversized Material, if applicable:

DRAWING 1-1: EXISTING SITE PLAN

[X] Map [ ] Photograph [ ] Other (Specify Below)

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DRAWING 4-1: POTENTIAL CONFIRMATORY SAMPLING LOCATIONS

[X] Map [ ] Photograph [ ] Other (Specify Below)

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Attachment No. 2

Revised Pages
Request for Variance
Engineered Control of Polluted Soils

REQUEST FOR VARIANCE
ENGINEERED CONTROL OF POLLUTED SOILS
UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
WILLOW BROOK AND WILLOW BROOK POND
EAST HARTFORD, CT

January 2001
Revised May 2001
Revised July 2001

Prepared for

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Table of Contents

		Page
1.	**INTRODUCTION**	**1-1**
1.1	Project Limits	1-1
1.1.1	Upstream of the Dam	1-2
1.1.2	Downstream of the Dam	1-2
1.2	Facility Background	1-4
1.3	Description of Site	1-4
1.4	Report Scope and Organization	1-5
2.	**CONTAMINANT DELINEATION INVESTIGATIONS**	**2-1**
2.1	Initial Site Characterization Investigation	2-1
2.2	Supplemental Site Characterization Investigation – Phase II	2-3
2.3	Supplemental Site Characterization Investigation – Phase III	2-4
2.4	Nature and Extent of Contamination	2-7
2.4.1	Soil and Sediment	2-7
2.4.2	Groundwater	2-7
2.4.3	Surface Water	2-7
3.	**EVALUATION OF REMEDIAL ALTERNATIVES**	**3-1**
3.1	Complete Excavation and Offsite Disposal	3-1
3.1.1	Demolition and Removal of Existing Structures	3-2
3.1.2	Contaminated Soil and Sediment Excavation and Offsite Disposal	3-3
3.1.3	Site Restoration	3-3
3.1.4	Capital Cost	3-4
3.2	Partial Excavation and Installation of Engineered Control	3-4
3.2.1	Demolition and Removal of Existing Structures	3-5
3.2.2	Contaminated Soil and Sediment Excavation and Offsite Disposal	3-6
3.2.3	Site Restoration	3-6
3.2.4	Capital Cost	3-7
3.3	Cost Comparison	3-8
4.	**DESIGN, MANAGEMENT AND ADMINISTRATIVE REQUIREMENTS**	**4-1**
4.1	Design of Engineered Control	4-1
4.2	Groundwater Monitoring	4-2
4.3	Maintenance of Engineered Control	4-2
4.4	Institutional Controls	4-3
4.5	Financial Assurance	4-3
4.6	Public Notice	4-3

5. CONCLUSIONS 5-1

FIGURES

1-1 Site Location Map
1-2 Existing Site Plan
3-1 Remediation Activities – Complete Excavation
3-2 Site Restoration – Complete Excavation
3-3 Proposed Willow Street Realignment
3-4 Remediation Activities – Partial Excavation and Engineered Control
3-5 Site Restoration – Partial Excavation and Engineered Control
3-6 Stream Channel Cap Detail
3-7 Composite Cap, Upper Pond and Lower Pond Cap Details
3-8 Wetland Restoration Area Detail

APPENDICIES

Appendix A Summary of Historical Analytical Results
Appendix B Detailed Construction Cost Estimate – Complete Excavation
Appendix C Detailed Construction Cost Estimate – Partial Excavation and Engineered Control
Appendix D Post Remediation Groundwater Monitoring Plan
Appendix E Post Remediation Maintenance and Monitoring Program

1. INTRODUCTION

Loureiro Engineering Associates, Inc. (LEA) was retained by United Technologies Corporation/Pratt & Whitney (UTC/P&W) to perform investigations and evaluation of remedial alternatives to address soil and sediments contaminated with polychlorinated biphenyls (PCBs) within and immediately surrounding Willow Brook and Willow Brook Pond at the UTC/P&W manufacturing facility in East Hartford, Connecticut. LEA completed a comprehensive subsurface investigation of the site during the period from December 1997 to April 1999. The results of the investigation form the basis upon which the proposed remediation, detailed herein, is based. The proposed remediation is also presented in detail in the document entitled *Remedial Action Work Plan - United Technologies Corporation, Pratt & Whitney, Willow Brook and Willow Brook Pond, East Hartford, CT* by Loureiro Engineering Associates, Inc., dated November 2000, revised May 2001. The Remedial Action Work Plan is incorporated herein by reference.

The selected remediation approach consists of the excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 milligram per kilogram (mg/kg or parts per million (ppm)). Following excavation, a geotextile, soil and rock cap will be installed over the entirety of Willow Brook Pond and the open channel of Willow Brook from Willow Brook Pond to Main Street. The exception to this approach is the wetland downgradient of the dam where excavation of PCBs at concentrations greater than the residential direct exposure criteria (RDEC) will be performed and the area backfilled and planted to restore the wetland.

Following remediation, the open channel of Willow Brook from the pond to Main Street will be restored to the current configuration. In response to a request by the Department of Environmental Protection (DEP) staff, the Willow Brook stream channel will be slightly modified between the dam that impounds Willow Brook Pond and Main Street to reduce the slope of the banks to control potential erosion and to modify the character of the channel bottom to create a low flow channel with pools and eddies. Willow Brook Pond will be restored to the current configuration. The proposed sediment cap will be installed throughout the pond bottoms. Due to the thickness of the cap (3-feet) and based on the proposed sediment removal volume, the final bathymetry within the ponds will be slightly modified to accommodate the proposed cap section.

1.1 Project Limits

The limits of the project are defined in two separate areas (upstream of the dam and downstream

of the dam) and each area in two separate parts. The limits of the project area upstream of the dam is defined in two parts, Willow Brook Pond and the area of the former oil/water separator and process water buildings. The project area downstream of the dam is defined in two parts, the stream channel of Willow Brook Pond and the wetland area. It is recognized that the potential exists that contamination may exist outside these project limits. However, the intent of this remediation project is to address soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. Measures to address contamination beyond those limits described below would be addressed in the future as separate projects.

1.1.1 Upstream of the Dam

Willow Brook Pond: With one exception, the lateral limit of the project area of Willow Brook Pond, inclusive of the small embayment west of the Process Water Facility and south of the lower section of Willow Brook Pond, is defined as the horizontal location of the ordinary water level (reference Figure 1-2). The single exception is the location east of the upper section of Willow Brook Pond in the vicinity of a single soil boring WT-SB-132 (see Appendix A). The project area encompasses this boring to the limits shown on Figure 1-2. Remediation, if necessary, beyond the limits shown will be performed as a separate project.

Former Oil/Water Separator: The lateral limits of the project area in the vicinity of the former oil/water separator is currently defined as the lateral limit of soils containing PCBs at concentrations greater than 25 ppm. However, it is recognized that the potential exists that PCBs and other constituents may exist in soils outside this lateral limit that would require remediation as part of the project. The current estimate of the lateral limits of the project in this area is depicted on Figure 1-2.

Process Water Buildings: The lateral limits of the project area in the vicinity of the process water buildings is defined as that area of disruption necessary to facilitate removal of the related subsurface structures (i.e. foundations, footings, etc.).

1.1.2 Downstream of the Dam

Stream Channel Cap: The lateral limit of the project area for the stream channel cap is the 10-year flood elevation (22.0 to 24.0 feet above mean sea level) as shown on Figure 1-2.

Wetland Area: The lateral limit of the project area for the wetland is currently defined to the south by the northern limit of the stream channel cap and to the north, east and west as the lateral limit of soils containing PCBs at concentrations greater than the RDEC. The lateral limits of these areas are also depicted on Figure 1-2.

As noted in Section 1 of the May 2001 revision to the November 2000 Remedial Action Work Plan, volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbons and select metals were also detected in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. These constituents are commingled with soil and sediment containing PCBs. These constituents will remain in place in those areas in which they are commingled with soil and sediment containing less than 25 ppm PCBs and will be rendered inaccessible with the geotextile, soil and stone cap.

In summary, the components of the remediation approach include:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;
- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;

- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and

- The implementation of two institutional controls consisting of 1) an environmental land use restriction (ELUR) to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

This particular alternative necessitates a variance to the criteria of the Remediation Standard Regulations (RSRs). In accordance with 22a-133k-2(f)(2)(A) and (B) of the Regulations of Connecticut State Agencies (RCSA), a request to use an engineered control must be submitted to the Commissioner of the Department of Environmental Protection (DEP) and must be accompanied by a detailed written report and plan. This report, coupled with the May 2001 revision of the November 2000 Remedial Action Work Plan, have been prepared to satisfy these requirements.

1.2 Facility Background

The UTC/P&W facility is located at 400 Main Street in East Hartford, Connecticut, and is approximately 1,100 acres in size. P&W initiated aircraft engine manufacturing operations in East Hartford in December 1929. Current site operations are conducted in a 6.5 million square foot complex and include administration and management, manufacturing, testing, research and development and ancillary services. All of these activities take place in the western portion of the 1,100-acre property. The Rentschler Airport and the Klondike Area occupy the eastern portion of the property. P&W previously used these two areas as an airport and a storage/testing area, respectively.

1.3 Description of Site

The Willow Brook and the Willow Brook Pond remediation area is about 4 acres in size. The site is within a mixed residential, commercial, and industrial area of East Hartford, Connecticut. Willow Brook is a small stream transecting the UTC/P&W facility from the northern portion of the Rentschler Airport through to the northwest portion of the current UTC/P&W operations complex. Willow Brook flows in a southwesterly direction in an open channel from the Rentschler Airport, is then hard-piped underground to the inlet of Willow Brook Pond, and continues from the pond as an open channel to a culvert under Main Street. From Main Street, Willow Brook flows in an open channel for a distance of approximately 2,500 feet to the confluence with the Connecticut River (see Figure 1-1). Willow Brook Pond is a man made water body located in the northern portion of the Site (See Figure 1-2). The pond, a single body

of water when first created, has been modified various times through the years. It is now comprised of two ponds subdivided by a culvert. Historically, basement dewatering, industrial waters and process wastewater were directed to the pond. Some of these discharges were routed through an oil/water separator. Currently, Willow Brook Pond serves as part of the non-contact cooling water re-circulation system serving the Site.

During routine draining of Willow Brook Pond in September 1997, an oil sheen was noticed seeping through the sediment. P&W reported the sheen to the United States Coast Guard and the DEP in accordance with discharge reporting requirements. Following the detection of PCBs in a sample, the DEP issued P&W a notice of violation (NOV), No. PCB 97-08, on November 7, 1997. In response to the NOV, UTC/P&W developed a sampling work plan and conducted three phases of remedial investigation from December 1997 to April 1999. These investigations identified the probable sources and provided the analytical data to sufficiently define the horizontal and vertical limits of contamination allowing development of a remediation plan.

1.4 Report Scope and Organization

The following sections of this report have been prepared to satisfy the requirements set forth in Section 22a-133k-2(f)(2)(A) and (B) of the RCSA. More specifically, the following sections address the following requirements:

- Demonstrating that the cost of remediating the polluted soil at this site is significantly greater than the cost of installing and maintaining an engineered control and conducting groundwater monitoring;
- Demonstrating that the significantly greater cost outweighs the risk to the environment if the engineered control fails to prevent mobilization or human contact with substances in the soil;
- Demonstrating that the engineered control is well designed and will isolate polluted soil;
- Demonstrating that plans for groundwater monitoring are adequate to ensure that any substance migrating from the subject area will be detected;
- Demonstrating that maintenance plans for the control are adequate and the integrity of the control will be maintained;
- Ensuring that an Environmental Land Use Restriction (ELUR) will be recorded limiting the future use and activities upon the subject area; and
- Ensuring that a surety will be posted to adequately cover the costs for five years of maintenance and monitoring.

The following is a general description of the contents of each of the following sections of the report.

- Section 2 presents a discussion summarizing the site characterization and identifies the areas for which remediation is warranted.

- Section 3 presents an evaluation of the alternatives considered to address the remediation of Willow Brook and Willow Brook Pond. The alternatives presented in this section include complete excavation and offsite disposal of all soil and sediment containing PCBs at concentrations greater than the RDEC and the selected alternative of partial excavation and offsite disposal and the use of an engineered control. The primary focus of Section 3 is presentation of a cost comparison as it is concluded that both alternatives are technically and administratively feasible.

- Section 4 presents a discussion of the design, management and administrative requirements that are necessary when implementing an engineered control. Specifically, this section details the design elements of the proposed engineered control, presents a general description of the planned maintenance and monitoring plan for the proposed engineered control and a statement of intent that financial assurance for the performance of maintenance and monitoring will be provided, and statements of intent to record an ELUR for the subject area and to provide adequate public notice of the planned engineered control.

- Section 5 presents conclusions regarding the use of an engineered control to address soil and sediment contaminated with PCBs, volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbons and select metals within and immediately surrounding Willow Brook and Willow Brook Pond.

2. CONTAMINANT DELINEATION INVESTIGATIONS

This section presents a summary of the three previous phases of investigation conducted at Willow Brook and Willow Brook Pond from December 1997 to April 1999. This information is also presented in the May 2001 revision of the November 2000 Remedial Action Work Plan, which has been submitted to DEP and the United States Environmental Protection Agency. A summary of the analytical results for the entire sampling program is included as Appendix A as a series of detailed site plans.

The investigations identified some probable sources and provided the analytical data to define the horizontal and vertical limits of contamination in sufficient detail to allow for the identification and evaluation of remedial alternatives. Appendix A contains an overview of the delineation of the extent of PCBs in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond.

2.1 Initial Site Characterization Investigation

On February 13, 1998, LEA prepared a report entitled *Phase I: Report on PCB Investigation for Willow Brook and Willow Brook Pond Sediment*. The purpose of this report was to present the findings of the PCB investigation conducted on Willow Brook and Willow Brook Pond sediment in order to address the requirements of item (1) of the third paragraph of the NOV, No. PCB 97-08 issued by the DEP and dated November 7, 1997. The sampling was performed in accordance with the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997, and approved by the DEP on December 22, 1997.

The report describes the field activities performed based on a predetermined sampling grid and presents the analytical results of the investigations. A Toxic Substances Control Act (TSCA) sampling grid was developed to specify the number and location of samples for the investigation in accordance with USEPA's guidance document entitled *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup*. Two separate sampling grids were prepared for the east and west surface water bodies of Willow Brook Pond. The sampling was performed in accordance with the approved Work Plan, with the exception that the pond was not drained in response to DEP's concerns about sediment disturbance. Detectable PCB values on the sediment samples collected ranged up to a maximum concentration of 617 ppm total PCBs at sampling point WT-SD-33, located immediately downgradient of the subsurface connector between the eastern and western surface water bodies comprising Willow Brook Pond. Relatively high PCB concentrations were also observed in sediment samples collected in the vicinity of this location in both water bodies. Relatively elevated PCB concentrations were also observed along Willow

Brook immediately downstream of Willow Brook Pond. A total PCB concentration of 327 ppm was observed in the sediment at location WT-SD-52. The results of the investigations indicated the presence of elevated PCB concentrations throughout Willow Brook Pond and in the section of Willow Brook between the pond and Main Street. The PCB concentrations observed beyond that point were below 1 ppm.

Selected sediment samples were also analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and the RCRA eight metals (arsenic, barium, cadmium, chromium, mercury, lead, silver, selenium) plus nickel and zinc.

Among the limited sediment samples analyzed for these parameters, elevated levels of SVOCs were detected in the sediment at location WT-SD-47 in the eastern water body of Willow Pond. Some of the highest SVOC concentrations reported in that sample included pyrene (480 mg/kg), phenanthrene (514 mg/kg), fluoranthene (537 mg/kg), chrysene (232 mg/kg), etc. Some of the highest metal concentrations observed in this location included lead (153 mg/kg), zinc (152 mg/kg), barium (37.7 mg/kg), and nickel (36.4 mg/kg), etc. The only VOC compounds identified in this location included trichloroethylene (23 mg/kg), tetrachloroethylene (11.6 mg/kg), 1,1,1-trichloroethane (9.7 mg/kg), and 1,1-dichloroethane (10 mg/kg). Generally lower SVOC and VOC concentrations were observed in the other locations samples.

Elevated TPH concentrations were observed at WT-SD-47 (1,160 mg/kg) and WT-SD-09 (4,340 mg/kg and 3,930 mg/kg in the duplicate). Relatively elevated metal concentrations were also observed at this location (zinc 772 mg/kg and 689 mg/kg in the duplicate, nickel 595 mg/kg and 593 mg/kg in the duplicate, lead 714 mg/kg and 691 mg/kg in the duplicate, chromium 490 mg/kg and 497 mg/kg in the duplicate).

It should be noted that no sediment was encountered in upstream accessible locations within the Willow Brook conduit to allow sample collection. Several manholes along the subsurface conduit were opened to confirm no sediment had accumulated within the conduit. Historical measurements have indicated non-detectable PCB levels in sediment samples collected from upstream brook locations, upstream of the conduit.

Based on the results obtained, additional investigations were determined to be necessary to better characterize the vertical extent of the contamination within Willow Brook and Willow Brook Pond and to identify potential nearby sources of contamination.

2.2 Supplemental Site Characterization Investigation – Phase II

In April 1998, LEA published a report entitled *Phase II: Report on Supplemental PCB Investigation for Willow Brook and Willow Brook Pond.* The purpose of this report was to present the findings of the supplemental PCB investigation conducted on Willow Brook and Willow Brook Pond. The supplemental soil and sediment sampling was performed to identify potential nearby sources of contamination and to provide information of the vertical extent of the contamination within Willow Brook and Willow Brook Pond. An overview of the results of the investigation is presented in the following paragraphs.

Southwestern Bank of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic sludge drying beds located to the south of Willow Brook Pond was a potential source. Four soil borings were installed at the southwestern bank of Willow Brook Pond downgradient of the historic sludge drying beds. The borings were advanced to a depth of 20 to 24 feet from the western bank of the pond. Low total PCB concentrations (up to about 2 ppm) were detected in the borings installed along the southwestern bank of Willow Brook Pond. These concentrations did not appear to be indicative of a source of PCB contamination.

Area of Former Oil Basin, Western Section of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the pond area was a potential source. The existing oil-water separator is currently operating in this area. Four soil borings were installed in the vicinity of the area of the Former Oil Basin, the small embayment west of the Process Water Facility and south of the lower section of Willow Brook Pond. Two of these borings were installed on top of the bank immediately to the south of the area of the Former Oil Basin using a Geoprobe®. These soil borings were advanced and sampled to a depth of 20 to 24 feet. The other two were installed by hand auger techniques to a depth of 2 to 8 feet in the immediate proximity of the existing oil/water separator. PCBs were detected in the soils collected from the four soil borings. However, the highest total PCB concentrations were of the order of 1.3 ppm. These concentrations do not appear to be indicative of a source of contamination.

Former Oil/Water Separator: This area was investigated to determine if infiltration or seepage from historic operations in the Pond area was a potential source. Five soil borings were installed in the vicinity of the Former Oil/Water Separator in between the two sections of Willow Brook Pond to identify potential historic sources of PCB contamination. The soil borings were installed using a Geoprobe®. These soil borings were advanced and sampled to a depth of approximately 20 feet. Soil samples were collected every 2 feet and screened visually for the presence of oil.

Three samples were submitted for analysis from each boring. Elevated total PCB concentrations were observed in the soil samples from this location. The total PCB concentration observed in this area ranged up to 128 ppm (location WT-SB-88) at a depth of 10 to 12 feet. Free oil was also observed in this location. However, the oil was not extracted from the soil matrix for separate analysis. The highest PCB concentrations were observed at a depth of approximately 8 to 12 feet below ground surface corresponding approximately to the depth of the water and sediment within the pond, and the approximate level of the water table in the area. These concentrations and findings from this area are indicative of a probable source. It should be noted that the contamination might have originated from multiple sources.

Sediment Sampling: In-depth sampling was also performed within the eastern and western water body of Willow Brook Pond, and along Willow Brook in the vicinity of the wetlands area, and in the wetland area within UTC/P&W's property. These samples were collected to develop at-depth profiling information. It should be noted that only surface sediment samples were collected during the initial Phase I investigation. A 5-foot core was used for collection of the sediment and underlying soil samples during Phase II. Generally, one sediment and two soil samples of the underlying soil were selected from each sampling location. Detected total PCB concentrations within the two sections of Willow Brook Pond (east and west) ranged in concentrations up to 258 ppm in the upper 0- to 2-foot interval. The highest concentration was observed in location WT-SD-72 near the effluent point from Willow Brook Pond. Approximately 73.5 ppm of total PCBs were detected at a depth interval of 2 to 4 feet in location WT-SD-78, located at the eastern portion of Willow Brook Pond. Significantly lower and/or non-detectable levels were observed at greater depths. PCB concentrations remained at detectable levels at certain locations at depths up to 8 or 12 feet. Total organic carbon (TOC) concentrations up to 162,000 mg/kg were detected in sediment samples within Willow Brook Pond (location WT-SD-75 at a depth of 0 to 2 feet).

The total PCB concentrations detected in Willow Brook in the vicinity of the wetlands area and within the wetlands for surface samples (0 to 6 inches) varied in concentration up to 299 ppm (location WT-SD-92). The total PCB concentrations observed in the at-depth samples (1.5 to 2.0 feet) were significantly lower ranging from 2.6 ppm to 5.7 ppm.

Additional investigations were then proposed, focusing on the areas where the highest levels of PCB contamination were identified to further investigate and define the extent of contamination.

2.3 Supplemental Site Characterization Investigation – Phase III

In April 1999, LEA prepared a report entitled *Phase III: Report on PCB Investigation for Willow Brook and Willow Brook Pond.* The purpose of this report was to present the findings of

the third phase of PCB investigations in Willow Brook and Willow Brook Pond. During this phase, soil samples were collected from soil borings and monitoring wells installed in the vicinity of Willow Brook Pond. In addition, surface sediment and soil samples to depths of up to 6 feet were collected along the banks of Willow Brook. Soil/sediment samples were collected from the wetland area at Willow Arms and from other adjacent residential properties along the portion of Willow Brook, which lies downstream of Willow Brook Pond and to the east of Main Street. Groundwater sampling was also performed in monitoring wells installed at the perimeter of Willow Brook Pond.

Willow Brook Pond Perimeter Sampling: Twelve soil borings and eight monitoring wells were installed in the vicinity of Willow Brook Pond to assess the lateral extent of the contamination. The borings and monitoring wells were installed using a Geoprobe® to a depth of approximately 20 feet. Hand auger borings to an approximate depth of 12 feet were installed in locations inaccessible by the Geoprobe®. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for PCB analysis from each boring, including the most contaminated one, based on visual observations, and random ones corresponding approximately to the depth of contamination obtained during the previous investigation. Total PCB concentrations of 50.87 ppm were observed to the east of the eastern water body at Willow Brook Pond, along the reinforced concrete pipe that conveys flow from Willow Brook into Willow Brook Pond. Relatively elevated PCB concentrations up to 14.33 ppm were observed in the area of the Former Oil-Water Separator between the two sections of Willow Brook Pond. This is consistent with previous findings and assists in delineating the contamination in this area. Elevated concentrations of semi-volatile organic compounds (SVOCs) and select metals have been observed at some locations. The elevated compounds are consistent and appear to be co-located with the elevated PCB concentrations.

PCBs may have seeped into nearby soils at certain locations, for example at location WT-PZ-140 to the north of the larger water body of Willow Brook Pond (3.82 ppm). However, concentrations detected at depth are generally much lower or below detectable levels. The contamination was confirmed to be primarily contained within Willow Brook Pond.

Wetlands and Stream Bank Sampling: Soil/sediment samples were collected from several abutting residential properties along the segment of Willow Brook between Willow Brook Pond and Main Street. The samples were collected at different elevations along the bank of the brook to assess the lateral extent of contamination. Samples were also collected from the wetlands area at the Willow Arms property and from the adjacent portion of UTC/P&W's property. Surface soil/sediment samples were collected in a total of 28 locations. In seven of these locations, hand auger borings were advanced to approximately 6 feet to assess the vertical extent of

contamination. Relatively elevated PCB concentrations (up to 596.2 ppm) were observed within the wetland area. Relatively elevated SVOC and select metals concentrations were also observed within this area, and, as stated before, are consistent and co-located with elevated PCB concentrations. The total PCB concentrations typically decrease to less than 1 ppm at a depth of 4 to 6 feet below grade. Similar concentrations were observed in the wetland area within UTC/P&W property. Total PCB concentrations up to 21.77 ppm were detected from sediment within Willow Brook in the off-site properties (downstream of the wetland area). The PCB concentrations observed drop substantially at higher elevations along the bank of Willow Brook, indicating that the contamination is confined within the brook and the wetland. PCB concentrations decrease to less than 1 ppm prior to Main Street.

Groundwater Sampling: LEA personnel collected groundwater samples from the installed monitoring wells during two separate sampling events (December 4, 1998 and February 10, 1999). During the December 4, 1998 sampling event, samples were collected from WT-PZ-124, WT-PZ-129, WT-PZ-131, WT-PZ-134, WT-PZ-136, WT-PZ-139, WT-PZ-140, and WT-PZ-142 using a peristaltic pump and dedicated polyethylene tubing. PCBs were only detected at two locations, monitoring wells WT-PZ-136 [8.5 parts per billion (ppb)] and WT-PZ-139 (0.73 ppb). These wells are in the vicinity of locations where the highest PCB concentrations in soil have been detected.

The second round of groundwater monitoring was performed to supplement the first round in which certain analyses were not performed due to sample breakage while in transit to the laboratory and to provide additional monitoring data on all parameters detected during the initial round. During the February 10, 1999 sampling event, samples were collected from WT-PZ-124, WT-PZ-129, WT-PZ-131, WT-PZ-134, WT-PZ-136, WT-PZ-139, WT-PZ-140, and WT-PZ-142 using a peristaltic pump and dedicated polyethylene tubing. The data from the second round generally confirmed the results of the previous round as PCBs were detected at the same two locations. PCBs were detected in groundwater from monitoring wells WT-PZ-136 (7.9 ppb) and WT-PZ-139 (1.7 ppb).

Surface Water Sampling: Surface water samples were collected from two locations at Willow Brook Pond (at the pumps from the larger water body prior to entering the facility for non-contact cooling water use and at the dam) and from Willow Brook (downstream of Willow Brook Pond at the intersection with Main Street). No PCBs were detected in any of the surface water samples collected.

2.4 Nature and Extent of Contamination

2.4.1 Soil and Sediment

Overall and with consideration of the data collected to date, PCB concentrations are generally distributed in the brook and pond sediments gradually decreasing in concentration in the downgradient direction. This decrease trends from > 100 ppm in the pond and wetland areas to a concentration of < 1 ppm at Main Street. PCBs were also found in the soils between the two ponds, where the former oil/water separator was located. The vertical extent of PCB impacts has been defined by the sampling conducted, generally achieving non-detect or concentrations < 1 ppm at depths ranging from 4 to 6 feet below grade in the wetlands area and 14 to 16 feet below grade in the area between the eastern and western section of the pond. Soil samples collected along and up the banks of the brook and ponds define the horizontal limits of PCB to non-detect or concentrations of < 1 ppm. Appendix A contains drawings depicting the extent of PCB impact in the Willow Brook and Willow Brook Pond area. SVOCs and select metals are co-located with the elevated PCB concentrations.

2.4.2 Groundwater

Groundwater samples collected during the investigations identified only two locations where PCBs were detected in groundwater at concentrations exceeding the analytical reporting limits (WT-PZ-136 and WT-PZ-139). Well WT-PZ-136 is located in the immediate vicinity of the former oil/water separator and locations of high PCB content in soil. Well WT-PZ-139 is adjacent to an area of elevated PCB in soils.

2.4.3 Surface Water

Surface water sampling from Willow Brook and Willow Brook Pond was performed on February 6, 1998. Samples were collected from Willow Brook Pond at the pumps pumping from the larger water body and dam and from Willow Brook downstream of Willow Brook Pond at Main Street. No PCBs were detected in any of the surface water samples collected.

3. EVALUATION OF REMEDIAL ALTERNATIVES

As stated in Section 2, an adequate level of investigation has been performed to allow for the identification and evaluation of alternatives to address soil and sediment contaminated with PCBs, semi-volatile organic compounds, petroleum hydrocarbons and select metals within and immediately surrounding Willow Brook and Willow Brook Pond. For the purposes of this request, the following section presents an evaluation of two alternatives to address the identified contamination. The alternatives presented are:

1. The complete excavation and removal of contaminated soil and sediment exceeding the RDEC for PCBs within the Willow Brook Pond project limits as defined in Section 1.1;

2. The excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 ppm (the RDEC in a 1-acre wetland and in the southwestern portion of the lower section of Willow Brook Pond) and the placement of an engineered control over the entirety of the Willow Brook and Willow Brook Pond (with the exception of the 1-acre wetland) within project limits as defined in Section 1.1.

3.1 Complete Excavation and Offsite Disposal

The proposed construction activities involve:

- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;

- The removal and offsite disposal of an oil/water separator and the excavation and offsite disposal of soil containing concentrations of PCBs in excess of the RDEC and, SVOCs, TPH and select metals in excess of commercial/industrial direct exposure criteria (IDEC) and GB pollutant mobility criteria (GBPMC) in the vicinity of the oil/water separator;

- The excavation and offsite disposal of approximately 36,800 cubic yards of soil and sediment containing total PCBs at concentrations greater than the RDEC from within and immediately surrounding the Willow Brook and Willow Brook Pond;

- The placement of granular backfill within excavation areas to restore the site to existing grade;

- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and

- The implementation of an institutional control consisting of an ELUR to ensure the affected area will not be used for residential purposes.

The following parts of this section describe in general each of the anticipated construction activities necessary to complete under this alternative. Figure 3-1 presents the approximate limits of the planned excavation. Figure 3-2 presents the planned surface restoration activities.

3.1.1 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Figure 3-1). A list and description of the primary structures to be demolished are as follows:

- Five buildings and components associated with the process water facility; and

- The abandoned underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Prior to demolition, a complete survey of the structures and their components will be performed. The survey is necessary to determine decommissioning, demolition, and disposal requirements. UTC/P&W will be responsible for shutdown and removal of components they intend to reuse from the process water facility.

Process Water Buildings: Demolition of the process water buildings will extend to a depth necessary to achieve the project objectives of removal of soil and sediment containing total PCBs in excess of the IDEC in inaccessible locations and RDEC in accessible locations. Other related structures, such as pilings, erosion structures, etc., will also be demolished and removed to a depth necessary to achieve the project objectives. Pipes and utilities connected to these buildings will be abandoned during the demolition activities or during the soil and sediment removal phase of the project.

Former Oil/Water Separator: A buried oil/water separator is located between the upper and lower sections of Willow Brook Pond. This structure and surrounding soils are contaminated with PCBs. The oil/water separator, its contents, and the impacted soil containing PCBs at concentrations greater than 1 ppm surrounding the structure will be completely removed and disposed of at an offsite location during the project. Prior to removal of the structure, the oil/water separator will be exposed and any remaining contents will be removed, characterized, and disposed of at an offsite location.

3.1.2 Contaminated Soil and Sediment Excavation and Offsite Disposal

It is anticipated that approximately 36,800 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. In general, soil and sediment excavated, as part of the remediation will be stockpiled in a staging area and stabilized with clean sand to eliminate free-draining water. Details of stream flow management during construction, dewatering and excavation methods have been presented in Section 2.3 of the May 2001 revision of the November 2000 Remedial Action Work Plan.

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Figure 3-1. Based on the prior investigations, it is anticipated that an average of 4 feet of sediment will be removed from the pond and brook and up to 6 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bulldozers, and loaders. It is likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

3.1.3 Site Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The site restoration involves the backfilling of Willow Brook and Willow Brook Pond to match existing grades, the placement of a 6-inch thick layer of 4-inch stone within Willow Brook Pond, and the placement of a 12-inch thick layer of 6-inch stone within the Willow Brook stream channel. The wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of process gravel, and 12-inches of wetland soil. The wetland will be planted with native wetland plants. It is anticipated that restoration activities for areas outside the waterway and wetland will consist of the installation of paved parking areas or grassed areas. Planned final site restoration under this alternative is presented in Figure 3-2.

The future site use options may consist of the following:

- Additional automobile and/or truck parking; and
- Relocation/rerouting of Willow Street to the northern portion of the property as indicated on Figure 3-3.

3.1.4 Capital Cost

Provided, as Appendix B, is a detailed estimate of the capital cost for the implementation of the completed excavation and offsite disposal alternative. As detailed in Appendix B, the cost for the implementation of this alternative is $9,265,888. The cost for a single year of post-remediation groundwater monitoring is estimated at $20,000. This is based on the collection of groundwater samples from six locations on a quarterly basis, the analysis of the groundwater samples for volatile organic compounds, the RCRA 8 metals plus copper, nickel, and zinc, extractable petroleum hydrocarbons, and PCBs, and the preparation of a single annual report evaluating the groundwater monitoring data from the four previous quarters. For the purposes of evaluation of overall costs of this alternative, it has been assumed the groundwater monitoring will be performed for a period of 5 years. The estimated present worth cost of the groundwater monitoring program (assuming an interest rate of 4 percent) is $89,000 bringing the total cost of this alternative to $9,354,888.

3.2 Partial Excavation and Installation of Engineered Control

This alternative has been presented in detail in the May 2001 revision to the November 2000 Remedial Action Work Plan. The proposed construction activities involve:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;

- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;

- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;

- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and

- The implementation of two institutional controls consisting of 1) a ELUR to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

3.2.1 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Figure 3-4). A list and description of the primary structures to be demolished are as follows:

- Five buildings and components associated with the process water facility; and

- The former underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Process Water Buildings: Upon completion of the building and related structure demolition activities, the remaining soil will be evaluated and remediated, if necessary, to meet the industrial/commercial direct exposure criteria in all inaccessible locations and the RDEC within the accessible soil (within 4-feet of the final ground surface).

Former Underground Oil/Water Separator: The activities to be carried out under this alternative are, with one exception, identical to those presented for the complete excavation alternative. The single exception is with regard to the extent of removal activities. Under this alternative, soil and sediment containing total PCBs in excess of 25 ppm will be removed, rather than the RDEC limit established for the complete excavation alternative.

3.2.2 Contaminated Soil and Sediment Excavation and Offsite Disposal

It is anticipated that approximately 12,500 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. In general, soil and sediment excavated, as part of the remediation will be stockpiled in a staging area and stabilized with clean sand to eliminate free-draining water. Details of stream flow management during construction, dewatering and excavation methods have been presented in Section 2.3 of the May 2001 revision of the November 2000 Remedial Action Work Plan.

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Figure 3-4. Based on the prior investigations, it is anticipated that an average of 2 to 3 feet of sediment will be removed from the pond and brook and up to 6 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bulldozers, and loaders. It is likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

3.2.3 Site Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The planned restoration activities are described in detail below and depicted on Figure 3-5. The site restoration involves the installation of 3 types of caps (engineered controls) over soil and sediments remaining following excavation and removal of those containing total PCBs at concentrations greater than 25 ppm. The cap details were derived based on the anticipated stream flow velocities and considered the ultimate use of the area as a combined wetland, pond, and stream channel. The base of each cap consists of a non-woven geotextile, a 9-inch layer of organic rich soil, and a non-woven geotextile. This layer is referred to below as an organic-rich layer. This organic-rich layer is included as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. Each engineered control is described below and are depicted on Figures 3-6 through 3-8.

- Within Willow Brook Pond, a 36-inch soil and stone cap is proposed (refer to Figure 3-6). The cap will consist of a 9-inch organic rich layer, 21 inches of process gravel, and a 6-inch layer of 4-inch stone. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.

- Within Willow Brook (downstream of the dam), a 36-inch soil and stone cap is proposed (refer to Figure 3-7). The cap will consist of a 9-inch organic rich layer, a 15-inch layer of modified riprap and a 12-inch layer of cobbles, gravel and coarse sand. The 15-inch layer of modified riprap extends the width of the channel bottom and transitions into a 24-inch layer of intermediate riprap on the side slopes of the channel banks. The 24-inch layer of modified riprap extends up the channel banks to the elevation of the 10-year flood. The riprap channel lining has been designed to withstand the erosive forces anticipated in the stream channel following completion of the construction project.

- The area of the underground oil/water separator will be provided with a composite cap (refer to Figure 3-7). The composite cap will consist of a 40-mil flexible membrane liner, a geotextile drainage layer, 30-inches of granular backfill, and a 6-inch loam and seed layer.

In addition to the above, the wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of granular fill, and 12-inches of wetland soil. The wetland will be planted with native wetland plants (refer to Figure 3-8).

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) a ELUR to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 3-5).

In the event that redevelopment of this area involves a bike path or roadway, UTC/P&W will remediate the areas directly beneath those uses to the RDEC.

3.2.4 Capital Cost

Provided, as Appendix C, is a detailed estimate of the capital cost for the implementation of the partial excavation and installation of engineered control alternative. As detailed in Appendix C, the capital cost for the implementation of this alternative is $5,846,260. The post-remediation groundwater monitoring program to be implemented following the construction of this alternative is detailed in Appendix D. The cost for the implementation of a single year of post-remediation groundwater monitoring is estimated at $26,000.

In addition, under this option it will be necessary to maintain the engineered control. The costs for maintaining the engineered control are those associated with:

- Regular mowing and maintenance of the area surrounding Willow Brook and Willow Brook Pond (assumed to be 3 acres mowed 20 times per year);
- Annual visual inspection of the stream channel of Willow Brook to ensure the rip-rap channel lining has not been impacted; and
- Annual inspection, via probing, of the bottom of Willow Pond to ensure the stone layer has not been eroded.

It has been anticipated that onsite UTC/P&W maintenance personnel and existing landscape contractors will be engaged for the purposes of performing the above maintenance activities. The annual cost for the implementation of the above maintenance program, including the preparation of an annual report documenting the maintenance activities, is estimated to be $3,500.

For the purposes of evaluation of overall costs of this alternative, it has been assumed the maintenance and groundwater monitoring will be performed for a period of 30 years. The estimated present worth cost of the maintenance and groundwater-monitoring program (assuming an interest rate of 4 percent) is $505,040 bringing the total cost of this alternative to $6,351,300.

3.3 Cost Comparison

In accordance with Section 22a-133k-2(f)(2)(A)(iv) of the RCSA, a determination must be made that the "cost of remediating the polluted soil at such release area is significantly greater than the cost of installing and maintaining an engineered control for such soil and conducting ground-water monitoring at such release area in accordance with subsection (g) of section 22a-133k-3". The cost for the complete excavation and offsite disposal alternative is approximately $9,354,888. The cost for the implementation of the partial excavation and offsite disposal and engineered control alternative inclusive of operation and maintenance is approximately $6,351,300. Based on the discussions above and the detailed evaluation of costs for each alternative, it is concluded that the complete excavation alternative is significantly more expensive than the partial excavation and engineered control alternative and the additional cost is not commensurate with environmental benefit.

4. DESIGN, MANAGEMENT AND ADMINISTRATIVE REQUIREMENTS

This section details design, management and administrative requirements set forth in Section 22a-133k-2(f) of the RCSA. Specifically, this section provides a direct regulatory citation and the activities that will be undertaken to satisfy that requirement.

4.1 Design of Engineered Control

In accordance with Section 22a-133k-2(f)(2)(B)(i)(aa) of the RCSA "The proposed engineered control is designed and will be constructed to physically isolate polluted soil and to minimize migration of liquids through soil, to function with minimum maintenance, to promote drainage and minimize erosion of or other damage to such control, and to accommodate settling and subsidence of the underlying soil so as to maintain the control's structural integrity and permeability".

The engineered control to be installed as part of this project consists of two sub aqueous caps (see Figure 3-6 for Willow Brook and Willow Brook Pond cap details) and a cap to be installed in the area of the former oil water separator. Each of the caps has been designed to physically isolate polluted soils by providing a minimum separation distance of 36 inches. The cap to be installed in the vicinity of the former oil water separator has also been designed to minimize infiltration of precipitation to the underlying polluted soil. With regard to Willow Brook and Willow Brook Pond, the caps are sub aqueous and, in an effort to minimize the potential for alteration of the current hydrology of the area, are permeable. The caps for Willow Brook and Willow Brook Pond have been designed to include a 9-inch organic-rich layer. This organic rich layer was added as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. This layer will act as a sorbent media to minimize the potential for underlying groundwater that is in contact with contaminated soils to pass through the control and impact the overlying surface water.

By design, each of the caps comprising the engineered control will function with minimal maintenance. The cap installed in the vicinity of the former oil/water separator will require frequent mowing during the growing season. The cap within Willow Brook and Willow Brook Pond will, by design, require no maintenance unless repairs are necessary based on observations during annual inspections.

With regard to promoting drainage and minimizing erosion, the cap installed in the vicinity of the former oil/water separator will be designed to promote runoff and minimize run on. The cap will be vegetated to minimize the potential for erosion. With regard to the sub aqueous caps,

each have been designed to minimize the potential for erosion. The cap to be installed in Willow Brook has been designed to include a 24-inch layer of modified riprap extending up the channel banks to the elevation of the 10-year flood to counteract erosive forces within the stream channel. The cap to be installed in Willow Pond has been designed to include a 4-inch stone layer. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.

With regard to accommodating settling and subsidence of the underlying soil, each of the proposed caps is flexible in nature. The cap to be installed in the vicinity of the former oil/water separator contains as its low-permeability component, a 40-mil high-density polyethylene liner. Additionally, the sub grade for this cap will be prepared to promote runoff and minimize the potential for ponding. The sub aqueous caps are composed of earthen materials and will accommodate subsidence of underlying soils. However, with regard to the sub aqueous caps, subsidence is not considered as significant factor in the design of the control as it will have no detrimental affect on the ability of the control to preclude direct human contact with the underlying contaminated soil.

4.2 Groundwater Monitoring

In accordance with 22a-133k-2(f)(2)(B)(ii) of the RCSA, "plans for ground-water monitoring at the subject release area are adequate to ensure that any substance migrating there from will be detected". Appendix D contains a proposed post-remediation groundwater monitoring program to be implemented following the installation of the engineered control.

4.3 Maintenance of Engineered Control

In accordance with 22a-133k-2(f)(2)(B)(iii) of the RCSA, "plans for maintenance of the subject release area are adequate to ensure that the structural integrity, design permeability, and effectiveness of the engineered control will be maintained; such plans shall include without limitation measures to prevent run-on and run-off of storm water from eroding or otherwise damaging the engineered control and measures to repair such control to correct the effects of any settling, subsidence, erosion or other damaging events or conditions". Appendix E contains a proposed post remediation maintenance and monitoring program to be implemented following the installation of the engineered control. The post remediation maintenance and monitoring will continue for the life of the engineered control.

4.4 Institutional Controls

In accordance with 22a-133k-2(f)(2)(B)(iv) of the RCSA, "an environmental land use restriction is or will be in effect with respect to the parcel at which the subject release area is located, which restriction ensures that such parcel will not be used in a manner that could disturb the engineered control or the polluted soil".

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the engineered control. The institutional controls consist of 1) environmental land use restrictions to ensure the affected area will not be used for residential purposes and to ensure that activities that could disturb the engineered control will not be performed; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 2-2).

4.5 Financial Assurance

In accordance with 22a-133k-2(f)(2)(B)(vi) of the RCSA, "...the owner of the subject parcel shall demonstrate that he has posted or will post a surety in a form and amount approved in writing by the Commissioner, which surety during the first year after installation of the engineered control shall be equal to the cost of one year's maintenance and monitoring of the engineered control, and which in each subsequent year shall be increased in amount by adding an amount equal to the cost of one year's maintenance and monitoring, until the total amount of such surety is equal to the cost of five years of maintenance and monitoring, which amount shall be maintained in effect for the next twenty-five years or for such other period as may be required by the Commissioner." UTC proposes to demonstrate financial assurance for the maintenance and monitoring of the engineered control by performing the RCRA TSDF financial test specified in 40 CFR section 264.143(e), substituting the costs of maintaining and monitoring UTC's proposed control (as specified in RCSA section 22a-133k-2(f)(2)(B)(vi)) for the closure, post-closure and other RCRA financial test costs (as specified in the RCRA financial test). UTC's first demonstration will be submitted within 30 days after the construction of the engineered control is completed. UTC shall maintain this financial assurance for a period of twenty-five years after the construction of the engineered control is completed or any shorter period approved by the Department and, during this period, shall make the proposed demonstrations annually, on or before the anniversary of the first submission.

4.6 Public Notice

In accordance with 22a-133k-2(f)(2)(A)(iv) of the RCSA, UTC/P&W plans to public notice the proposed use of an engineered control by two of the following three methods "(i) by publication

in a newspaper of substantial circulation in the affected area; (ii) by placing and maintaining on the subject parcel, for at least thirty days, in a legible condition a sign which shall be not less than six feet by four feet which sign shall be clearly visible from the public highway; or (iii) by mailing notice to the owner of record of each property abutting the subject parcel at his address on the most recent grand tax list of the municipality or municipalities in which such properties are located." In providing public notice, UTC/P&W will follow all requirements of Section 22a-133k-2(f)(2)(A)(iv) of the RCSA.

5. CONCLUSIONS

The comprehensive subsurface investigations resulted in sufficient information to allow for a thorough evaluation of alternatives to address contaminated soil and sediment in and immediately surrounding Willow Brook and Willow Brook Pond at the UTC/P&W facility in East Hartford, Connecticut. The alternatives considered herein included: limited excavation and offsite disposal in conjunction with an engineered control; and complete excavation and offsite disposal. Based on the evaluation detailed in Section 3 of this report, it was concluded that limited excavation and offsite disposal in conjunction with an engineered control is the most appropriate alternative to address the contaminated soil and sediment. To implement this alternative, UTC/P&W has submitted the necessary applications to obtain approvals from the Town of East Hartford Inland Wetlands Commission (approval granted April 24, 2001), Town of East Hartford Planning and Zoning Commission, the Department of Environmental Protection, the United States Army Corps of Engineers. As noted, a Remedial Action Work Plan detailing the selected alternative has been presented to the United States Environmental Protection Agency and the Department of Environmental Protection for review.

From the evaluation presented herein, it is concluded that the cost for complete excavation of the polluted soil at such release area is significantly greater than the cost of installing and maintaining an engineered control for such soil and conducting ground-water monitoring at such release area in accordance with subsection (g) of section 22a-133k-3. As detailed in Section 3, the cost for remediating the polluted soil by complete excavation, inclusive of 5 years of post-remediation groundwater monitoring is $9,354,888. The cost for partial excavation and offsite disposal in conjunction with an engineered control, inclusive of 30 years of maintenance and groundwater monitoring is $6,351,300.

In conclusion, the significantly greater cost of implementing a complete excavation alternative in comparison to the partial excavation and engineered control alternative (over 47 percent) is not commensurate with the benefits to human health and the environment. Specifically:

- **Risk to the environment if the engineered control fails to prevent the mobilization of contaminants in soil:** Investigations performed to date have resulted in the collection of data that substantiate the conclusion that the PCBs in soil represent an insignificant risk to groundwater as a result of mobilization in groundwater. PCBs were detected in only two locations in groundwater in the immediate vicinity of the elevated PCB concentrations in either soil or sediment. These areas would be addressed by excavation of source areas (contaminated soil and the former oil/water separator) during the implementation of the partial

excavation and offsite disposal and engineered control alternative described herein. Additional information was submitted to the DEP on April 27, 2001 that further supports this conclusion. Furthermore, groundwater monitoring will be performed around the periphery of Willow Brook and Willow Brook Pond following the installation of the engineered control to confirm that PCBs are not migrating in groundwater.

- **Risk to the environment as a result of mobilization to surface water (transport of contaminated sediment via groundwater to surface water):** This is considered an unlikely event. However, each of the sub aqueous caps is designed with a 9-inch organic layer to prevent the migration of contaminated soil through the cap section and, as detailed in Appendix D, monitoring will be performed to confirm its effectiveness. In the event the engineered control was to be eroded, the potential for soil and sediment containing residual concentrations of PCBs to be transported via surface water would exist. The potential for transport of sediment from the pond is considered very low due to the low surface water velocities within the water body. The potential for transport of sediment from Willow Brook is considerably higher in comparison to Willow Pond as surface water velocities within the brook are considerably higher. However, following remediation, the average concentration of PCBs that will remain in soil and sediment within Willow Brook and Willow Brook Pond would be approximately 5 ppm. The average concentration that would remain in Willow Brook alone is approximately 4 ppm. Though the potential for the transport of contaminated soil and sediment would exist in the event the engineered control were to be eroded, the overall risk to the environment in comparison to the risk that exists today would be significantly decreased as a result of the intended remediation approach which would result of the excavation of the most contaminated soils and sediments.

- **Risk to human health if the engineered control fails to prevent human exposure to such substance:** The engineered control has been designed to have a total thickness of 36 inches. The stone surface on each of the sub aqueous caps minimizes the potential for erosion and the potential for thinning of the cap to a point where direct human contact could be a potential. The cap installed in the vicinity of the former oil/water separator will include a flexible membrane liner and will be designed and constructed in a manner minimizing the potential for erosion. Following installation, the maintenance program detailed in Appendix E will further ensure the future integrity of the engineered control. However, in the

event that the engineered control was to be eroded, the potential for human exposure to contaminated soil and sediment would exist. As noted in previous sections, following remediation ELURs to ensure the affected area will not be used for residential purposes and to prohibit excavation of soil and sediment will be recorded for the entirety of the project area. Following remediation, the average concentration of PCBs that will remain in soil and sediment would be approximately 5 ppm. This concentration is one-half of the default numeric commercial/industrial direct exposure criteria established in the RSR.

Appendix D

Post Remediation Groundwater Monitoring Plan

The following is a description of the planned groundwater monitoring to be implemented following the remediation of contaminated soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. The groundwater monitoring will be performed in accordance with subsection (g)(2) of Section 22a-133k-3 of the RCSA.

This groundwater monitoring program has been designed to determine:

- The effectiveness of soil remediation in preventing further pollution of ground water by substances from the release area;
- The effectiveness of any remediation taken to eliminate or minimize identified health or safety risks associated with such release; and
- Whether applicable surface-water protection criteria and volatilization criteria have been met.

New Well Installation

During construction, it is likely that a number of existing groundwater monitoring wells will be impacted. Following implementation of remedial activities, groundwater monitoring wells will be installed at the 12 locations depicted on the attached Site Plan. Nine of the groundwater monitoring wells will be installed around the periphery of Willow Brook and Willow Brook Pond and three wells will be installed within Willow Brook and Willow Brook Pond. Each of the nine wells will be small-diameter monitoring wells constructed using the Geoprobe® Pre-Pack monitoring well construction materials. The pre-pack construction consists of three foot-long sections of ½ inch inside diameter, 0.010-inch slotted Schedule 80 PVC screen with a 1.5-inch diameter filter pack held in place by stainless steel mesh. The pre-pack screen sections may be joined to provide screen length multiples of three feet. A ½-inch diameter Schedule 80 PVC riser connects the screen to the surface.

Screen lengths for the nine monitoring wells to be installed along the periphery of Willow Brook and Willow Brook Pond will be nine feet, with approximately 5 to 7 feet placed below the water table. After the screen and riser are installed, one to two feet of sand will be placed above the screen to prevent the bentonite seal from leaking downward into the screened interval. A bentonite seal will be placed from the top of the sand cap to the surface. Emplacement of the sand cap and the bentonite seal will be performed while slowly retrieving the casing, allowing the native formation material to collapse around the backfill material.

Screen lengths for the three wells to be installed within the limits of Willow Brook and Willow Brook pond will be one foot. The screen section will be installed so that the screen will partially penetrate the granular fill portion of the cap section to allow for the collection of a sample that is representative of soil water above the organic-rich layer within the cap. These wells are being proposed to allow for the collection of data to confirm that the organic-rich layer is preventing the upward migration of PCBs through the cap. These three monitoring wells will be installed during the installation of the caps.

All wells will be installed in general conformance with LEA's SOPs entitled, *Standard Operating Procedure for Installing and Developing Monitoring Wells and Piezometers* and *Geoprobe® Probing and Sampling.*

Well Development

All post remediation groundwater monitoring wells will be developed to ensure that an adequate hydraulic connection exists between the well and the aquifer. Prior to development, measurements of total depth and water level will be made at each well. Development will be conducted in general conformance with the LEA SOP entitled, *Standard Operating Procedure for Installing and Developing Monitoring Wells and Piezometers.* Development water will be placed into DOT-approved 55-gallon containers for offsite disposal at a licensed disposal facility.

Monitoring wells will be developed by over-pumping using a peristaltic pump to draw down the well, followed by physical surging. After surging, the well will be pumped to remove accumulated sediment. The cycle will be repeated until the well produces clean water or until the physical parameters (temperature, pH, specific conductance) stabilize. Further development by over-pumping or surging will be performed as necessary to stabilize the field parameters.

Groundwater Monitoring Implementation Schedule

Groundwater samples will be collected from each of the 12 groundwater monitoring wells on a quarterly basis for a period of not less than two years. If, following the two years of quarterly groundwater monitoring, it is determined that the area is in compliance with the requirements of subsection (f) of Section 22a-133k-3 of the RCSA, groundwater monitoring will be discontinued. If the area is not in compliance with the requirements of subsection (f) of Section 22a-133k-3 of the RCSA, groundwater monitoring will be continued for a period of time until the results of four

consecutive quarterly sampling events indicate compliance with the surface water protection and commercial/industrial volatilization criteria.

Groundwater Sampling and Analysis

All groundwater samples will be collected and preserved, as appropriate, in accordance with the LEA SOP entitled, *Liquid Sample Collection and Field Analysis.* Prior to sampling each groundwater monitoring well noted above, the depth to water and total depth of each well would be recorded. From this information the total volume of water contained in each monitoring well will be calculated. The water will be purged initially and parameters such as pH, temperature, and specific conductance will be recorded. Once the initial volume of water is removed, the monitoring well will be purged a minimum of three times the standing water volume or until all standing water is evacuated. Samples will be collected using a peristaltic pump equipped with dedicated polyethylene tubing. A section of tubing equipped with a check valve will be used for the collection of samples to be analyzed for volatile organic compounds (VOCs). Samples collected for metals will not be filtered prior to analysis. All sampling containers will be sealed, placed in a cooler, and shipped to a laboratory selected by UTC/P&W under chain-of-custody procedures for the following analyses:

- Volatile Organic Compounds
- The RCRA 8 metals plus copper, nickel, and zinc;
- Extractable petroleum hydrocarbons; and
- Polychlorinated biphenyls.

Trip blanks, equipment blanks, and duplicate/replicate samples will be submitted for analysis for quality assurance/quality control (QA/QC) purposes. In addition, on an annual basis, one performance evaluation sample will be submitted to the analytical laboratory.

Water-Level Measurements

Water level measurements will be performed. Both groundwater and surface water level measurements will be obtained. Surface water elevations will be obtained from stream gauges to be installed in Willow Brook and Willow Brook Pond. All water levels will be recorded to the nearest 0.01-foot using an electronic water level indicator. Between measurements the water level indicator will be decontaminated to prevent cross-contamination. Based on the data

collected from the shallow monitoring wells and piezometers, contour maps showing groundwater elevation and flow direction will be developed.

Surface Water Sampling

If during the performance of groundwater sampling, polychlorinated biphenyls (PCBs) are detected at concentrations in excess of the surface water protection criteria in groundwater samples collected from the four groundwater monitoring wells installed in the granular fill portion of the cap, surface water samples will be collected to verify that PCBs are not present in surface water at concentrations in excess of the ambient water quality criteria. The surface water samples would be collected at a depth not greater than 4 inches above the top of the cap section in the immediate vicinity of the well or wells for which the exceedance of the surface water protection criteria was noted. Surface water samples would be collected within one month of receipt of analytical data indicating an exceedance of surface water protection criteria in the above-mentioned wells.

Reporting

On an annual basis, the results of the quarterly sampling will be summarized in a single report. The report will contain a description of the sampling activities, an evaluation of the analytical results including a discussion of any observed trends, a site location plan, groundwater contour maps for each of the four quarterly sampling events, and tabular presentations of the data. Following the completion of the second year of groundwater monitoring, the annual report will include a discussion regarding the compliance status with respect to the requirements of the surface water protection criteria and commercial/industrial volatilization criteria in the RSR. If the site is determined to be in compliance, the report will also contain a discussion regarding the cessation of groundwater monitoring. If the site is determined to not be in compliance, the report will contain a discussion regarding the continuation of groundwater monitoring.

Each annual report will be submitted to the DEP and the USEPA for review.

WETLAND RESTORATION, STREAM AND SEDIMENT CAPS

SEE FIGURE 3 FOR DETAILS

WETLAND RESTORATION AREA

LIMIT OF STREAM CHANNEL CAP

LIMIT OF SEDIMENT CAP

LIMIT OF COMPOSITE CAP

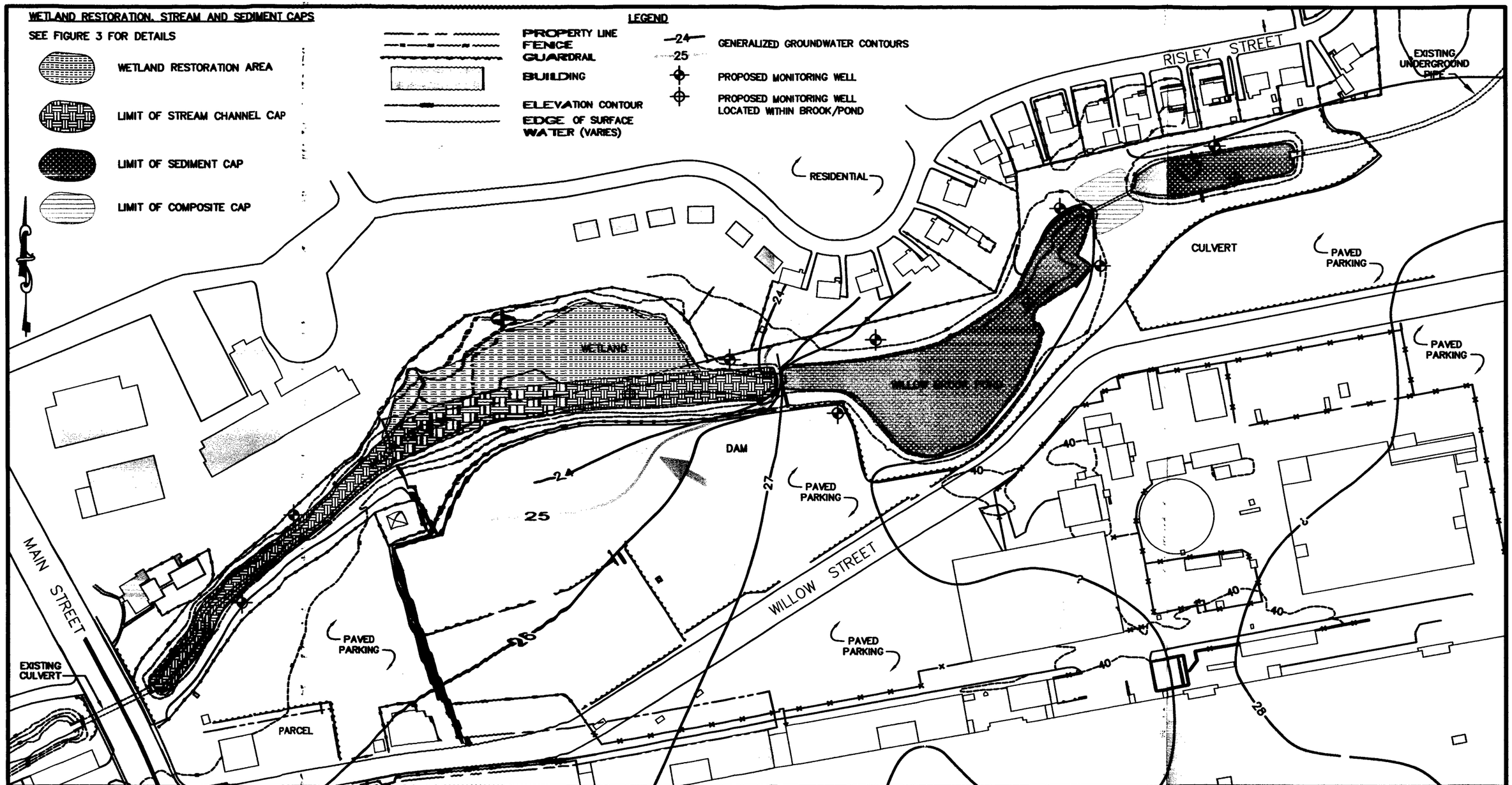
LEGEND

PROPERTY LINE
FENCE
GUARDRAIL
BUILDING
ELEVATION CONTOUR
EDGE OF SURFACE WATER (VARIES)

GENERALIZED GROUNDWATER CONTOURS

PROPOSED MONITORING WELL

PROPOSED MONITORING WELL LOCATED WITHIN BROOK/POND



0 150' 300'

GRAPHIC SCALE

NOTES:

1. BASE MAP FROM ELECTRONIC FILE OF LOUREIRO ENGINEERING ASSOCIATES, P.C. DRAWING, DATED 12/11/98 AND FROM USGS AERIAL PHOTOGRAPHY, 1994.

REQUEST FOR ENGINEERED CONTROL VARIANCE

UTC\P & W, Willow Brook & Willow Brook Pond

POST REMEDIATION
GROUNDWATER MONITORING PLAN
MONITORING WELL LOCATIONS

REV: 7/12/01	Comm.No.	FIGURE 1
REV: 5/29/01	88UT002.001	

LEA

88UT002-FIG1GWRV3.dwg

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Appendix E

Post Remediation Maintenance Program

United Technologies/Pratt & Whitney
Post Remediation Maintenance and Monitoring Program
Willow Brook and Willow Brook Pond

This post-remediation maintenance program for the engineered control has been developed to ensure that the structural integrity, design permeability, and effectiveness of the engineered control will be maintained. This maintenance program describes:

- Measures to be taken to periodically inspect the engineered control;
- Measures to be taken to prevent run-on and run-off of stormwater from eroding or otherwise damaging the engineered control; and
- Measures to be taken to correct the effects of any settling, subsidence, erosion or other damaging events or conditions.

The engineered control has been designed to require a minimal amount of maintenance. The required maintenance tasks are presented below.

- Regular mowing and maintenance of the area surrounding Willow Brook and Willow Brook Pond (assumed to be 3 acres mowed 20 times per year);
- Visual inspection of the stream channel of Willow Brook to ensure the rip-rap and stone layer channel protection has not been impacted;
- Inspection, via probing at up to 20 locations, of the bottom of Willow Pond to ensure the stone layer has not been eroded;
- Inspection of the engineered control installed in the vicinity of the former oil/water separator; and
- Preparation of a report documenting the inspection and the required maintenance tasks have been completed and the completion of any repairs performed in response to findings from inspections. The annual reports will be maintained by UTC/P&W.

Annual Inspections and Corrective Actions

The engineered control and the area surrounding the engineered control will be inspected on an annual basis by a representative of United Technologies Corporation/Pratt & Whitney Division in the following areas:

1. Signs of erosion

2. Signs of settling
3. Loss of vegetative cover
4. Undesirable growth
5. Signs of ponding and run on
6. Condition of fencing and gates
7. Condition of rip-rap in Willow Brook stream channel
8. Condition of stone layer in Willow Brook
9. Burrowing animals
10. Monitoring well network

The results of these inspections will be summarized in the Final Cover Inspection Form presented as Exhibit 1. If any deficiencies are noted, the appropriate corrective actions will be taken as described in the following paragraphs.

Any erosion damage to vegetated surfaces will be corrected during the growing season (April through September) by reapplying the appropriate soil layers and reseeding the damaged areas. Similarly, any damage related to settling would be repaired in the same manner. Erosion to sub aqueous caps or rip-rap along the Willow Brook stream channel would be corrected within one month of the inspection by installation of additional stone or rip-rap.

Loss of vegetative cover will be repaired by reseeding, replanting, fertilizing and watering as necessary until plant growth is re-established. Reseeding and replanting will be performed during the growing season (April through September). In addition, any undesirable plant growth that could affect the integrity of the engineered control (i.e. small trees, saplings, shrubs) would be manually removed as soon as detected, and the cover system would be repaired as described previously for erosion damage.

If any burrowing animals were found to be living in the area of the engineered control, appropriate measures would be taken to remove the animals from the site. The synthetic components of the engineered control in the vicinity of the oil water separator will also be inspected to verify that no damage has taken place. Any holes made by burrowing animals would be filled with topsoil and reseeded. Damage to the synthetic liner will be repaired by patching in accordance with the manufacturer's requirements.

Any damaged fence or gates will be repaired.

Any deficiencies found will be corrected within 4 weeks from the time of discovery or as soon as practicable if weather conditions prohibit correction within 4 weeks.

Inspections Following Significant Precipitation Events and Corrective Actions

The engineered control and the area surrounding the engineered control will be inspected on an annual basis as described above, and following the occurrence of a precipitation event resulting in greater than or equal to 2 inches of rainfall over a 24-hour period. The inspection would be performed by a representative of United Technologies Corporation/Pratt & Whitney Division in the same areas as described for the annual inspection above. Documentation of the inspection and corrective actions would be in accordance with the procedures outlined above for annual inspections.

Inspections During Regular Maintenance Activities

During the performance of regular maintenance activities such as mowing, or other landscaping tasks, representatives of United Technologies Corporation/Pratt & Whitney Division will be instructed to report any and all compromising conditions observed within the engineered control areas to an appropriate party. Documentation of the follow-up inspection and corrective actions implemented would be in accordance with the procedures outlined above for annual inspections.

Reporting

On an annual basis, a report will be generated documenting all inspection, maintenance and corrective actions completed during the previous calendar year. The report will be completed by January 31. United Technologies Corporation/Pratt & Whitney Division will maintain the annual reports.

Attachment No. 3

Public Notice Documentation

The Hartford Courant.

A TRIBUNE PUBLISHING COMPANY

Affidavit of Publication

State of Connecticut

Monday, April 30, 2001

County of Hartford

I, Diane Luka, do solemnly swear that I am Senior Credit Representative of the Hartford Courant, printed and published daily, in the state of Connecticut and that from my own personal knowledge and reference to the files of said publication the advertisement of Legal Notice was inserted in the regular edition.
On dates as follows: 04/28/2001

In the amount of $224.00
LOUREIRO ENGINEERING ASSOC NOTICE
228775
Full Run

Sr.Credit Representative
Diane Luka

Subscribed and sworn to before me on April 30, 2001

Notary Public
LISA PEREZ
Notary Public
My Commission Expires
June 30, 2001

EAST HARTFORD

Notice of Proposed Use of Engineered Control

nited Technologies Corporation, Pratt & Whitney Division
y notifies pursuant to RCSA 22a-133k-1 that it intends to un-
ke actions at its facility located at 400 Main Street in East
ford, Connecticut. The actions to be taken at the site include:
xcavation and offsite disposal of soil and sediment from with-
d immediately surrounding Willow Brook and Willow Brook
l and the installation of engineered controls consisting of one
ore of the following materials: soil, rock and/or plastic liners.
soil/sediment that will be removed is contaminated with poly-
inated biphenyls, volatile organic compounds, semi-volatile
nic compounds, and inorganic constituents. These actions are
ner described, in the report entitled, "Request for Variance
ineered Control of Polluted Soils - United Technologies Corpo-
on - Pratt & Whitney - Willow Brook and Willow Brook Pond -
Hartford, CT," dated January 2001. The actions will begin on
fter July 1, 2001. DEP will hold a hearing on this matter upon re-
t of a petition signed by 25 or more persons.

Written comments should be directed within 45 days to:

United Technologies Corporation
Pratt & Whitney Division
400 Main Street, East Hartford, CT 06108
Attn: Martin D'Eramo
(860) 565-6944
and
State of Connecticut
Department of Environmental Protection
Bureau of Water Management
79 Elm St, Hartford, CT 06106-5127
Attn: Richard Hathaway
(860) 424-3780

Attachment No. 4

Revised Text and Tables
Remedial Action Work Plan
Request for Variance, Engineered Control of Polluted Soils
Revisions Highlighted

REMEDIAL ACTION WORK PLAN

United Technologies Corporation
Pratt & Whitney
Willow Brook and Willow Brook Pond
East Hartford, CT

November 2000
Revised May 2001

Prepared for

UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
400 Main Street
East Hartford, CT 06018

Prepared by

LOUREIRO ENGINEERING ASSOCIATES, INC.
100 Northwest Drive
Plainville, CT 06062

LEA Comm. No 88UT002

REMEDIAL ACTION WORK PLAN
TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
1.1 General 1
1.2 Background Information 3
1.3 Summary of Previous Investigations 7
1.4 Nature and Extent of Contamination 11
2.0 STATEMENT OF WORK 12
2.1 General 12
2.2 Pre-Construction Activities 13
2.3 Construction Activities 15
2.4 Post-Construction Activities 24
3.0 PROJECT SCHEDULE 25
4.0 FIELD SAMPLING AND ANALYSIS PLAN 26
4.1 Introduction 26
4.2 Remedial Action Field Sampling 27
4.3 Sample Designation System 32
4.4 Sample Handling and Documentation 33
4.5 Management of Sampling-Related Materials and Wastes 34
4.6 Field Quality Assurance/Quality Control 34
5.0 QUALITY ASSURANCE PROJECT PLAN 36
5.1 Introduction 36
5.2 Project Organization and Responsibilities 40
5.3 Quality Assurance Objective for Measurement of Data 43
5.4 Sampling Procedures 45
5.5 Sample and Document Custody 45
5.6 Calibration Procedures and Frequency 48
5.7 Analytical Procedures 48
5.8 Data Reduction, Review, and Reporting 49
5.9 Field and Laboratory Quality Control Checks 51
5.10 Performance and System Audits 54
5.11 Data Assessment Procedures 55
5.12 Reports to Management 58

TABLES

Table 4-1 Confirmatory Sampling Summary
Table 4-2 Quality Control Analyses Summary
Table 4-3 Required Containers, Preservatives, and Analysis Holding Times for Solid, Aqueous, and Vapor Samples
Table 5-1 Recommended Project Specific Practical Quantitation Limits for Constituents for Which Analysis may be Conducted
Table 5-2 Recommended Accuracy and Precision Data Quality Objectives
Table 5-3 Recommended Matrix Spike and Laboratory Control Sample Precision and Accuracy Objectives

Table 5-4 Quality Assurance project Plan - Field Calibration Frequency
Table 5-5 Quality Assurance Project Plan - Field Measurements Quality Control

FIGURES

1-1 Site Location Map
1-2 Willow Brook Pond - PCBs in Soil/Sediment
1-3 Willow Brook - PCBs in Soil/Sediment
2-1 Detail – Erosion Controls
2-2 Detail – Culvert Transition at Bypass Channel
2-3 Detail – Chain Link Fence
2-4 Detail – Bypass Channel
2-5 Detail – Bypass Channel Energy Dissipater
2-6 Detail - Pond Bottom Cap
2-7 Detail - Stream Channel
2-8 Detail – Composite Cap
2-9 Detail – Wetland Restoration
2-10 Willow Street Roadway Realignment
3-1 Schedule for Willow Brook and Willow Brook Pond Remediation Project
4-1 Proposed Sampling Grid
4-2 Sample Labels
4-3 Custody Seal
4-4 Field Sampling Record
4-5 Sample Chain of Custody

DRAWINGS

Drawing 1-1 Existing Site Plan
Drawing 2-1 Site Preparation
Drawing 2-2 Bypass Channel
Drawing 2-3 Excavation Areas
Drawing 2-4 Site Restoration
Drawing 2-5 Channel Improvements
Drawing 4-1 Potential Confirmatory Sampling Locations

APPENDICES

A Summary of Historical Analytical Results
B Standard Operating Procedures
C CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater to the Sanitary Sewer
D Willow Brook/Willow Brook Pond Dust Control Plan

1.0 INTRODUCTION

1.1 General

This Remedial Action Work Plan (RAWP) has been developed to present the approach and strategy for the remediation of Polychlorinated Biphenyl (PCB) contaminated sediment within Willow Brook and Willow Brook Pond at the United Technologies Corporation (UTC), Pratt & Whitney (P&W) manufacturing facility in East Hartford, Connecticut (Site). A Site Location Map is included as Figure 1-1. The remediation approach consists of the excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 milligram per kilogram (mg/kg or parts per million (ppm)).

Following excavation, a geotextile, soil and rock cap (engineered control) will be installed over the entirety of Willow Brook Pond and the open channel of Willow Brook from Willow Brook Pond to Main Street. The exceptions to this approach is the wetland downgradient of the dam where excavation of PCBs at concentrations greater than the Residential Direct Exposure Criteria will be performed and the area backfilled and planted to restore the wetland, and the footprint of the process water facility where excavation of PCBs at concentrations greater than the Commercial Industrial Direct Exposure Criteria (for soils within 4 feet of the ground surface) and the GB Pollutant Mobility Criteria (for soils above the seasonal high water table) will be performed prior to the placement of backfill. This particular alternative necessitates a variance to the criteria of the Remediation Standard Regulations (RSRs). In accordance with 22a-133k-2(f)(2)(A) and (B) of the Regulations of Connecticut State Agencies (RCSA), a request to use an engineered control (Request for Variance) was submitted to the Commissioner of the Connecticut Department of Environmental Protection (CTDEP) in January 2001 and was subsequently revised in response to CTDEP comments in May 2001. This report, coupled with the May 2001 revision of the January 2001 Request for Variance, have been prepared to satisfy these requirements. The Request for Variance is incorporated herein by reference.

Following remediation, the open channel of Willow Brook from the pond to Main Street will be restored to the current configuration. In response to a request by the Department of Environmental Protection (DEP) staff, the Willow Brook stream channel will be slightly modified between the dam that impounds Willow Brook Pond and Main Street to reduce the slope of the banks to control potential erosion and to modify the character of the channel bottom to create a low flow channel with pools and eddies. Willow Brook Pond will be restored to the current configuration. The proposed sediment cap will be installed throughout the pond bottoms. Due to the thickness of the cap (3-feet) and based on the proposed sediment removal volume, the final bathymetry within the ponds will be slightly modified to accommodate the proposed cap section.

The limits of the project are defined in two separate areas (upstream of the dam and downstream of the dam) and each area in two separate parts. The limits of the project area upstream of the dam is defined in two parts, Willow Brook Pond and the area of the former oil/water separator. The project area downstream of the dam is defined in two parts, the stream channel of Willow Brook Pond and the wetland area. It is recognized that the potential exists that contamination may exist outside these project limits. However, the intent of this remediation project is to address soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. Measures to address contamination beyond those limits described below would be addressed in the future as separate projects.

1.1.1 Upstream of the Dam

Willow Brook Pond: With one exception, the lateral limit of the project area of Willow Brook Pond, inclusive of the small embayment west of the Process Water Facility and the footprint of the process Water Facility, is defined as the horizontal location of the ordinary water level (reference Drawing 1-1). The single exception is the location east of the upper section of Willow Brook Pond in the vicinity of a single soil boring WT-SB-132 (see Appendix A). The project area encompasses this boring to the limits shown on Drawing 1-1. Remediation, if necessary, beyond the limits shown will be performed as a separate project.

Former Oil/Water Separator: The lateral limits of the project area in the vicinity of the former oil/water separator is currently defined as the lateral limit of soils containing PCBs at concentrations greater than 25 ppm. However, it is recognized that the potential exists that PCBs and other constituents may exist in soils outside this lateral limit that would require remediation as part of the project. The current estimate of the lateral limits of the project in this area are depicted on Drawing 1-1.

1.1.2 Downstream of the Dam

Stream Channel Cap: The lateral limit of the project area for the stream channel cap is the 10-year flood elevation (22.0 to 24.0 feet above mean sea level) as shown on Drawing 1-1).

Wetland Area: The lateral limit of the project area for the wetland is currently defined to the south by the northern limit of the stream channel cap and to the north, east and west as the lateral limit of soils containing PCBs at concentrations greater than the Residential Direct Exposure Criteria. The lateral limits of these areas are also depicted on Drawing 1-1.

As discussed subsequently in this section, semi-volatile organic compounds, petroleum hydrocarbons and select metals were also detected in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. These constituents are commingled with soil and sediment containing PCBs. These constituents will remain in place in those areas in which they are commingled with soil and sediment containing less than 25 ppm PCBs and will be rendered inaccessible with the geotextile, soil and stone cap.

In summary, the components of the remediation approach include:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;

- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below and the footprint of the process water facility) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;
- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and
- The implementation of two institutional controls consisting of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

1.2 Background Information

The UTC/P&W facility is located at 400 Main Street in East Hartford, Connecticut, and is approximately 1,100 acres in size. P&W initiated aircraft engine manufacturing operations in East Hartford in December 1929. Current site operations are conducted in a 6.5 million square foot complex and include administration and management, manufacturing, testing, research and development and ancillary services. All of these activities take place in the western portion of the 1,100-acre property. The Rentschler Airport and the Klondike Area occupy the eastern portion of the property. P&W previously used these two areas as an airport and a storage/testing area, respectively.

The Willow Brook and the Willow Brook Pond remediation area is about 4 acres in size as depicted in Drawing 1-1. The site is within a mixed residential, commercial, and industrial area of East Hartford, Connecticut. Property usage in the vicinity of the proposed RA area includes the following:

- UTC/P&W parking facilities and the Rentschler Airport, to the east;
- Apartment complex and residential areas to the north;
- A commercial business, parking facilities, and UTC/P&W manufacturing to the south; and
- Predominantly commercial areas with some residential to the west (across Main Street).

1.2.1 Site Description

Willow Brook is a small stream transecting the UTC/P&W facility from the northern portion of the Rentschler Airport through to the northwest portion of the current UTC/P&W operations complex. Willow Brook flows in a southwesterly direction in an open channel from the Rentschler Airport, is then hard-piped underground to the inlet of Willow Brook Pond, and continues from the pond as an open channel to a culvert under Main Street. From Main Street, Willow Brook flows in an open channel for a distance of approximately 2,500 feet to the confluence with the Connecticut River (see Figure 1-1). Willow Brook Pond is a man made water body located in the northern portion of the Site (See Drawing 1-1). The pond, a single body of water when first created, has been modified various times through the years. It is now comprised of two ponds subdivided by a culvert.

Known water discharges to surface water that have existed at one point in time or another at the P&W East Hartford Facility include Discharge Nos. 001 through 015. The principal discharge from the facility is Discharge 001. Discharge 001 is the discharge of effluent from the dilute wastewater treatment plant at

Colt Street. The other water discharges are permitted through the National Pollutant Elimination System (NPDES) program and are comprised mostly of cooling water and stormwater runoff. Only Discharge Nos. 001 through 004 and 007 through 009 are or were associated with Willow Brook or Willow Brook Pond. These discharges contained basement dewatering, industrial waters and process wastewater. Some of the discharges to the pond were routed through an oil/water separator. A map showing site wide discharge locations was previously provided in the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997.

The majority of the water historically drawn from Willow Pond was used in buildings as a source of process water. The water was then collected and rerouted back to Willow Pond via NPDES discharge 003 and 004 and the Willow Brook via NPDES discharge 002. Historically water has discharged through the Experimental Test Airport Laboratory (ETAL) to Willow Brook upstream of Willow Pond. Basement dewatering operations and industrial waters had discharged through an oil/water separator into the brook. This building has been demolished and the oil/water separator water was removed.

During routine draining of Willow Brook Pond in September 1997, an oil sheen was noticed seeping through the sediment. P&W reported the sheen to the United States Coast Guard and the CTDEP in accordance with discharge reporting requirements. Following the detection of PCBs in a sample, the CTDEP issued P&W a NOV, No. PCB 97-08, on November 7, 1997. In response to the NOV, UTC/P&W developed a sampling work plan and conducted three phases of remedial investigation from December 1997 to April 1999. These investigations identified the probable sources and provided the analytical data to sufficiently define the horizontal and vertical limits of contamination allowing development of a remediation plan.

1.2.2 Physical Setting

Physiography

The UTC/P&W East Hartford facility lies within the Central Lowland province of Connecticut, a north-south trending valley system, which is approximately 20 miles wide at East Hartford. The valley system consists of a series of parallel valleys separated by linear north-south trending ridges. The Connecticut River flows southward just west of the site and drains the northern part of the valley system, ultimately discharging to Long Island Sound. The Connecticut River Valley, which is 5 to 6 miles wide and flat (local relief on the order of 30 feet), has created a broad floodplain and eroded terraces in the flatter portion of the valley system. The central portion of the Connecticut River Valley was occupied during deglaciation of the area by a large glacial lake. This lake, known as Glacial Lake Hitchcock, was formed during the northward retreat of the last continental ice sheet and existed about ten thousand years ago.

A regional drainage divide between the Connecticut River Basin and Hockanum Regional Basin lies to the north of the site and approximately 3 miles to the east of the site. The Hockanum River is a tributary of the Connecticut River.

Surface Water

From a review of the "Water Quality Classifications Map of Connecticut," published in 1987 by the CTDEP, surface water quality in Willow Brook has been designated as "B" along its entire reach to the confluence with the Connecticut River. As noted, the Willow Brook/Connecticut River confluence is approximately 2,500 feet from the Main Street culvert. The "B" designation indicates Willow Brook is known or presumed to meet water quality criteria for recreational use, fish and wildlife habitat,

agricultural and industrial supply, and navigation. The Connecticut River has been designated "SC/SB." This designation indicates that the water quality in the river does not presently meet class "SB" water quality criteria for one or more designated uses, but the goal is to meet class "SB" criteria. Designated uses for class "SB" include potential for certain fish and wildlife habitat, recreational boating, industrial supply, and other legitimate uses including navigation.

Storm water

Surface water drainage in the immediate vicinity of Willow Brook and Willow Brook Pond is predominantly overland sheet flow. Storm water in the adjacent plant area is handled by a number of catch basins, roof drainage systems, and storm drain pipelines, which discharge directly into Willow Brook or through an oil/water separator prior to discharge to Willow Brook. The Flood Insurance Rate Map, prepared by the Federal Emergency Management Agency and dated October 23, 1981, for East Hartford, Connecticut (Community No. 090026 0003-D Panel 3 of 4), shows the projected 100-year floodplain of the Willow Brook area. Most of the flood-prone areas depicted along Willow Brook lie between the 100-year to 500-year floodplain.

Meteorology

The climate of central Connecticut is a cool, humid, modified oceanic type. Winters are long and moderately cool; summers are short and mild. The mean annual temperature is approximately 50 degrees Fahrenheit (°F), ranging from an average of approximately 28°F in January to an average of 73°F in July. The average annual precipitation of approximately 44 inches is fairly evenly distributed throughout the year (National Oceanic and Atmospheric Administration, 1990); snowfall is about 40 inches per year (Soil Conservation Service, 1962). The prevailing wind is from the south or southwest in spring and summer and from the north or northwest the rest of the year.

1.2.3 Regional and Site Geology

Regional Geology

The geology of the region consists of sedimentary and igneous bedrock overlain by unconsolidated sediments. The UTC/P&W East Hartford facility is situated in the central portion of the Hartford Basin of the Newark Terrain. The rocks of the Hartford Basin were originally deposited as sediments or as the result of volcanic activity in a rift valley setting. The bedrock stratigraphy consists of four terrigenous sedimentary rock formations: the New Haven, Shuttle Meadow, East Berlin, and Portland. These units are composed of interlayered reddish siltstones, sandstones, and conglomerates. The sedimentary formations are separated from each other by three laterally continuous basalt units: Talcott, Holyoke, and Hampden Basalts. The bedrock layers dip gently eastward and are crosscut by numerous steep faults.

The unconsolidated sediments in much of the region can be divided into three major units: glacial till and limited deposits of stratified sand and gravel, glaciolacustrine deposits, and post-glacial fluvial deposits. These three units were deposited in this order, with the till and the limited stratified sand and gravel deposits generally lying directly over bedrock.

The till is poorly sorted and varies widely from a non-compact mixture of sand, silt, gravel, and cobbles with trace amounts of clay to a compact mixture of silt and clay with some sand, gravel and cobbles. The till is typically less than 10 feet thick in the vicinity of the UTC/P&W facility. The stratified sandy sediments (stratified drift) are much less extensive than the till and usually consist of sand, gravel and silt

deposited by melt water in contact with or in front of the glacier. These sediments appeared to be of limited extent and occurred in relatively thin layers (less than 10 feet) beneath the UTC/P&W facility.

Glaciolacustrine deposits include both lake-bottom sediments consisting of silt and clay and sand and gravel deposits formed by beaches and deltas in the lake. Thicknesses of lacustrine clays and silts as great as 270 feet have been reported beneath the UTC/P&W facility. These deposits are thickest in areas of deep bedrock valleys, one of which trends north-south and underlies the Main Plant Area. In a few isolated cases, thin layers of gravelly sands have been documented within the deeper portion of the glaciolacustrine unit.

Post-glacial fluvial sediments generally consist of sand and gravel deposited as the Connecticut River flowed across the exposed lake bed and cut stream terraces into the exposed lacustrine clays and silts, creating stream terrace deposits. These deposits are laterally extensive over the UTC/P&W facility, and are typically 15 to 30 feet thick across the facility.

Site Geology

Bedrock beneath the UTC/P&W facility consists of red sandstone and siltstone of the Portland Formation. Depth to bedrock within the facility boundaries is over 300 feet in the Main Plant Area, and approximately 30 feet along the eastern property boundary. Near the western property boundary along the Connecticut River, depth to bedrock is about 150 feet. A north-south trending, buried bedrock valley underlies the UTC/P&W facility; this buried valley may have been a pre-glacial channel of an ancient river following a similar course to that of the Connecticut River.

A thin layer of glacial till, up to 10 feet thick, typically directly overlies bedrock. A gravelly sand stratified drift deposit has been reported above or in place of the till in a few isolated instances.

Glaciolacustrine lake bottom sediments occur over most of the UTC/P&W facility, and range in thickness from 9 to 270 feet. These deposits thicken towards the central part of the facility (near the Main Plant Area) and are generally absent near the eastern boundary of the site.

The deposits consist of laminated (varved) silts and clays with red fine sand partings. The color varies from gray near the surface to red at the base of the unit. The presence of local sand or gravel lenses within the glaciolacustrine unit near its base has also been reported, but these are not assumed to be laterally extensive.

Beneath the eastern portion of the site, the contact between the silt and clay and overlying sediments is distinct. However, in the Main Plant Area, an intermediate layer of fine sand and silt that varies in thickness from approximately 5 to 20 feet occurs between these two deposits. A similar zone may occur at the base of the glaciolacustrine unit as well; these zones are typical of depositional facies changes that are characteristic of the depositional environment (glaciolacustrine).

Post-glacial fluvial deposits on the UTC/P&W facility are floodplain sediments of the Connecticut River. As the river cuts a channel through the floodplain, terraces were formed along the banks. The stream terrace deposits occur across the facility and generally range from 15 to 30 feet in thickness. These deposits increase in thickness toward the central part of the facility where greater erosion of the top of the glaciolacustrine silt and clay may have occurred along a former (perhaps earlier post-glacial), abandoned channel of the Connecticut River. These deposits generally consist of uniform brown fine, or fine-to-medium, sand. More recently deposited laminated silt and sand (alluvium) occurs near the western

boundary of the site. This alluvium is thickest near the Connecticut River and likely interfingers with the older stream terrace deposits. Other recent alluvial deposits are found scattered across the facility near existing and former streams or wetland areas.

1.3 Summary of Previous Investigations

This section presents a summary of the three previous phases of investigation conducted at Willow Brook and Willow Brook Pond from December 1997 to April 1999. A summary of the analytical results for the entire sampling program is included as Appendix A in a series of detailed site plans developed by LEA during the remedial investigation.

The investigations identified some probable sources and provided the analytical data to define the horizontal and vertical limits of contamination in sufficient detail to allow for the development of a remediation plan. Figures 1-2 and 1-3 present an overview of the delineation of the extent of PCBs in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond.

Phase I: *Report on PCB Investigation for Willow Brook and Willow Brook Pond Sediment*, prepared by LEA, dated February 13, 1998. The purpose of this report was to present the findings of the PCB investigation conducted on Willow Brook and Willow Brook Pond sediment in order to address the requirements of item (1) of the third paragraph of the NOV, No. PCB 97-08 issued by the CTDEP and dated November 7, 1997. The sampling was performed in accordance with the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997, and approved by the CTDEP on December 22, 1997.

The report describes the field activities performed based on a predetermined sampling grid and presents the analytical results of the investigations. A Toxic Substances Control Act (TSCA) sampling grid was developed to specify the number and location of samples for the investigation in accordance with USEPA's guidance document *"Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup"*. Two separate sampling grids were prepared for the east and west surface water bodies of Willow Brook Pond. The sampling was performed in accordance with the approved Work Plan, with the exception that the pond was not drained in response to CTDEP's concerns about sediment disturbance. Detectable PCB values on the sediment samples collected ranged up to a maximum concentration of 617 ppm total PCBs at sampling point WT-SD-33, located immediately downgradient of the subsurface connector between the eastern and western surface water bodies comprising Willow Brook Pond. Relatively high PCB concentrations were also observed in sediment samples collected in the vicinity of this location in both water bodies. Relatively elevated PCB concentrations were also observed along Willow Brook immediately downstream of Willow Brook Pond. A total PCB concentration of 327 ppm was observed in the sediment at location WT-SD-54. The results of the investigations indicated the presence of elevated PCB concentrations throughout Willow Brook Pond and in the section of Willow Brook between the pond and Main Street. The PCB concentrations observed beyond that point were below 1 ppm.

Selected sediment samples were also analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and the RCRA eight metals (arsenic, barium, cadmium, chromium, mercury, lead, silver, selenium) plus nickel, zinc.

Among the limited sediment samples analyzed for these parameters, elevated levels of SVOCs were detected in the sediment at location WT-SD-47 in the eastern water body of Willow Pond. Some of the highest SVOC concentrations reported in that sample included pyrene (480 mg/kg), phenanthrene (514 mg/kg), fluoranthene (537 mg/kg), chrysene (232 mg/kg), etc. Some of the highest metal concentrations

observed in this location included lead (153 mg/kg), zinc (152 mg/kg), barium (37.7 mg/kg), and nickel (36.4 mg/kg), etc. The only VOC compounds identified in this location included trichloroethylene (23 µg/kg), tetrachloroethylene (11.6 µg/kg), 1,1,1-trichloroethane (9.7 µg/kg), and 1,1-dichloroethane (10 µg/kg). Generally lower SVOC and VOC concentrations were observed in the other locations samples.

Elevated TPH concentrations were observed at WT-SD-47 (1,160 mg/kg) and WT-SD-09 (4,340 mg/kg and 3,940 mg/kg in the duplicate). Relatively elevated metal concentrations were also observed at this location (zinc 772 mg/kg and 689 mg/kg in the duplicate, nickel 595 mg/kg and 593 mg/kg in the duplicate, lead 714 mg/kg and 691 mg/kg in the duplicate, chromium 490 mg/kg and 497 mg/kg in the duplicate).

It should be noted that no sediment was encountered in upstream accessible locations along the Willow Brook conduit to allow sample collection. Several manholes along the subsurface conduit were opened to confirm no sediment had accumulated within the conduit. Historical measurements have indicated non-detectable PCB levels in sediment samples collected from upstream brook locations, prior to the conduit.

Based on the results obtained, additional investigations were determined to be necessary to better characterize the vertical extent of the contamination within Willow Brook and Willow Brook Pond and to identify potential nearby sources of contamination.

Phase II: *Report on Supplemental PCB Investigation for Willow Brook and Willow Brook Pond*, prepared by LEA, dated April 1998. The purpose of this report was to present the findings of the supplemental PCB investigation conducted on Willow Brook and Willow Brook Pond. The supplemental soil and sediment sampling was performed to identify potential nearby sources of contamination and to provide information of the vertical extent of the contamination within Willow Brook and Willow Brook Pond. An overview of the investigation of the potential source areas and the delineation of Willow Brook and Willow Brook Pond sediments is as follows:

Southwestern bank of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic sludge drying beds located to the south of Willow Brook Pond was a potential source. Four soil borings were also installed at the southwestern bank of Willow Brook Pond downgradient of the historic sludge drying beds. The borings were advanced to a depth of 20 to 24 feet from the western bank of the pond. Low total PCB concentrations (up to about 2 ppm) were detected in the borings installed along the southwestern bank of Willow Brook Pond. These concentrations did not appear to be indicative of a source of PCB contamination.

Area of Former Oil Basin area, within the western section of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the pond area was a potential source. The existing oil-water separator is currently operating in this area. Four soil borings were installed in the vicinity of the area of Former Oil Basin, the small embayment west of the Process Water Facility and south of the lower section of Willow Brook Pond. Two of these borings were installed on top of the bank immediately to the south of the area of Former Oil Basin using a Geoprobe® and advanced to a depth of 20 to 24 feet. The other two were installed by hand to a depth of 2 to 8 feet in the immediate proximity of the existing oil/water separator. PCBs were detected in the soils collected from the four soil borings; however, the highest total PCB concentrations were of the order of 1.3 ppm. These concentrations do not appear to be indicative of a source of contamination.

Former Oil-Water Separator, located historically in the area between the two sections of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the

Pond area was a potential source. Five soil borings were installed in the vicinity of the Former Oil-Water Separator in between the two sections of Willow Brook Pond to identify potential historic sources of PCB contamination. The soil borings were installed using a Geoprobe® to a depth of approximately 20 feet. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for analysis from each boring. Elevated total PCB concentrations were observed in the soil samples from this location. The total PCB concentration observed in this area ranged up to 128 ppm (location WT-SB-88) at a depth of 10 to 12 feet. Free oil was also observed in this location. However, the oil was not extracted from the soil matrix for analysis. The highest PCB concentrations were observed at a depth of approximately 8 to 12 feet below ground surface corresponding approximately to the depth of the water and sediment within the pond, and the approximate level of the water table in the area. These concentrations and findings from this area are indicative of a probable source. It should be noted that the contamination might have originated from multiple sources.

Sediment Sampling: In-depth sampling was also performed within the eastern and western water body of Willow Brook Pond, and along Willow Brook in the vicinity of the wetlands area, and in the wetland area within UTC/P&W's property. These samples were collected to develop at-depth profiling information. It should be noted that only surface sediment samples were collected during the initial Phase I investigation. A 5-foot core was used for collection of the sediment and underlying soil samples during Phase II. Generally, one sediment and two soil samples of the underlying soil were selected from each sampling location. Detected total PCB concentrations within the two sections of Willow Brook Pond (east and west) ranged in concentrations up to 258 ppm in the upper 0- to 2-foot interval. The highest concentration was observed in location WT-SD-72 near the pond's effluent point. Approximately 73.5 ppm of total PCBs were detected at a depth interval of 2 to 4 feet in location WT-SD-78, located at the eastern portion of Willow Brook Pond. Significantly lower and/or non-detectable levels were observed at greater depths. PCB concentrations remained at detectable levels at certain locations at depths up to 8 or 12 feet. Total organic carbon (TOC) concentrations up to 162,000 mg/kg were detected in sediment samples within Willow Brook Pond (location WT-SD-75 at a depth of 0 to 2 feet).

The total PCB concentrations detected in Willow Brook in the vicinity of the wetlands area and within the wetlands for surface samples (0 to 6 inches) ranged in concentration from 44 ppm up to 299 ppm (location WT-SD-92). The total PCB concentrations observed in the at-depth samples (1.5 to 2.0 feet) were significantly lower ranging from 2.6 ppm to 5.7 ppm.

Additional investigations were then proposed, focusing on the areas where the highest levels of PCB contamination were identified to further investigate and define the extent of contamination.

Phase III: *Report on PCB Investigation for Willow Brook and Willow Brook Pond,* prepared by LEA, dated April 1999. The purpose of this report was to present the findings of the third phase of PCB investigations in Willow Brook and Willow Brook Pond. During this phase, soil samples were collected from soil borings and monitoring wells installed in the vicinity of Willow Brook Pond. In addition, surface sediment and soil samples to depths of up to 6 feet were collected along the banks of Willow Brook. Soil/sediment samples were collected from the wetland area at Willow Arms and from other adjacent residential properties along the portion of Willow Brook, which lies downstream of Willow Brook Pond and to the east of Main Street. Groundwater sampling was also performed in monitoring wells installed at the perimeter of Willow Brook Pond.

Willow Brook Pond Perimeter Sampling: Twelve soil borings and eight monitoring wells were installed in the vicinity of Willow Brook Pond to assess the lateral extent of the contamination. The borings and monitoring wells were installed using a Geoprobe® to a depth of approximately 20 feet. Hand borings to

an approximate depth of 12 feet were installed in locations inaccessible by the Geoprobe®. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for PCB analysis from each boring, including the most contaminated one, based on visual observations, and random ones corresponding approximately to the depth of contamination obtained during the previous investigation. Total PCB concentrations of 50.87 ppm were observed to the east of the eastern water body at Willow Brook Pond, along the reinforced concrete pipe that conveys flow from Willow Brook into Willow Brook Pond. Relatively elevated PCB concentrations up to 14.33 ppm were observed in the area of the Former Oil-Water Separator between the two sections of Willow Brook Pond. This is consistent with previous findings and provides delineation of contamination in this area. Elevated concentrations of semi-volatile organic compounds (SVOCs) and select metals have been observed at some locations. The elevated compounds are consistent and appear to be co-located with the elevated PCB concentrations.

PCBs may have seeped into nearby soils at certain locations, for example at location WT-PZ--140 to the north of the larger water body of Willow Brook Pond (3.82 ppm). However, concentrations detected at depth are generally much lower or below detectable levels. The contamination was confirmed to be primarily contained within Willow Brook Pond.

Wetlands and Stream Bank Sampling: Soil/sediment samples were collected from several abutting residential properties along the segment of Willow Brook between Willow Brook Pond and Main Street. The samples were collected at different elevations along the bank of the brook to assess the lateral extent of contamination. Samples were also collected from the wetlands area at the Willow Arms property and from the adjacent portion of UTC/P&W's property. Surface soil/sediment samples were collected in a total of 28 locations. In seven of these locations, hand auger borings were advanced to approximately 6 feet to assess the vertical extent of contamination. Relatively elevated PCB concentrations (up to 596.2 ppm) were observed within the wetland area. Relatively elevated SVOC and select metals concentrations were also observed within this area, and, as stated before, are consistent and co-located with elevated PCB concentrations. The total PCB concentrations typically decrease to less than 1 ppm at a depth of 4 to 6 feet below grade. Similar concentrations were observed in the wetland area within UTC/P&W property. Total PCB concentrations up to 21.77 ppm were detected from sediment within Willow Brook in the off-site properties (downstream of the wetland area). The PCB concentrations observed drop substantially at higher elevations along the bank of Willow Brook, indicating that the contamination is confined within the brook and the wetland. PCB concentrations decrease to less than 1 ppm prior to Main Street.

Groundwater Sampling: Groundwater samples were collected by LEA personnel from the installed monitoring wells on December 4, 1998. Samples were collected using a peristaltic pump and dedicated polyethylene tubing. Of the eight monitoring wells installed, PCBs were only detected at two locations. PCBs were detected in groundwater from monitoring wells WT-PZ-136 [8.5 parts per billion (ppb)] and WT-PZ-139 (0.73 ppb). These wells are in the vicinity of locations where the highest PCB concentrations in soil have been detected.

Surface Water Sampling: Surface water samples were collected from two locations at Willow Brook Pond (at the pumps from the larger water body prior to entering the facility for non-contact cooling water use and at the dam) and from Willow Brook (downstream of Willow Brook Pond at the intersection with Main Street). No PCBs were detected in any of the surface water samples collected.

1.4 Nature and Extent of Contamination

1.4.1 Soil and Sediment

Overall and with consideration of the data collected to date, PCB concentrations are generally distributed in the brook and pond sediments gradually decreasing in concentration in the downgradient direction. This decrease trends from > 100 ppm in the pond and wetland areas to a concentration of < 1 ppm at Main Street. PCBs were also found in the soils between the two ponds, where the former oil/water separator was located. The vertical extent of PCB impacts has been defined by the sampling conducted, generally achieving non-detect or concentrations < 1 ppm at depths ranging from 4 to 6 feet below grade in the wetland area and 14 to 16 feet below grade in the soil between the upper and lower Willow Brook Pond (in the vicinity of the former oil-water separator). Soil samples collected along and up the banks of the brook and ponds define the horizontal limits of PCB to non-detect or concentrations of < 1 ppm. Figures 1-2 and 1-3 depict the extent of PCB impact in the Willow Brook and Willow Brook Pond area. Within the pond and brook the PCBs are commingled with SVOCs and select metals.

1.4.2 Groundwater

Groundwater samples collected during the remedial investigation identified only two locations where PCB concentrations were above detection limits (WT-PZ-136 at 8.5 ppb and WT-PZ-139 at 0.73 ppb). Well WT-PZ-136 is located in the immediate vicinity of the former oil/water separator and locations of high PCB content in soil. Well WT-PZ-139 is adjacent to an area of elevated PCB in soils. It is expected that removal of soil and source material in these areas will address PCB in groundwater. As these areas and the previously sampled monitoring wells will be removed during RA, post-excavation groundwater monitoring will be conducted to confirm no impacts to groundwater remain following excavation. This monitoring will be conducted through the installation of new monitoring wells in the area.

1.4.3 Surface Water

Surface water sampling from Willow Brook and Willow Brook Pond was performed on February 6, 1998. Samples were collected from Willow Brook Pond at the pumps pumping from the larger water body and dam and from Willow Brook downstream of Willow Brook Pond at Main Street. No PCBs were detected in any of the surface water samples collected.

2.0 STATEMENT OF WORK

The remediation plan for Willow Brook and Willow Brook Pond project as defined in Section 1.0, involves the excavation and offsite disposal of soil and sediment containing total PCB concentrations in excess of 25 ppm. The remediation plan for the wetland area located north of Willow Brook involves the excavation and offsite disposal of soil and sediment containing PCB concentrations in excess of the Residential Direct Exposure Criteria. Following excavation and removal of the impacted soil and sediment within Willow Brook and Willow Brook Pond, a cap consisting of an organic rich soil layer, a gravel layer and a stone layer will be placed within the limits of Willow Brook and Willow Brook Pond. The dam structure between Willow Brook Pond and the open channel section of Willow Brook will remain intact. The area will be restored to much the same configuration as exists today with two ponds (upper and lower Willow Brook Ponds) and an open channel (Willow Brook) from the downstream end of the pond to the cross culvert at Main Street. The existing wetland downstream of the pond will also be restored. Details regarding site restoration and capping are further discussed in Section 2.3.

As noted previously, soil and sediment within Willow Brook and Willow Brook Pond are also impacted by SVOCs, metals, and petroleum hydrocarbons. During the removal of PCB contaminated soil and sediment, a large percentage of the soils and sediment impacted by these constituents will also be removed. Remediation of other constituents of concern found in the remediation areas will be completed in accordance with the Remediation Standard Regulation (RSR), 22a-133k-1 through 3 of the Regulations of Connecticut State Agencies (RCSA). The remediation goals for the ancillary constituents are presented in tabular format in Appendix A and B to 22a-133k-2, more specifically the Industrial/Commercial criteria in Appendix A, the GB Mobility Criteria in Appendix B and/or alternative criteria in accordance with those specific provisions. In any event, any remaining contamination will be capped in accordance with the variance provisions in the RSR as noted previously. Following remediation, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire project area to preclude access to Willow Brook and Willow Brook Pond.

The proposed 25 ppm total PCBs action level within Willow Brook and Willow Brook Pond assumes future use of the remediation area as an open pond to be flanked by green space. However, as noted above, a perimeter fence will be installed to preclude free access to the remediated area. In the event that redevelopment of this area involves a bike path or roadway, the area directly beneath those uses will be remediated to a total PCB concentration of less than the Residential Direct Exposure Criteria. A release of the aforementioned Environmental Land Use Restriction by the Commissioner of the Department of Environmental Protection would be necessary before any redevelopment activities are initiated. Such release would necessitate the preparation of a detailed remediation and restoration plan, which would be consistent with the future proposed use of the subject area or part thereof. Furthermore, should redevelopment of the area necessitate remediation to less than the Residential Direct Exposure Criteria, appropriate barriers (i.e. fencing or railings) would be installed between the capped areas and the areas remediated to less than the Residential Direct Exposure Criteria.

2.1 General

This section details the work to be completed during the project. The section begins with a discussion of pre-construction activities including the application for necessary Federal, State of Connecticut and Town of East Hartford permits to complete the work, and the design of the project. This is followed by a

discussion of the construction activities including site preparation, the demolition and removal of existing structures, contaminated soil and sediment excavation and offsite disposal, wetlands restoration, site restoration activities, implementation of institutional controls, and record keeping and reporting. The last part of this section details post-construction activities. This includes a discussion on the preparation of a post-remediation report detailing the remediation activities and a post-remediation groundwater monitoring program.

2.2 Pre-Construction Activities

This section contains a description of those activities that will be completed prior to the initiation of PCB removal activities at the site. The pre-construction activities are presented in three general categories: project permits, engineering design, and health and safety plan.

2.2.1 Project Permits and Approvals

Prior to the initiation of construction activities and the completion of design activities, it will be necessary to obtain permits from a variety of regulatory agencies maintaining jurisdiction over the work. The agencies include the Army Corps of Engineers, the State of Connecticut Department of Environmental Protection, and the Town of East Hartford Inland Wetlands, and Planning and Zoning Commissions.

US Army Corps of Engineers

The work of this project involves the excavation of nearly 12,500 cubic yards of contaminated soil and sediment from within Willow Brook and Willow Brook Pond. The majority of the excavation activities occur within the two ponds, within the wetlands west of the ponds, or immediately adjacent to these areas. The construction activities will result in the disturbance of greater than 1-acre of wetlands within and immediately abutting the work. A permit from the Army Corps of Engineers is necessary prior to performing a construction activity that impacts greater than 1-acre of inland wetlands. In consideration of the fact that the project will result in the disturbance of greater than 1-acre of inlands wetlands, the permit from the Army Corps of Engineers will be sought through the individual permit process. The permit application was filed on February 14, 2001 and is currently under review. As part of this permit application, a public notice was issued. In response to the notice, the Army Corps of Engineers has not received any substantive comments.

Connecticut Department of Environmental Protection

Prior to initiation of the construction activities, it will also be necessary to obtain a permit from the CTDEP Inland Water Resources Division. This permit will address the need to obtain a water quality certification for the excavation/placement of fill within the flood plain and wetlands pursuant to Section 401 of the Clean Water Act. The permit application was filed on February 14, 2001 and is currently under review. Comments from the DEP on the application have been received and addressed in a revised submission. As part of this permit application, a public notice was issued. In response to the notice, the CTDEP Inland Water Resources Division has not received any substantive comments. .

The application to the IWRD was prepared and submitted on forms approved by the DEP and included: a permit application transmittal form; the permit application for programs administered by the IWRD; the technical documentation form; an executive summary; a USGS site location map; a listing of all adjacent property owners;; a soil scientists report; an engineering/hydrogeologic report; flood management

consistency worksheets; an environmental report; an alternatives assessment; a flood contingency plan; and plans and drawings detailing the work.

In addition to the above pre-construction permit, it will also be necessary to register for the General Permit for the Discharge of Storm Water and Dewatering Wastewaters Associated With Construction Activities and the General Permit for the Discharge of Groundwater Remediation Wastewater. The CTDEP Bureau of Water Management issues both General Permits. Registration packages will be submitted to the CTDEP prior to initiation of construction activities. In addition, a Storm Water Pollution Control Plan (a requirement of the storm water general permit) will be prepared prior to the initiation of construction activities.

In addition to the above permits, it will also be necessary to secure an approval for the use of an engineered control to remediate soil and sediment within the project area. The engineered control consists of the pond bottom/sediment, stream channel, and composite caps to be installed following excavation activities within the project area. The request was submitted to the CTDEP on January 5, 2001 in accordance with Section 22a-133k-2(f)(2)(B) of the Regulations of Connecticut State Agencies. The request was a detailed report and plan which was prepared to satisfy the requirements of the above referenced regulatory section and to document that the cost of excavation and offsite disposal of the polluted soil at the site is significantly greater than the cost of installing and maintaining an engineered control and conducting groundwater monitoring. The request further documented that the significantly greater cost outweighs the risk to human health and the environment if the engineered control fails to prevent the mobilization of, or human exposure to the remaining polluted soils. The request is currently under review by the CTDEP. The use of an engineered control is also subject to a public comment process. The public notice of the intended use of the engineered control was advertised on April 28, 2001. To date, no substantive comments have been received.

Town of East Hartford

Prior to the initiation of construction activities, it will be necessary to obtain three permits from the Town of East Hartford. These permits will be issued by the Inland Wetlands, and Planning and Zoning Commissions. The Inland Wetlands Commission permit will be necessary prior to the performance of construction activities within wetlands or within specified distances from a wetland. The Inland Wetlands Commission issued an approval for the project following a public hearing on the application on April 24, 2001.

The Planning and Zoning Commission permits will be in the form of a Major Flood Hazard Permit and a Soil Erosion and Sedimentation Control Permit. The Major Flood Hazard Permit will be necessary prior to performing construction activities within a flood hazard area of the Town of East Hartford. This application was submitted to the Town of East Hartford on May 7, 2001 and is expected to be approved in June 2001. The Soil Erosion and Sedimentation Control Permit must be obtained prior to initiating a construction project, which includes disruption to greater than ½ acre of land in the Town of East Hartford. This application was submitted on May 29, 2001 and is expected to be approved during June 2001. It should be noted, an Excavation Permit will not be necessary, as a special exception has been sought as the construction activities are being undertaken as part of a remediation project.

2.2.2 Engineering and Design

Prior to the implementation of the construction activities at the site, design drawings and technical specifications necessary to support permitting activities will be prepared to depict each phase of the

project. The construction drawings will be used in support of applications to obtain necessary permits as well as to direct the efforts during the construction activities. The technical specifications will be of adequate detail to ensure that each phase of construction is performed in accordance with the terms and conditions of any permits obtained prior to the initiation of construction, this Remedial Action Plan, and other applicable local, state and/or federal requirements. The project is being performed as a design-build effort. As such, detailed design plans and specifications beyond that which is necessary to support the permitting efforts and to establish the performance criteria for the remediation project, are not necessary. The drawings and figures contained herein represent the current status of engineering design for the project. Additional engineering design is not anticipated, other than the anticipated minor field alterations necessitated by changed conditions.

2.2.3 Health and Safety Plan

A Health and Safety Plan (HASP) will be prepared prior to the initiation of construction activities. The HASP will detail safety organization, procedures, and personal protective equipment that are based on an analysis of potential site-specific hazards. The HASP, will meet the requirements of 29 CFR 1910 and 29 CFR 1926 (which includes 29 CFR 1910.120 and 29 CFR 1926.65). The HASP will include, but will not be limited to, the following components:

- Identification of key personnel - All on-site personnel involved with the construction activities at the site will be required to maintain Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Training (29 CFR 1910.120 and 29 CFR 1926.65) and the corresponding 8-hour refresher course update
- Training – A description of health and safety training requirements for supervisory and on-site personnel will be presented. Training requirements will include attending an initial site orientation prior to performing on-site activities
- Medical Surveillance – A description of appropriate medical examinations required for supervisory and on-site personnel.
- Site Hazards – A description of chemical, physical, and climatological hazards associated with the project.
- Work Zones – A description of the work zones that will be established during construction activities.
- Personnel Safety Equipment and Protective Clothing – A description of personnel protective equipment and protective clothing to be used and available on site.
- Equipment Cleaning – The methods and procedures for decontamination of personnel, materials, and equipment will be described.
- Confined Space Entry – A listing of confined spaces and description of procedures for confined space entry in accordance with Permit Required Confined Space Entry (29 CFR 1910.146).
- Excavation Safety – A description of excavation and trenching safety procedures as specified in 29 CFR 1926 Subpart P.
- Standard Operating Procedures and Safety Programs as required by applicable portions of 29 CFR 1910 and 29 CFR 1926.

2.3 Construction Activities

The proposed construction activities involve:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;
- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below and the footprint of the process water facility) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;
- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and
- The implementation of two institutional controls consisting of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

The following parts of this section describe in general each of the anticipated construction activities necessary to complete the remediation.

2.3.1 Site Preparation

Drawing 2-1 presents the general site preparation details associated with this project. The following is a general description of anticipated site preparation activities.

Erosion Control

Appropriate soil erosion and sedimentation control methods (e.g., silt fence, straw bale dikes, absorbent booms, etc. as depicted in Figure 2-1) will be installed to mitigate the transport of suspended solids or sediments downstream. A soil erosion and sediment control plan is a component of applications for local, state and federal permits. Due to the magnitude of excavation to accomplish the removal of contaminated soil and sediment, excavation activities may be suspended during periods of heavy precipitation.

Clearing and Grubbing

The area in the immediate vicinity of Willow Brook and Willow Brook Pond is covered with a variety of vegetation, including the wetland areas (see Drawing 2-1). Vegetation ranges from mowed grass to

mature trees. To gain access to perform the planned excavation activities, clearing and grubbing will be required. Cutting, processing, and appropriate disposal of heavy vegetation will be a component of the project. It is anticipated that stumps from trees located in areas known or suspected to be impacted by PCBs or other constituents will be disposed of at an offsite facility as PCB remediation waste. The remainder of the woody debris will be shipped offsite for volume reduction and/or disposal as a solid waste in accordance with the State of Connecticut Solid Waste Management Regulations.

Decontamination Facilities

Contractor equipment that has been in contact with contaminated soil and sediment will require decontamination prior performing work in an uncontaminated area or demobilization from the site. A decontamination pad or pads will be strategically located at the site adjacent to excavations and vehicle loading areas. Potential locations for decontamination facilities are shown on Drawing 2-1. The decontamination pad or pads will generally be constructed of a wood frame or similar materials, lined with heavy plastic, and include a layer of open stone. Equipment that has come into contact with contaminated soil and sediment will be cleaned with a pressure washer, scrub brushes and organic solvent using a double wash/rinse process in accordance with Subpart S of 40 CFR Part 761 over the decontamination pad.

Durable field sampling equipment (e.g., stainless steel trowels, plastic scoops, shovels, etc.) used to implement the Field Sampling and Analysis Plan will be decontaminated prior to each sample location to mitigate the potential for cross-contamination of samples collected for laboratory analysis. Decontamination will be performed in accordance with Standard Operating Procedures provided as Appendix B and in accordance with 40 CFR Part 761.79(c).

Wash water and detergents used in the decontamination process will be disposed of following pretreatment through a mobile water treatment system (described in more detail later in this document) to the sanitary sewer in accordance with the terms and conditions of the CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater. The terms and conditions of this General Permit require removal of PCBs to a concentration of 1 μg/L, which is more restrictive than §761.79 (c).

Site Security

Limiting access to the site during construction will be accomplished thorough the use of both existing and permanent fencing (refer to Drawing 2-1 and Figure 2-2), along the north side of Willow Brook and Willow Brook Pond, and temporary construction fencing to be installed along Willow Street. The fencing will be supplemented by the use of security personnel to ensure that unauthorized persons do not access the construction site during remediation activities.

2.3.2 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Drawing 1-1). A list and description of the primary structures to be demolished and removed are as follows:

- Five buildings and components associated with the process water facility; and
- The former underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Area Preparation

Prior to demolition, a complete survey of the structures and their components will be performed. The survey is necessary to determine decommissioning, demolition, and disposal requirements. UTC/P&W will be responsible for shutdown and removal of components they intend to reuse from the process water facility.

Process Water Buildings

Demolition of the process water buildings will extend to a depth necessary to achieve the project objectives of removal of soil and sediment containing total PCBs in excess of the Commercial/Industrial Direct Exposure Criteria that are located within 4 feet of the ground surface and in excess of the GB Pollutant Mobility Criteria that are located above the seasonal high water table. Other related structures, such as pilings, erosion structures, etc., will also be demolished and removed to a depth necessary to achieve the project objectives. Pipes and utilities connected to these buildings will be abandoned or removed during the demolition activities or during the soil and sediment removal phase of the project. Utilities designated for in-place abandonment will be will be analytically assessed and decontaminated if necessary. Utilities located within an area of soil remediation shall be excavated and disposed of as bulk remediation waste.

A Civil War marker/gravestone is located to the east of the main water processing building. This feature shall be protected during all aspects of the work.

Former Oil/Water Separator

A buried oil/water separator is located between the upper and lower sections of Willow Brook Pond. This structure and surrounding soils are contaminated with PCBs. The oil/water separator, its contents, and the soil containing greater than 25 ppm PCBs surrounding the structure will be completely removed and disposed of at an offsite location during the project. If a light-non-aqueous phase liquid (LNAPL) is identified during excavation, the remediation of will proceed until the LNAPL is removed in accordance with Section 22a-449(d)-106(f) of the Regulations of Connecticut State Agencies. However, it is anticipated that the presence of LNAPL is coincident with soils containing greater than 25 ppm PCBs and the removal of the LNAPL would be completed during excavation of those soils. Prior to removal of the structure, the oil/water separator will be exposed and any liquids will be removed, characterized, and disposed of at an offsite location.

Available analytical data are sufficient to delineate the three-dimensional extent of soil impacted by PCBs in the vicinity of the oil/water separator. However, the data are not adequate for the purposes of establishing the lateral limits of the composite cap to be installed in this area to address soils impacted by other constituents. As a result, prior to implementing the remediation in this area, soil borings will be advanced to a depth of 15 feet using the Geoprobe®. Soil samples will be collected from each Geoprobe®soil boring and analyzed for PCBs and constituents other than PCBs. The intent of the sampling will be to delineate the three-dimensional extent of other soils requiring remediation for other constituents pursuant to the RSRs. It is anticipated that soil samples will be analyzed for mass and SPLP metals (RCRA 8 plus copper, nickel and zinc), cyanide, VOCs, SVOCs, and TPH. The location of each soil boring is discussed in Section 4.0.

Demolition Debris Management

Further evaluation of the affected structures and components will be performed to determine disposal requirements prior to demolition. Appropriate samples will be collected and submitted for laboratory analysis to characterize the waste for disposal. Any demolition debris characterized as bulk PCB remediation waste shall be disposed of at a chemical waste landfill approved under 40 CFR 761.75The sampling procedures and protocols are further discussed in Section 4.0, Field Sampling and Analysis Plan. It is anticipated that all material removed in the demolition process will be disposed of off site. An expected waste stream summary is presented in Section 4.0.

Soil Sampling and Analysis

Sampling and analysis of certain soils below and adjacent to the subject buildings and structures will be required to confirm horizontal and vertical limits, disposal and handling requirements. Soil confirmatory samples will be collected and analyzed in accordance with the Field Sampling and Analysis Plan presented in Section 4.0. The excavated and staged soil will be sampled for disposal characterization. The soil disposal characterization samples will also be collected in accordance with the Field Sampling and Analysis Plan. All confirmatory and disposal characterization samples will be analyzed in accordance with the Quality Assurance Project Plan in Section 5.0.

2.3.3 Contaminated Soil and Sediment Excavation and Offsite Disposal

This section presents a summary description of the planned soil and sediment excavation and offsite disposal activities. As noted, it is anticipated that approximately 12,500 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. The proposed by-pass channel was incorporated into this project primarily to facilitate in-situ dewatering and to mitigate potential logistical complications associated with other water handling options. Based on the available historic stream channel bathymetry and utility invert data, the by-pass channel is expected to effectively relieve the groundwater table to an elevation below 21.00 in the pond areas. A field determination will be made based on the percent solids observed in the in-situ material, to excavate the material and direct-load the haul vehicles for off-site disposal, or to excavate the material and stage it in a temporary staging area for further gravity dewatering. The staged material would again be evaluated after a 24-hour period to assess the percent solids. If the percent solids are unacceptable for over-the-road transport, lime will be added to the material to further stabilize it and to achieve compliance with shipping requirements.

If it is determined that material staging in stockpiles is necessary to facilitate the offsite disposal of the contaminated soil and sediment, a material staging and stockpile area will be constructed. The material staging and stockpile area construction and operation is discussed in greater detail below.

Contaminated soil and sediment will be characterized for disposal based on the "as-found" concentration of PCBs. Additional analysis will be performed on stockpile grab samples as needed to satisfy the disposal vendor. The waste will be disposed of based upon the more restrictive analytical data regardless of the as-found concentrations (e.g. if in-situ characterization documents < 50 ppm PCBs and the stockpile data suggests > 50 ppm, the waste disposal profile used for this particular load would be based on the stockpile data). Stockpile analytical data would not be used to reduce any disposal restrictions on the material.

Stream Flow During Construction

The construction project involves the excavation of submerged sediments from within Willow Brook and Willow Brook Pond. Remediation will begin at the upstream pond and progress downstream. To accomplish the excavation, it will be necessary to temporarily redirect flow within Willow Brook.

During construction, all flow entering the PCB remediation work area from the upstream conduit of Willow Brook will be bypassed by the construction of a channel capable of conveying a 100 year flood as defined by the Flood Insurance Study prepared for the Town of East Hartford in January of 1979. The bypass channel will be constructed on the south side of the Willow Brook and Willow Brook Ponds as depicted in Drawing 2-2 and as detailed in Figure 2-3 through 2-5. Provisions will be made to direct local drainage that enters the work area directly from storm sewers on United Technologies Corporation, Pratt & Whitney property on the south side of the work area into the bypass channel. Storm water discharges from municipal and privately owned storm sewers that enter the work area from the north will either be conveyed or pumped around active work areas. During a 500-year flood, the hydraulic gradient above the work area would be higher than the conduit, and the backwater would cause some catch basins to be surcharged above the surface elevation of the inlets upstream of the conduit outlet. Provision has been made to seal the catch basins within the temporary staging and stockpile areas upgradient of the conduit outlet and to block surface flow from entering either the work area or the storage areas.

Dewatering

In addition to water diversion, it is also likely that construction dewatering will be necessary to facilitate the removal of soil and sediment containing greater than 25 ppm total PCBs. Conventional sump or well-point techniques will be employed to allow for spot dewatering of excavation areas. All dewatering wastewater will be containerized, treated as necessary, sampled, then discharged to the Town of East Hartford Water Pollution Control Facility through a sanitary sewer under a general permit, issued by the DEP, for the Discharge of Groundwater Remediation Wastewater to a Sanitary Sewer. The collected water will be pumped to a settling tank within which solids will be separated. Water will be decanted from the settling tank, treated in an onsite mobile water treatment system through a wet-phase carbon adsorption system then discharged. All related monitoring and record keeping shall be implemented as mandated by this general permit. A copy of this general permit is provided as Appendix C.

Excavation Methods

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Drawing 2-3. Based on the prior investigations, it is anticipated that an average of 2 to 3 feet of sediment will be removed from the pond and brook, respectively and up to 4 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the former oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bulldozers, and loaders. It likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

Once the target soils and sediment have been removed and verified, the excavation will continue in the next remediation area and the placement of the geotextile, soil and stone cap (See Section 2.3.4) can proceed. Should the confirmatory samples indicate that the 25 ppm total PCB limit has not been achieved within the pond and brook or the Residential Direct Exposure Criteria for PCBs within the wetland area,

additional excavation will be performed. Excavation will continue until all soil and sediment containing PCBs at concentrations in excess of 25 ppm within the pond and brook and the Residential Direct Exposure Criteria for PCBs within the wetland are removed.

Soil/Sediment Sampling and Analysis

Sampling and analysis of certain soils/sediments will be required to confirm horizontal and vertical limits, disposal and handling requirements. Soil and sediment confirmatory samples will be collected in accordance with the Field Sampling and Analysis Plan presented in Section 4.0. The excavated and staged soil and sediment will be sampled for disposal characterization. The soil and sediment disposal characterization samples will also be collected in accordance with the Field Sampling and Analysis Plan. All confirmatory and disposal characterization samples will be analyzed in accordance with the Quality Assurance Project Plan in Section 5.0.

Soil/Sediment Staging

During the soil and sediment removal activities the excavated soil and sediment may need to be temporarily relocated into staging areas adjacent to the excavation area for gravity dewatering and lime stabilization as detailed above. The staging areas will consist of a perimeter berm and will be lined with polyethylene and pavement to contain all soils and liquids. Soil and sediment placed within the staging areas shall be covered with a low permeability sheet to limit exposure to precipitation. All water within the staging areas will be collected in a pre-formed sump located at an intentionally defined low spot within the staging area(s). The collected water will be pumped to a settling tank within which solids will be separated. Water will be decanted from the settling tank, treated in an onsite water treatment system through a wet-phase carbon adsorption system then discharged to the Town of East Hartford Water Pollution Control Facility. Sampling, as necessary to comply with the terms and conditions of the general permit for discharge and the Town's discharge requirement will be performed. Prior to initiating the discharge to the sanitary sewer, the treated water will be sampled to ensure that the PCB concentration is less than 1 ug/l and all other constituents comply with the terms and conditions of the general permit.

Stabilization

The excavated soil and sediment shall be staged for dewatering by gravity within a staging area in order to meet applicable requirements for disposal (i.e., no free liquids). It is anticipated that the soil and sediment will be further stabilized utilizing up to six percent lime by weight, only if necessary. Lime will be evenly incorporated into the excavated soil and sediment via mechanical mixing. This stabilization process is intended to facilitate the legal shipping of the contaminated material over-the-road to a permitted offsite disposal facility.

Off-Site Disposal

It is anticipated that all soil and sediment excavated as part of this project will be shipped to an offsite facility for disposal. The offsite disposal includes handling, storing, containerizing, transporting (including providing and preparing manifests, bills of lading, etc.) and disposing of excavated soil and sediment. The excavated soil and sediment will be transported via a licensed waste hauler to a permitted chemical or solid waste disposal facility dependant on the waste characterization. The estimated in-place volume of soil and sediment requiring offsite disposal is 12,500 cubic yards.

Dust-Control

Included as Appendix D is a project-specific Dust Control Plan. This plan establishes the activities that will be performed to minimize the potential exposure to unacceptable levels of airborne contaminants during the work.

2.3.4 Pond/Stream Channel Cap, Engineered Control, Wetland Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The planned restoration activities are described in detail below and depicted on Drawings 2-4 and 2-5 with related details and sections presented in Figures 2-6 through 2-8. The site restoration involves the installation of 3 types of caps/engineered controls over soil and sediments remaining following excavation and removal of those containing total PCBs at concentrations greater than 25 ppm. The cap details were derived based on the anticipated stream flow velocities and considered the ultimate use of the area as a combined wetland, pond, and stream channel. The base of each cap consists of a non-woven geotextile, a 9-inch layer of organic rich soil, and a non-woven geotextile. This layer is referred to below as an organic-rich layer. This organic-rich layer is included as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. The caps are described below and are depicted on Figures 2-6 through 2-8.

- Within Willow Brook Pond, a 36-inch soil and stone cap is proposed (refer to Drawing 2-4 and Figure 2-6). The cap will consist of a 9-inch organic rich layer, 21 inches of process gravel, and a 6-inch layer of 4-inch stone. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.
- Within Willow Brook (downstream of the dam), a 36-inch soil and stone cap is proposed (refer to Drawing 2-4 and Figure 2-7). The cap will consist of a 9-inch organic rich layer, a 15-inch layer of modified rip-rap and a 12-inch layer of cobbles, gravel and coarse sand. The 15-inch layer of modified rip-rap extends the width of the channel bottom and transitions into a 24-inch layer of intermediate rip-rap on the side slopes of the channel banks. The 24-inch layer of modified rip-rap extends up the channel banks to the elevation of the 10 year flood. The rip-rap channel lining has been designed to withstand the erosive forces anticipated in the stream channel following completion of the construction project.
- The area of the underground oil/water separator will be provided with a composite cap (refer to Drawing 2-4 and Figure 2-8). The composite cap will consist of a 40-mil flexible membrane liner, a geotextile drainage layer, 30-inches of granular backfill, and a 6-inch loam and seed layer.
- In addition to the above, the wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of granular fill, and 12-inches of wetland soil. The wetland will be planted with native wetland plants (refer to Drawing 2-4 and Figure 2-9).

In response to a request by the Department of Environmental Protection (DEP) staff, the Willow Brook stream channel will be slightly modified between the dam that impounds Willow Brook Pond and Main Street to reduce the slope of the banks to control potential erosion and to modify the character of the channel bottom to create a low flow channel with pools and eddies. The limits of these improvements are shown on Drawing 2-5.

2.3.5 Site Restoration

Following the completion of the excavation and offsite disposal of contaminated soil and sediment, all areas disturbed by construction will be restored. The restoration of the waterway and wetland were previously described. It is anticipated that restoration activities for area outside the waterway and wetland will consist of the installation of paved parking areas or grassed areas. Planned final site restoration is presented in Drawing 2-4.

The future site use options may consist of the following:

- Additional automobile and/or truck parking; and
- Relocation/rerouting of Willow Street to the northern portion of the property as indicated on Figure 2-10.

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) an Environmental Land Use Restriction to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 2-5 and Drawing 2-4).

In the event that redevelopment of this area involves a bike path or roadway, the area directly beneath those uses will be remediated to a total PCB concentration of less than the Residential Direct Exposure Criteria. A release of the Environmental Land Use Restriction by the Commissioner of the Department of Environmental Protection would be necessary before any redevelopment activities are initiated. Such release would necessitate the preparation of a detailed remediation and restoration plan, which would be consistent with the future proposed use of the subject area or part thereof. Furthermore, appropriate barriers (i.e. fencing or railings) would be installed between the capped areas and the areas remediated to a concentration less than the Residential Direct Exposure Criteria.

2.3.6 Record Keeping and Reporting

The following records will be maintained during construction to document the remedial activities:

1. The delineation of the final horizontal and vertical limits of the soil and sediment removal activities;
2. A photographic record of construction progress;
3. Records of all quality assurance/quality control (QA/QC) testing performed;
4. A record of all field screening and confirmatory sampling and analytical results, including sampling methods, locations and depths, frequency, and analytical results;
5. Results of all waste disposal characterization samples of excavated materials;
6. Results of all samples of treated effluent from the temporary on-site wastewater treatment system;
7. A record of all daily activities; quantities of materials removed, generated, used, and disposed of; and document manpower, material, and equipment used;
8. A record of all materials and equipment delivered to the site; and
9. Copies of all hazardous waste manifests, non-hazardous waste bills of lading, and certificates of disposal for wastes generated during the project.

2.4 Post-Construction Activities

The following is a general description of the post-construction activities. It is anticipated that the post construction activities will include the preparation of a report documenting the remediation of the site and the implementation of a post-remediation groundwater monitoring program.

2.4.1 Post-Remediation Reports

A post remediation report will be prepared for submission to the appropriate regulatory agencies. The report will contain a detailed description of remediation activities, confirmatory samples, offsite disposal documentation, appropriate figures and drawings, and analytical data tables presenting results of confirmatory samples. The post remediation report will be prepared to provide a full accounting of all activities performed and documentation necessary to support the conclusion that the remedial activities met the objectives of this Remedial Action Work Plan. The report will be submitted to the CTDEP and EPA for review and ultimate approval. A separate report will be generated to satisfy the project closeout reporting requirements of the wetlands restoration efforts. The project closeout report is a likely condition of a permit or approval issued by the Army Corps of Engineers.

2.4.2 Post Remediation Groundwater Monitoring Program

Following completion of remedial activities, it will be necessary to perform post remediation groundwater monitoring of groundwater in the vicinity of Willow Brook and Willow Brook Pond. A Post-Remediation Groundwater Monitoring Program has been developed and submitted to the CTDEP and EPA. The Post-Remediation Groundwater Monitoring Program specifies groundwater monitoring wells to be sampled, field collection and analytical methods, quality assurance/quality control procedures, program duration, and reporting requirements. It is anticipated that post-remediation groundwater monitoring will be performed on a quarterly basis for a period of not less than two years.

3.0 PROJECT SCHEDULE

The anticipated completion dates for major project activities are as follows:

• Permits from US Army Corps of Engineers, CTDEP and East Hartford	June 2001
• Site Remediation Construction Period	December 2001
• Site Restoration/Establishment of Vegetation	June 2002
• Post Remediation Report, filing ELURs and Groundwater Monitoring Plan	June 2002

A detailed project schedule is included as Figure 3-1.

4.0 FIELD SAMPLING AND ANALYSIS PLAN

4.1 Introduction

4.1.1 General

This plan addresses the field procedures, samples to be collected, sample type, sample location and the sample collection methods to be used during implementation of the remedial activities outlined in the RAWP. The Quality Assurance Project plan (QAPP), is presented in Section 5.0.

4.1.2 Objectives of the Sampling and Analysis Plan

The overall objective of the sampling and analysis program is to provide analytical data that verify the achievement of the remediation goals for the site. The sampling program has been developed in consultation with the requirements presented in 40 CFR Part 761 Section 761.61 (c), 40 CFR Part 761 Subpart O, and the documents entitled *Verification of PCB Spill Cleanup By Sampling and Analysis*, EPA August 1985 and *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup*, EPA May 1986. The objective of this risk managed remediation program is to remove PCB-impacted soil exhibiting concentrations in excess of 25 ppm and place a 3-foot cap over the residual contamination areas (i.e., those areas that exhibit PCB concentrations less than 25 ppm). The proposed caps were described in previous sections. The portion of the wetlands to the north of the Willow Brook stream channel will be excavated to a PCB concentration less than the Residential Direct Exposure Criteria. Based on the objectives of the remediation program, the following specific objectives have been established for the sampling and analysis program:

- Confirm that PCB concentrations remaining in soil/sediment at the limits of the excavation are consistent with the Remedial Action (RA) objectives; and
- Determine the handling and disposal requirements for the soil/sediment and miscellaneous materials generated during implementation of the RA.

4.1.3 Overview of the Sampling and Analysis Program

Analytical results associated with samples collected as part of the RA activities will be used to document that the objectives of the RA have been satisfied. Samples that will be collected as part of the RA will consist of the following:

- Post-excavation soil/sediment samples to confirm the successful implementation of the RA and document residual contamination concentrations;
- Post PCB excavation soil sampling to confirm the limits of soil requiring remediation pursuant to the RSR (as a result of other constituent concentrations) in the vicinity of the former oil/water separator and the wetland area;
- Concrete disposal characterization samples;
- Soil/sediment disposal characterization samples for verification of constituent concentrations ; and

- Miscellaneous material samples for the assessment of disposal options and/or treatment performance (e.g., the temporary wastewater treatment system) associated with the implementation of the RA.

The location of the characterization samples performed and PCB isoconcentration contours are shown on Figures 1-2 and 1-3 for Willow Brook and Willow Brook Pond, respectively. The proposed sampling grid for the confirmatory samples to be collected is shown schematically in Figure 4-1. The proposed layout for the confirmatory sampling is presented on Drawing 4-1. In addition, disposal characterization samples will be collected from excavated materials associated with the RA.

4.2 Remedial Action Field Sampling

4.2.1 General

Details associated with implementing the Field Sampling Program (FSP) are presented in this section. The following information concerning the FSP is also provided:

- Proposed sample grid, sample identification numbers, and sample type;
- Procedures for sampling and for measuring field parameters; and
- A summary of the data to be generated from each sampling effort, including field and analytical parameters.

Detailed information regarding the RA field sampling including the number/type of environmental samples and quality control samples to be collected, sample intervals, analytical parameters, sample containers, preservation, and holding times are presented in tables located at the end of this section. A description of these tables is provided below:

Table No.	Title	Contents
4-1	Confirmatory Sample Summary	Presents the sample media, anticipated number of samples to be collected from the excavations, the sampling frequency, anticipated sample depth, and laboratory analytical parameters.
4-2	Quality Control Analyses Summary	Indicates the number and type of quality assurance/quality control (QA/QC) samples, which will be required.
4-3	Sample Containers, Preservation, and Holding Times For Soil/Sediment and Water Samples	Indicates the appropriate sample containers, preservation methods, and holding times for the samples to be collected.

All sampling activities will be performed in accordance with the Loureiro Engineering Associates, Inc. Standard Operating Procedures provided in Appendix B.

4.2.2 Post-Excavation Confirmatory Sampling

Post-excavation confirmatory sampling of soil/sediment will be conducted in the areas to be excavated (Drawing 2-3) to confirm that residual PCB concentrations do not exceed the RA objectives at the limits of the excavations (25 ppm PCBs in all areas to be capped, the Commercial Industrial and GB Pollutant Mobility Criteria in inaccessible soil locations within and immediately adjacent to the process water buildings, and the Residential Direct Exposure Criteria for PCBs in the wetland area to the north of the stream channel). The proposed layout for the confirmatory sampling is presented on Drawing 4-1. Confirmatory soil sampling will be performed throughout the project as necessary to document the adequacy of the remedial measures as proposed.

PCB Confirmatory Soil Sampling – Engineered Control Areas

Post-excavation confirmatory soil/sediment samples for PCBs will be collected from the bottom and sidewalls of the excavated areas which will be located beneath the engineered controls within Willow Brook, Willow Brook Pond, and the oil-water separator area as defined above at a frequency of one sample per 400 square feet, which equates to a 20-foot grid spacing. Grab samples will be obtained within each grid node. A maximum of four grab samples from adjacent grid nodes will be composited into one sample in the field for PCB analysis in the laboratory. This analysis will represent the respective 1,600 +/- square foot area as shown in Figure 4-1.

The grid will be conservatively applied to a two-dimensional diagram of the entire three-dimensional remediation area to maximize the total number of sample locations. The sampling points will proceed in every direction to the extent sufficient to result in a comprehensive two-dimensional grid completely overlaying the excavation area. Judgmental samples would be added as appropriate based upon field observations and as needed to adequately represent the sidewalls (where present) and floor area of each remediation area. Based on the available analytical data and related proposed limits of the remedial excavation, Drawing 4-1 (Potential Confirmatory Sample Locations) was prepared to demonstrate the expected layout of the grid with additional judgmental samples spotted as appropriate.

Evaluation of the composite data for PCBs would be based upon a direct comparison of the sample data to the 1 ppm and 25 ppm criteria. More specifically, any result for a composite sample below 1 ppm in a 1-ppm target area located beneath an engineered control and 25 ppm in a 25-ppm target area located beneath the engineered control would result in the conclusion that remediation in those areas has been completed.

PCB Confirmatory Soil Sampling – Non-Engineered Control Areas

Non-engineered control areas within the limits of the project include the wetland west of the dam, the footprint of the process water facility and ancillary structures to the process water facility, and the single area east of the eastern limits of the upper section of Willow Brook Pond (the vicinity of WT-SB-132). Post-excavation confirmatory soil/sediment grab samples for PCBs will be collected from the bottom and sidewalls of these excavated areas as shown in Drawing 4-1. The data from the individual grab samples will be evaluated pursuant to the RSR to confirm the completion of remediation in these areas.

Confirmatory Soil Sampling for Constituents Other than PCBs

As defined by the available analytical data, there are other constituents of concern that are noted in soil and sediment within the project area. These other constituents include metals, VOCs, SVOCs, TPH and

cyanide. The remediation is designed to address these constituents as well as PCBs. Remediation of other constituents of concern found in the remediation areas will be completed in accordance with the RSR. In addition, an engineered control (EC) will be installed within the limits of the project area (with the exception of the wetland area which will be remediated to less than the Residential Direct Exposure Criteria for PCBs, a small area in the vicinity of WT-SB-132, and the footprint of the process water facility which will be remediated in accordance with the Commercial/Industrial Direct Exposure Criteria and in excess of the GB Pollutant Mobility Criteria that are located above the seasonal high water table as previously described) in accordance with the variance provision in the RSR thereby allowing soils exceeding the tabular criteria to be left in place.

As discussed earlier in this section, two specific areas of the site will need to be evaluated for PCBs as well as other constituents of concern, i.e. in the vicinity of the former oil/water separator and within the wetland area. In order to document the adequacy of the lateral extent of the remediation within the wetland area, soil grab samples will be obtained from the sidewalls of the excavations at varying depths of not less than 1-sample per 3-vertical feet every 20-feet (e.g. a 5- foot deep excavation that has a 60-foot long sidewall would have 3- sidewall samples at 2-feet below original grade and 2-sidewall samples at 4-feet below original grade at alternating depths on 10-foot centers). This sampling pattern will be enhanced with judgmental samples as needed based on field observations. This pattern would be implemented on the northern, eastern and western sidewalls of the wetland remediation area. Since the wetland area will be restored without a cap, floor sampling for constituents of concern other than PCBs will be necessary. Floor sampling will be accomplished by obtaining one grab sample at the center point of the four adjacent grid nodes defined for PCB sampling. This analysis will represent the respective 1,600 +/- square foot area as shown in Figure 4-1.

For the oil/water separator area, the excavation will proceed until the results of the previously described PCB confirmatory sampling verify removal of all soil and sediment containing greater than 25 ppm PCBs. The limits of the composite cap to be installed over this area will be defined through additional soil sampling and analysis discussed in Section 2.0. The initial sampling locations are shown on Drawing 4-1. Additional soil borings would be added, as necessary, to delineate the three-dimensional extent of soils impacted by constituents other than PCBs (i.e. metals, cyanide, VOCs, SVOCs, and TPH). It is anticipated that soils requiring remediation for constituents other than PCBs extends beyond the lateral limits of soil impacted by greater than 25 ppm PCBs. As a result, following excavation of soils greater than 25 ppm PCBs, soils from the upper three-feet outside the lateral limits of the PCB excavation, but within the limits defined as requiring remediation for other constituents pursuant to the RSRs, will be stripped and used to backfill the PCB excavation. Confirmatory sidewall grab sampling as described above will be implemented to ensure all soils requiring remediation pursuant to the RSR will be located beneath the composite cap.

The analytical data derived from these analyses for other constituents would be compared to the appropriate criteria presented in the RSR. As noted above, exceedances would be addressed by extension of the cap or further remediation, as appropriate.

Sample Collection

Procedures for collecting post-excavation PCB confirmatory soil/sediment samples are presented as follows:

- Soil/sediment will be collected from each of the discrete sampling locations through the use of a calibrated disposable syringe. One syringe will be used for each composite sample. The individual grab samples will be used to form a single composite sample in the field.
- The aliquots will be composited and mixed thoroughly in the laboratory-supplied glassware.
- At the laboratory, a final sample, of sufficient weight and volume will be collected from the composite, dried at low temperature or in a desiccator at ambient temperature, extracted and analyzed to represent the post-excavated confirmatory soil/sediment sample.
- A second portion of the sample will be weighed out at the same time as the portion to be used for analytical determination. This portion will be weighed, oven-dried and used to calculate the percent dry weight of the sample. The oven-dried aliquot will not be extracted or used for analytical determination.

Procedures for collecting vertical and lateral limit confirmatory soil samples (constituents other than PCBs) are presented as follows:

- Soil will be collected from each of the discrete sampling locations. The individual grab samples will not be used to form a composite sample.
- A sample, of sufficient weight and volume will be obtained from the sample container, extracted and analyzed to represent the post-excavated confirmatory soil present.
- Samples for VOC analysis will be collected in accordance with SW-846 Method 5035.
- A second portion of the sample will be weighed out at the same time as the portion to be used for analytical determination. This portion will be weighed, oven-dried and used to calculate the percent dry weight of the sample. The oven-dried aliquot will not be extracted or used for analytical determination.

Soil/sediment samples shall be collected using disposable sampling equipment or decontaminated spatulas, split-spoon samplers, augers or an equivalent. All disposable components of a sampling device will be disposed of prior to sample collection and all fixed components of a sampling device will be decontaminated prior to sample collection. The materials and procedures to collect post-excavation confirmatory soil/sediment samples are presented below.

- Appropriate health and safety equipment;
- Plastic sheeting;
- Tape measure (50 feet or greater);
- Appropriate soil sample containers;
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- Field forms and labels;
- Chain-of-custody forms; and
- Site map with post-excavation confirmatory soil/sediment locations.

Each component of the sampling device will be decontaminated or replaced with a new, dedicated, or disposable component prior to collecting soil/sediment samples for laboratory analysis. The sampling equipment will be decontaminated as previously discussed.

A portion of each confirmatory soil sample will be used for visual characterization. In addition, field analysis will be conducted to determine if PCB concentrations are above or below the RA objective of 25 ppm. The field analysis will be performed using screening tests, as for example, rapid immunoassay

screen test kits. The PCB field test kits are a semi-quantitative screening method that determines whether the total PCB concentration is above or below the specified threshold values by comparison with a standard. Rapid immunoassay screen tests will not be used to determine final compliance with the RA objectives, rather they will be used as a means to direct the need for further excavation prior to embarking on final confirmatory sampling and analysis at a fixed laboratory in accordance with the procedures outlined above. The manufacturer will provide standard operating procedures for PCB field test kits. Final confirmatory samples will be submitted to the laboratory for analysis for PCBs (USEPA SW-846 Method 8082A revised Jan. 1998).

QA/QC soil/sediment samples will also be collected as described in Section 4.5.2 and in the QAPP presented in Section 5.0. Trip blanks, equipment blanks, duplicate samples and performance evaluation samples will be submitted for analysis. Table 4-1 presents the number of soil/sediment samples to be collected, and Table 4-2 presents the associated QA/QC soil sampling frequencies. Samples will be placed in appropriate laboratory supplied sample containers, preserved as described in Section 4.4.1, and labeled as described in Section 4.4.2. The samples will be handled, packaged, and shipped under appropriate chain-of-custody procedures as presented in Section 4.4.3.

4.2.3 Disposal Characterization Sampling

Contaminated soil and sediment will be characterized for disposal based on the "as-found" concentration of PCBs in accordance with 40 CFR 761.61. This data will establish the basis for segregation within the staging areas. Additional analysis will be performed on stockpile grab samples as needed to satisfy the disposal vendor. Additional analytes beyond PCBs will include metals, VOCs, SVOCs, TPH, or cyanide as appropriate for thorough characterization. The waste will be disposed of based upon the more restrictive analytical data regardless of the as-found concentrations (e.g. if in-situ characterization documents < 50 ppm PCBs and the stockpile data suggests > 50 ppm, the waste disposal profile used for this particular load would be based on the stockpile data). Stockpile analytical data would not be used to reduce any disposal restrictions on the material.

A minimum of two and a maximum of four separate waste streams are expected. The minimum two waste streams are PCB remediation waste (PCBs > 50 mg/kg) and PCB contaminated waste (PCBs < 50 mg/kg). The additional two waste streams would include the above minimum two but with the addition of other underlying hazardous constituents. Supplemental analysis (for PCBs as well as other constituents of concern) will be performed for disposal vendor satisfaction and for disposal characterization of the concrete debris from demolition of the process water facility and the former oil/water separator. Supplemental analysis for disposal vendor satisfaction will be performed from stockpile grab samples using a random node sampling technique. Disposal characterization sampling of concrete debris will be performed at a rate of approximately 1 sample per 500 tons of concrete debris or at a more frequent rate as directed by the disposal vendor.

4.2.4 Miscellaneous Sampling

In addition to the sampling activities described above, additional sampling may be performed to determine handling and disposal requirements. These samples may include effluent samples from the temporary wastewater treatment system and debris from the demolition of the existing process water facility. A description of the sampling and analysis to be conducted for each of these materials is presented below.

Effluent Samples from the Temporary Wastewater Treatment System

Surface water or groundwater that enters the active remedial excavations and water generated from soil/sediment dewatering activities will be pumped to on-site storage tanks and treated on site at a temporary wastewater treatment system. During normal operation of the temporary wastewater treatment system, effluent samples will be collected and analyzed for specific parameters as required by the discharge permit. Effluent samples will be collected and analyzed in accordance to the frequency specified by the permit to confirm that discharge permit limits are achieved.

Demolition of the Existing Water Process Facility

As part of the RA, the existing process water facility will be demolished. Further evaluation of the building system and building components will be performed to determine disposal requirements; these requirements will be reviewed in the RD.

4.3 Sample Designation System

4.3.1 Sample Codes

A six-digit designation code and sample date will provide each sample with a unique sample identification number. This alphanumeric system will apply to all samples collected and submitted to the designated laboratory for analysis. The designation codes that will be used for the samples collected, as part of the RA, are presented below:

Sample Type	Sample Location Designation
Confirmatory Soil/Sediment Samples	• A prefix indicating that the sample was collected in the Waste Treatment area (WT-) • A designation (CS) indicating that the sample is a confirmatory sample; • A consecutive number indicating the sample collected.
Disposal Characterization Soil/Sediment Sample	• A prefix indicating that the sample was collected in the Waste Treatment area (WT-) • A designation (DC-) indicating that the sample is a disposal characterization sample; • A consecutive number indicating the sample collected.
Temporary Wastewater Treatment System Effluent Samples	• A prefix indicating that the sample was collected in the Waste Treatment area (WT-) • Samples of the effluent water from the treatment system will contain a the designation (EW) followed by a consecutive sample number.

Blind sample numbers will be assigned to the samples submitted to the laboratory for QA/QC purposes. The blind sample numbers will be associated with the sample location designations only in the field forms.

4.4 Sample Handling and Documentation

4.4.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for samples collected as part of the RA are shown in Table 4-3. The analytical laboratory will supply appropriate sample containers, sample labels, and preservatives.

An example of a sample label, custody seal, field sampling record and chain–of–custody form are included in Figures 4-2 through 4-5, respectively.

4.4.2 Packing, Handling, and Shipping Requirements

Sample custody seals and packing materials for filled sample containers will also be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler with ice and packed to eliminate the possibility of container breakage.

All samples will be packaged by the field personnel and transported as low concentration environmental samples. The packaged samples will be shipped either by carrier or hand delivered to the laboratory within 36 hours of sample collection.

4.4.3 Documentation

Field personnel will provide documentation for all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes a record, which allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the fieldwork will be retained in the project file.

Various forms of documentation to be maintained throughout the RA include:

- Daily Production Documentation – Daily field forms containing a record of all field sampling activities.
- Sampling Information – Detailed notes will be made concerning the sample location, physical observations, sample depths, and weather conditions.
- Chain-of-Custody – Chain-of-custody forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Chain-of-custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by one of the field personnel designated to be responsible for sample custody.
- Field Equipment Calibration, and Maintenance Logs – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment.

4.4.4 Electronic Database

All data including field and analytical data collected will be maintained in a site-specific electronic database. The database already contains all characterization data obtained during the Willow Brook and Willow Brook Pond investigations to date. All data entered in the database will be verified for accuracy.

4.5 Management of Sampling-Related Materials and Wastes

The handling of sampling related materials and wastes is discussed below.

4.5.1 Disposable Equipment and Debris

Disposable equipment and debris, such as health and safety equipment, plastic sheeting, sampling equipment, and other equipment and/or sampling debris not reused during the RA will be collected in plastic bags during sampling and disposed of as bulk PCB remediation waste and would be included in the soil loads in accordance with the miscellaneous H&S waste provisions permitted under a standard disposal profile.

4.5.2 Decontamination Rinsate

Decontamination rinsate (< 50 mg/kg PCB) will be containerized at a controlled, centralized location in an appropriate temporary storage container or in labeled 55-gallon drums. Upon completion of the field sampling activities, the rinsate will be treated to comply with the maximum allowable concentrations stipulated in the General Permit for the Discharge of Groundwater Remediation Wastewater prior to discharge to the sanitary sewer..

4.6 Field Quality Assurance/Quality Control

This section summarizes the Quality Assurance/Quality Control (QA/QC) requirements for sampling activities associated with the RA at the site.

4.6.1 Field Instrument Calibration and Preventative Maintenance

Field personnel will document the calibration and maintenance of all applicable field equipment in the appropriate field forms.

4.6.2 QA/QC Sample Collection

QA/QC samples will be collected at a frequency of one every 20 samples and submitted to the laboratory for analysis. The number of QA/QC field samples to be collected is provided in Table 4-2. The type of QA/QC samples to be collected during the RA includes trip blanks, equipment blanks, duplicate samples, aqueous performance evaluation (PE) samples, and matrix spike/matrix spike duplicate (MS/MSD) samples. Guidance on the collection of the QA/QC samples is presented below:

Trip Blanks

Trip blanks will be collected at a frequency of one every 20 samples or one per cooler per day to ensure that the samples are not contaminated by VOCs while in transit to the laboratory. The equipment blanks will be prepared by the laboratory and delivered along with the sample glassware. No trip blanks will be collected in sample batches that do not include analysis for VOCs.

Equipment Blanks

Equipment blanks are collected as a check that the decontamination procedure has been adequately performed and that cross-contamination of samples will not occur due to the sampling equipment. Equipment blanks will be prepared in the field by pouring laboratory supplied analyte-free water into or over decontaminated sampling equipment and then directly into the laboratory supplied sample bottles. One equipment blank will be collected for each representative type of equipment used (i.e., spoons, bowls, split-spoon sampler, etc.) for every 20 samples collected and/or at a minimum of once per week.

Duplicate Samples

Duplicate samples will be sent for laboratory analysis to evaluate the reproducibility of the sampling technique used. Duplicate samples will be collected at a frequency of one every 20 samples collected.

Performance Evaluation Samples

Performance evaluation samples will be sent for laboratory analysis to ensure that environmental data collection results in the delivery of analytical data of known and documented quality, suitable for its use. Aqueous PE samples for each suite of analytes (PCBs, metals, VOCs, SVOCs, TPH, and cyanide as applicable) will be collected at a frequency of one every 20 samples collected. The analytical results of the PE samples will be evaluated following USEPA Region I Performance Evaluation Sample Guidance – Attachment H, July 1996. The PE samples will be counted as field samples in the 20-sample SDG total.

5.0 QUALITY ASSURANCE PROJECT PLAN

5.1 Introduction

5.1.1 General

This Quality Assurance Project Plan (QAPP) has been prepared in accordance with the USEPA referenced document SW-846 and presents analytical methods and procedures which will be used during implementation of the Remedial Action (RA0, as outlined in the Remedial Action Work Plan, (RAWP).

5.1.2 Objectives of the Quality Assurance Project Plan

The objective of the QAPP is to present the quality assurance/quality control (QA/QC) procedures to be implemented during the RA. The QAPP ensures that the data generated is of sufficient quality and quantity to allow confirmation that the RA objectives for the site are achieved. The sampling objectives of the QAPP are as follows:

- Confirm that residual PCB soil/sediment concentrations (at the horizontal and vertical limits of the excavation) satisfy the objectives of the RA;
- Determine handling and disposal requirements for the soil/sediments generated during the RA; and,
- Determine handling and disposal requirements for the miscellaneous materials generated during the RA.

5.1.3 Remedial Action Data Quality Objectives

To obtain data necessary to meet the objectives previously stated, the following categories of field sampling will be conducted as part of the RA:

- Post-excavation confirmatory soil/sediment samples to confirm the successful implementation of the RA and document residual contamination concentrations.
- Soil/sediment disposal characterization samples for assessment of disposal options; and
- Miscellaneous material samples for the assessment of disposal options and/or treatment performance (e.g., the temporary wastewater treatment system) associated with the implementation of the RA.

Preliminary Data Quality Objectives (DQOs) were identified to ensure that the data generated during field sampling will be of adequate quality and sufficient quantity to form a sound basis for decision making purposes relative to the above objectives. DQOs have been specified for each data collection activity.

DQO summaries for the RA activities are presented in the following section. The summary consists of stated DQOs relative to the following items:

- Data Uses;
- Data Types;
- Data Quality;
- Data Quantity;

- Sampling and Analytical Methods; and
- Data Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters (PARCC Parameters).

The categories of analytical data discussed in the following sections with regard to data quality are defined as follows:

Screening Data: Screening data will be used to provide a quick assessment of site characteristics or conditions. This objective for data quality is available for data collection activities that involve rapid, non-rigorous methods of analysis and quality assurance. This includes field measurements such as immunoassay test kit results. This data will be reviewed and verified for accuracy and completeness as the field forms are processed by the LEA task manager.

Disposal Characterization Data: This includes all disposal characterization data, debris sampling and routine wastewater sampling prior to discharge. This data will be generated by a state-certified laboratory using EPA-approved analytical methods. The data will be reviewed for accuracy and data verification will be performed. This data will also be entered in the site-specific database. No data validation will be performed.

Confirmatory Data: Confirmatory data will be generated from a state-certified analytical laboratory using EPA-approved analytical methods. The data will reviewed for accuracy and data verification will be performed. A Tier II data validation will be performed on the confirmatory data obtained in accordance with EPA Region I data validation guidelines. This data will also be entered in the site-specific database.

5.1.4 Post-Excavation Confirmatory Soil/Sediment Sampling

Data Uses

Post-excavation confirmatory soil/sediment sampling will be conducted to confirm that residual concentrations of PCBs, metals, VOCs, SVOCs, TPH, and cyanide (if applicable) present at the limits of excavations in the excavated areas are below the RA objectives.

Data Types

Confirmatory soil/sediment sampling will include the collection and analysis of samples for PCBs, metals, VOCs, SVOCs, TPH, and cyanide (if applicable). Table 4-1of the QAPP presents the anticipated number of confirmatory soil/sediment samples to be collected and the laboratory analysis to be performed. Visual observation, and field screening of soil/sediment samples using PCB immunoassay field test kits will also be conducted to select soil/sediment samples for laboratory analysis.

Data Quality

Sample analysis for PCBs metals, VOCs, SVOCs, and cyanide (if applicable) will be conducted in accordance with the methods referenced in the USEPA document SW-846. TPH analysis will be conducted in accordance with "*Analysis of Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection* (ERI, 1999). Alternatively, if requested by EPA, TPH analysis will be conducted by SW-846 Method 418.1 The final determination of the TPH method will occur after consultation with EPA and DEP and prior to commencement of work. In

addition, field screening of soil/sediment samples will be performed using PCB immunoassay field test kits in accordance with the Standard Operating Procedures (SOPs) have been provided by the manufacturer and are included in Appendix B. The results will be presented using a Tier II laboratory data quality package and final electronic deliverables.

QA/QC samples will be performed for the confirmatory soil/sediment samples collected. No QA/QC samples will be performed for the screening immunoassay data. The number and type of QA/QC soil/sediment samples to be analyzed are summarized in Table 4-2.

Data Quantity

The location, number and type of analysis of post-excavation confirmatory soil/sediment samples to be analyzed from the excavation area will be determined based on a 20-ft grid as discussed in the previous section. The samples collected will be analyzed for PCBs, metals, VOCs, SVOCs, and cyanide in select areas.

Sampling and Analysis Methods

The Field Sampling Plan contains a description of the post-excavation confirmatory, disposal characterization and additional miscellaneous sampling procedures to be employed during the RA. The recommended project-specific laboratory analytical methods and reporting limits are listed in Table 5-1 of this QAPP. The final project-specific laboratory analytical methods and reporting limits will be supplied by the selected analytical laboratory prior to commencing work.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Recommended precision and accuracy quality control limits for chemical constituents that are used during data review to assess analytical performance, are included in Tables 5-2 and 5-3. Final precision and accuracy quality control limits will be generated by the selected analytical laboratory though internal control limits. These limits will be provided to LEA prior to commencing work. Data comparability will be achieved through the use of standard CTDEP/USEPA approved methods. Data completeness will be assessed at the conclusion of the RA.

5.1.5 Disposal Characterization Sampling

Data Uses

Disposal characterization sampling will be conducted to determine handling requirements for soil/sediment excavated during the RA.

Data Type

The disposal characterization sampling will include the collection of soil/sediment samples for field screening for PCBs using an immunoassay field test kit.

Data Quality

Laboratory analysis for PCBs will be performed in accordance with the methods referenced in USEPA SW 846. The results will be presented using a standard laboratory report format and final electronic deliverables. Field screening of soil/sediment samples may be performed using field test kits in accordance with SOPs provided by the manufacturer.

Data Quantity

Typically, one composite disposal characterization sample will be collected for every 500 CY of soil/sediment removed from a RA excavation area as directed by LEA. LEA may elect to perform disposal characterization sampling at an alternate frequency based on review of previous investigation data to aid in the evaluation of disposal options. QA/QC disposal characterization samples will not be submitted for laboratory analysis.

Sampling and Analytical Methods

The Field Sampling Plan presents a description of the disposal characterization soil/sediment sampling procedures to be employed during the RA. The recommended laboratory methods to be utilized are presented on Table 5-1 of this QAPP. Final laboratory methods to be utilized will be provided by the selected analytical laboratory prior to commencing work.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits for chemical constituents analyzed as part of the characterization sampling will not undergo data review. Data comparability will be achieved through the use of standard CTDEP/USEPA approved methods. Data completeness will be assessed at the conclusion of the RA.

5.1.6 Miscellaneous Sampling

Data Uses

Miscellaneous sampling will be conducted to generate data to determine handling requirements for the following material, which will be generated during implementation of the RA:

- Effluent from the temporary wastewater treatment system; and
- Building components from demolition of the existing on-site process water facility.

Data Types

The miscellaneous sampling will include the collection and analysis of samples for laboratory analysis as described below:

- Surface water and/or groundwater which enters the active excavation area and water generated from soil/sediment dewatering activities (as applicable) will be pumped to an on-site temporary wastewater treatment system. Effluent samples from the temporary wastewater treatment system will be submitted for laboratory analysis, as described below, to confirm that limits for discharge to the local sanitary sewer system are achieved.
- Samples of identified existing process water facility components will be submitted for laboratory analysis to determine disposal requirements during the demolition process.

Data Quality

Sample analysis for miscellaneous samples will be conducted in accordance with USEPA standard methods. TPH analysis will be conducted in accordance with "*Analysis of Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection* (ERI, 1999). Alternatively, if requested by EPA, TPH analysis will be conducted by SW-846 Method 418.1 The final determination of the TPH method will occur after consultation with EPA and DEP and prior to commencement of work. Results for the miscellaneous samples will be presented in a standard laboratory report.

Data Quantity

The number of miscellaneous samples to be collected as part of the RA is presented below:

- Samples of the effluent water from the temporary on-site wastewater treatment system will be submitted based upon the requirements of the discharge permit; and

- The number of samples from the demolition of the process water facility will be determined during the RA effort.

Sampling and Analytical Methods

Field instruments used during the program will be calibrated daily to confirm appropriate analyses, as applicable. A summary of potential field equipment and calibration data is included in Table 5-4. Samples of building components will be submitted for laboratory analysis for PCBs, metals, VOCs, SVOCs, TPH, and other analytes as required by disposal vendors using EPA-approved methods. Samples effluent from the temporary water treatment system will be analyzed for those parameters specified in the discharge authorization.

Precision And Accuracy Quality Control Limits (PARCC) Parameters

Precision and accuracy quality control limits will not be reviewed for miscellaneous samples submitted for laboratory analysis as part of the RA.

Data representativeness is addressed by the sample quantities and/or locations identified in the Field Sampling Plan. Data comparability will be achieved through the use of standard USEPA/CTDEP approved methods. Data completeness will be assessed at the conclusion of the RA.

5.2 Project Organization and Responsibilities

5.2.1 Project Organization

The RA will require integration of personnel from the organizations identified below, referred to as the project team. A detailed description of the responsibilities of each members of the project team is presented below.

5.2.2 Overall Project Management

LEA, on behalf of UTC/P&W, has overall responsibility for the RA at the site. LEA will perform the confirmatory soil/sediment sampling, disposal characterization sampling and miscellaneous sampling described in the Field Sampling Plan. In addition, LEA will be responsible for evaluating resultant sampling data and preparing required data submittals. UTC/P&W will provide project direction and oversight.

5.2.3 Team Member Responsibilities

This section of the QAPP discusses the responsibilities and duties of the project team members.

UTC/P&W

UTC/P&W Project Manager responsibilities and duties include:

- Overall direction of the RA;
- Direction of LEA; and
- Review of LEA work products, including data, memoranda, letters, reports, and all documents transmitted to the USEPA and CTDEP.
- Assure corrective actions are taken for deficiencies cited during audits of sampling/analytical activities.

LEA

LEA's responsibilities and duties include:

- Oversight of remedial work activities and products; and
- Coordination with UTC/P&W, USEPA and CTDEP.

More specifically, LEA personnel will have the following responsibilities:

LEA Project Manager

Responsibilities and duties include:

- Management and coordination of all aspects of the project as defined in the RAWP with an emphasis on adhering to the objectives of the RA; and
- Coordination of office and field activities with P&W/UTC.

LEA Task Manager

Task Manager (Project Engineer/Geologist), as set forth in Section 5.2.3 will manage the ongoing sampling and analysis activities associated with the RA. Responsibilities and duties of each Task Manager include:

- Manage day to day remedial sampling activities;
- Develop, establish, and maintain files on remedial sampling activities;
- Review data from the remedial sampling activities;
- Assure corrective actions are taken for deficiencies cited during audits of remedial sampling activities;

- Overall QA/QC of the portions of the RA;
- Review all field records and logs;
- Instruct personnel working on remedial sampling activities;
- Coordinate field and laboratory schedules pertaining to remedial sampling activities;
- Ensure in coordination with the Quality Assurance Manager the preparation of QA/QC samples including performance evaluation samples;
- Request sample bottles from the laboratory;
- Review the field instrumentation, maintenance, and calibration to meet quality objectives;
- Prepare sections of reports pertaining to relevant RA; and
- Maintain field and laboratory files of field forms and logs, data reductions and calculations.

LEA Field Sampling Personnel

The field sampling personnel's responsibilities and duties include:

- Prepare sample labels and field paperwork
- Perform field procedures associated with the collection of samples as set forth in the FSP;
- Perform field analyses and collect QA samples;
- Calibrate, operate, and maintain field instrumentation equipment;
- Reduce field data;
- Maintain sample custody; and
- Complete field records and logs and provide copies to the LEA Task Manager.

Quality Assurance Manager (QAM)

The QAM's responsibilities and duties include:

- Review laboratory data packages;
- Coordinate field QA/QC activities with task managers, included audits of sampling activities, concentrating on field analytical measurements and practices to meet data quality objectives;
- Review audit reports; and
- Prepare interim QA/QC compliance reports.
- The QAM will be independent of the unit generating the data.

5.2.4 Analytical Laboratory

Selected Analytical Laboratory

The selected analytical laboratory's general responsibilities and duties include:

- Perform sample analyses and associated laboratory QA/QC procedures;
- Supply sampling containers, shipping packages, and preservatives;
- Maintain laboratory custody of sample; and
- Strictly adhere to all protocols in the QAPP.

Laboratory Project Manager

The Laboratory Project Manager's responsibilities and duties include:

- Serve as primary communication contact between LEA and the laboratory technical staff;
- Monitor work loads and ensure availability of resources;
- Oversee preparation of analytical reports;
- Provide data validation packages as requested, and
- Supervise in house chain-of-custody.

Laboratory Quality Assurance Manager

The Laboratory QAM's responsibilities and duties include:

- Supervise the group which reviews and inspects all project related laboratory activities; and
- Conduct audits of all laboratory activities.

Laboratory Sample Custodian

The Laboratory Sample Custodian's responsibilities and duties include:

- Receive all samples; and
- Maintain custody of the samples and all documentation.

Laboratory Data Reviewer

The Laboratory Data Reviewer's responsibilities and duties include:

- Verify final analytical data prior to transmittal to LEA.

5.3 Quality Assurance Objective for Measurement of Data

5.3.1 General

This section identifies the parameters that will be measured in the field and parameters that will be analyzed in the laboratory as part of the RA sampling. This section also identifies the quality assurance parameters objectives for field measurement/laboratory analysis.

5.3.2 Field Parameters and Methods

Selected soil/sediment samples collected during the RA may be screened using PCB field test kits.

5.3.4 Laboratory Parameters and Methods

As described in the Field Sampling Plan, laboratory analyses will be performed during the RA to determine concentrations of the following:

- PCBs, metals, VOCs, SVOCs, TPH, and cyanide in confirmatory soil/sediment samples;
- PCBs, metals, VOCs, SVOCs, and cyanide in disposal characterization samples; Additional analyses may be performed to satisfy disposal vendor requirements.

- Specific analyses as required by the applicable permit(s) for samples of the effluent water from the temporary on-site wastewater treatment system; and
- Miscellaneous samples to be determined for disposal of demolition debris from the existing process water facility.

QA/QC analyses will be performed for analyses of PCBs, metals, VOCs, SVOCs, and cyanide as set forth on Table 4-2. Table 5-1 presents the recommended reporting limits for each of the analytes. The final reporting limits will be supplied by the selected laboratory prior to commencing work. The reporting limits will be at a concentration consistent with the appropriate criteria of the State of Connecticut Remedial Standard Regulations or lowest appropriate reporting limit for each compound, whichever is lower.

5.3.5 Quality Assurance Objectives

The overall quality assurance objective for the RA sampling and analysis program is to develop and implement procedures for sampling, preservation, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, audits, preventative maintenance, and corrective actions, such that valid data will be generated. The measurement performance criteria will be communicated to the laboratory by the LEA Project Manager in order to ensure that the data users' quality objectives are linked to verifiable measurement performance criteria. These procedures are presented in the following sections of the QAPP. Specific QC checks are also discussed in the following sections.

Quality assurance objective are generally defined in terms of five parameters:

- Representativeness;
- Comparability;
- Completeness;
- Precision; and
- Accuracy.

Each of the parameters mentioned above are discussed below. Specific objectives for the RA sampling and analysis program are set forth in other sections of this QAPP.

5.3.6 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represents site conditions, and is dependent on sampling and the variability of environmental media at the site. The sampling program has been designed to assess the presence of the chemical constituents at the time of sampling. The FSP presents the rationale for sample quantities and location. The FSP and this QAPP presents field sampling methodologies and laboratory analytical methodologies, respectively.

5.3.7 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability throughout the RA will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP and the FSP through the use of established QA/QC procedures, and the utilization of appropriately trained personnel.

5.3.8 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results, as discussed in Section 5.11 of this QAPP.

5.3.9 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objective of the SAP. To maximize precision, specific sampling and analytical procedures will be followed. All sampling and analysis work for this RA will adhere to the established protocols presented in the QAPP and Field Sampling Plan. Checks for analytical precision may include the analysis of matrix spike, matrix spike duplicates, laboratory duplicates and field duplicates. Checks for field measurement precision may include obtaining duplicate field measurements.

5.3.10 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments (see Table 5-). In addition, reference standards, matrix spikes, blank spikes, and surrogate standards may be used to assess the accuracy of the analytical data.

5.4 Sampling Procedures

Post-excavation confirmatory soil/sediment samples, disposal characterization samples and miscellaneous samples will be collected as described in the FSP. In the event of a variance in the field sampling procedures, a case narrative will be included in the field notes. The narrative will describe the nature of the variance in procedure, the reason for the variance, any effect the action may have on the data, and any corrective action taken. The LEA Project Manager will be notified immediately of any variance taken in field and/or laboratory procedures.

Sample containers will be ordered from the laboratory to ensure a sufficient number are in inventory at least 3 days prior to sampling. The number of containers will be in excess of the expected number of samples collected to prevent a shortage due to breakage. Chain-of-custody forms and custody seals (if necessary) will be kept in inventory in a similar manner.

5.5 Sample and Document Custody

5.5.1 General

This section identifies the field and laboratory procedures for the handling and documentation of samples collected as part of the RA. The field and laboratory sample handling and documentation procedures are presented below.

5.5.2 Field Procedures

The objective of field procedures for sample custody is to assure that samples are not tampered with from the time of sample collection through time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so the samples cannot be tampered with.

5.5.3 Laboratory Procedures

This subsection presents information related to laboratory sample custody, sample receipt and storage, sample analysis, laboratory documentation, and laboratory project files.

Sample Custody

Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of custody form will accompany samples requiring laboratory analysis. Samples will be kept secured in the laboratory until all stages of analysis are complete.

Sample Receipt and Storage

Immediately upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, and compare the contents against the field chain of custody and sign as recipient. If a sample container is received broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, LEA will be notified. The laboratory sample custodian will be responsible for logging in the samples, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis.

Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets, which contain all pertinent information for analysis. The analyst will sign and date the laboratory chain of custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. A SDG may contain up to 20 field samples (field duplicates, performance evaluation samples, trip blanks, and equipment blanks are considered field samples for the purposes SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of five calendar days (less, when five-day holding times for extraction must be met), and must be processed through the laboratory (preparation, analysis and reporting) as a group. Every SDG will include a minimum of one site-specific matrix spike/matrix spike duplicate (MS/MSD or MS/Dup) pair, which shall be received by the laboratory as part of the SDG assignment.

Each SDG will be self-contained for all of the required quality control samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will ensure that the quality control samples for an SDG are applicable to the field samples of the same SDG, and that the best possible comparisons may be made.

In case of a failure in the analytical system, the laboratory will be responsible for the necessary corrective action as described by the laboratory SOP or the analytical method. Any questionable laboratory data

will be subjected to data validation as described in Region I, EPA-New England Data Validation Functional Guidelines For Evaluating Environmental Analyses, Rev. December 1996. As noted above, data validation packages will be requested for all confirmatory sampling data.

In the event of a variance in the laboratory analysis procedures, a case narrative will be included in the laboratory data package. The narrative will describe the nature of the variance in procedure, the reason for the variance, any effect the action may have on the data, and any corrective action taken. The LEA Project Manager will be notified immediately of any variance taken in field and/or laboratory procedures.

Laboratory Project Files

The laboratory will establish a file for all pertinent analytical data generated during the RA. The file will include the chain of custody forms, raw data, chromatograms (required for all constituents analyzed by chromatography), and sample preparation information. The laboratory will retain all project files and data packages for a period of five years.

Laboratory Documentation

Workbooks, bench sheets, instrument logbooks, and instrument printouts are used to trace the history of the samples through the analytical process, and document and relate important aspects of the work, including the associated quality controls. As such, all logbooks, bench sheets, instrument logs, and instrument printouts are part of the permanent record of the laboratory.

Each page or entry is dated and initialed by the analyst at the time of entry. Errors in entry are crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by writing directly over the erroneous entry, and initialed and dated by the individual making the correction.

Laboratory notebooks are periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP.

Computer and Hard Copy Storage

Gas Chromatograph/Mass Spectrometry (GC/MS) raw data files are maintained on computer disk for five years, hard copy GC chromatograms are maintained in files for a minimum of five years, or as dictated by the policy of the selected laboratory.

Sample Storage Following Analysis

The laboratory maintains samples for a minimum of one month after the final report is delivered to LEA, or for a duration equal to the sample holding time. After this period, the samples shall be transferred to P&W/UTC for disposal in accordance with applicable rules and regulations.

5.6 Calibration Procedures and Frequency

5.6.1 Field Equipment Maintenance and Calibration Procedures and Frequency

Any field equipment will be thoroughly inspected on a daily basis. Any equipment deficiencies will be noted and remedied prior to leaving for the site. Any equipment found not in good working order will be repaired or replaced as necessary. No equipment shall return to field use unless found to be in good working order after repair. The LEA Equipment Manager will be responsible for assuring replacement equipment is available in case of equipment malfunction. In the event of equipment malfunction, replacement equipment in good working order will be transported to the site.

Any critical spare parts for field equipment will be in stock prior to the start of the project. After the project begins, the inventory of spare parts will be replenished as needed by the Equipment Manager. Specific procedures for performing and documenting calibration and maintenance for the field equipment for total organic vapors are provided in the FSP. Field equipment, frequency of calibration, and calibration standards are provided in Table 5-4. Maintenance will be performed according to the instrument instruction manual. Any critical spare parts for field equipment will be in stock prior to the start of the project. After the project begins, the inventory of spare parts will be replenished as needed by the Equipment Manager.

Calibration standards for the pH meter, conductivity meter, and turbidity meter are purchased as solutions certified by the manufacturer.

5.6.2 Laboratory Equipment Calibration Procedures and Frequency

Instrumentation calibration will follow the specifications provided by the SOPs for the analytical methods used as outlined in USEPA SW846.

5.7 Analytical Procedures

5.7.1 Field Analytical Procedures

Field analytical procedures may include field screening for PCBs using a field test kits. Specific field measurement quality in terms of precision and accuracy are presented in Table 5-5.

5.7.2 Laboratory Analytical Procedures

Specific requirements related to each sample medium to be analyzed and details of the methods to be used for this project are presented in the subsections below. The methods to be include the following:

- Standard USEPA methods will be used for the laboratory analysis of PCB's and the required analyses for the RA material disposal and permit requirements.
- CTDEP approved methods and updates will be used for laboratory analysis where applicable.

The anticipated turnaround times for receipt of analytical results for samples are summarized in the table below.

Sample Type	Turnaround Time
Post-excavation soil/sediment samples	24 hours to 2 weeks
Disposal characterization samples	24 hours to 2 weeks
Effluent samples from wastewater treatment	24 hours to 2 weeks

system	
Water treatment building demolition	1 week to 2 weeks

5.7.3 General Analytical Requirements

The number of environmental and QC samples to be analyzed are summarized in Tables 4.1 and 4-2. The analytical parameters, recommended methods and recommended reporting limits are presented in Table 5-1. Final methods and reporting limits will be provided by the analytical laboratory prior to commencing work.

5.7.4 Remedial Action Sample Matrices

Soil/Sediment, and Solids

Soil/sediment and solids analytical results will be determined on a dry weight analysis as specified in the appropriate sample extraction method. The results will be reported in the units presented in Table 5-1. Moisture content will be reported separately. Recommended QC limits for soil/sediment samples to be analyzed for PCBs, metals, VOCs, SVOCs and cyanide (at select locations) are presented in Table 5-2. The final limits will be established using the selected analytical laboratory's internal control limits.

Water

Water from the temporary wastewater treatment system in this category that will be analyzed. Analytical results for the water analysis will be reported in the units identified in Table 5-1.

Analytical Requirements

The primary sources for methods used to analyze soil/sediment are provided in the USEPA documents. LEA will assess data usability of PCBs. The primary sources for methods used to analyze water samples associated with the on-site temporary wastewater treatment system are provided in 40 CFR 136.

Tables summarizing QC limits required to evaluate analytical performance are provided as follows:

Table	Title
5-2	Soil Analysis Quality Control Limits
5-3	Water Analyses Quality Control Limits

5.8 Data Reduction, Review, and Reporting

After field and laboratory data are obtained, the data will be subject to the following:

- Reduction or manipulation mathematically or otherwise into meaningful and useful forms;
- Review;
- Organization, interpretation, and reporting; and
- External data review.

The subsections below present descriptions of the data reduction, review, and reporting activities that will be conducted in the field and laboratory as part of the RA sampling and analysis program.

5.8.1 Field Data Reduction

Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field forms. The LEA Task Manager will review such data for adherence to the FSP and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and as necessary, incorporated into the data evaluation process. Data reduction will be performed for the confirmatory soil/sediment sampling and the disposal characterization soil sampling associated with determining PCB concentrations using a field test kits.

5.8.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by field personnel and reviewed for accuracy by the LEA Task Manager and the QAM. All logs and documents will be checked for:

- General Completeness;
- Readability;
- Usage of appropriate procedures;
- Appropriate instrument calibration and maintenance;
- Reasonableness in comparison to present and past data collected;
- Correct sample locations; and
- Corrected calculations and interpretations.

5.8.3 Laboratory Data Reduction

The calculations used for data reduction are specified in each of the analytical methods referenced previously. Whenever possible, analytical data is transferred directly from the instrument to a computerized data system. Raw data is entered into permanently bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses (as for example, PCBs, VOCs) are based on response factors. Quantitation is performed using internal or external standards.

5.8.4 Laboratory Data Review

All data will be subject to review by the laboratory. The group leader will review all data reports prior to release for final data report generation. The QAM will review a random sample of a minimum 5 percent of the final data reports, and laboratory director will review a cross-section of the final data reports.

If discrepancies exist in the analytical results, then corrective action is taken as discussed in Section 5.11.

5.8.5 Laboratory Data Reporting

The laboratory is responsible for preparing standard laboratory reports for all samples analyzed.

Data will be tabulated by sample and method, with reference to both field and laboratory identifications. In addition, the laboratory will provide documentation backup (laboratory calculation sheets, chain of custody, etc.)

5.9 Field and Laboratory Quality Control Checks

5.9.1 General

Both field and laboratory quality control checks will be implemented during the RA. If a failure in the established sampling protocol occurs before the sample is collected, the field personnel shall use professional judgment to determine the location of an appropriate replacement sample. This alternative sample location will be documented in the field forms, and the information as to the reason for and location of the alternative sampling will be reported to the LEA Project Manager or designated person. If a failure in the established sampling protocol occurs after sample submission (for example, if part of the complete sample set is found to be inadmissible), the Project Manager will determine the location of replacement samples and collection methodology. The proposed field and laboratory control checks are discussed below.

5.9.2 Field Quality

Field quality control checks will include obtaining duplicate field measurements, using analyte-free water for the preparation of sample blanks, using clean sample containers, collecting duplicate samples, and preparing rinse blanks, as further described in the subsections below.

5.9.3 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field measurements.

5.9.4 Sample Containers

Certified-clean sample containers will be supplied by analytical laboratory. Certificates of analysis will be filed in the project file.

5.9.5 Field Duplicates

Field duplicates will be collected for soil/sediment samples to verify the reproducibility of the sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, soil and soil/sediment sample field duplicates will be analyzed at a frequency of one every 20 samples for chemical constituents. Table 4-2 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix. Acceptable field duplicate precision for soil samples must be less than 50%. Data that do not meet the criteria will be qualified according to USEPA Region I, Data Validation Guidelines, revised December 1996.

5.9.6 Equipment Blanks

Equipment blanks are used to monitor the cleanliness of sampling equipment and the effectiveness of the decontamination procedures. Equipment blanks will be prepared and submitted for analysis at a frequency of one every 20 samples. Equipment blanks will be prepared by filling sample containers with analyte free water, which has been routed through a cleaned sampling device. If dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be required. Table 4-2 provides the estimated number of equipment blanks for environmental samples to be collected. The criterion for equipment blanks is such that no target compound should be present at or above the

laboratory quantitation limit. Data that do not meet the criteria will be qualified using the 5X action rule according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.7 Method Blanks

Sources of contamination in the analytical process, whether specific analytes or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for potential contamination attributable to glassware, reagents, instrumentation, or other sources, which could affect the sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples. The criterion for method blanks is such that no target compound should be present at or above the laboratory quantitation limit. Data that do not meet the criteria will be qualified using the 5X action rule (10X rule for common laboratory contaminants) according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.9.8 Matrix Spike/Matrix Spike Duplicates

MS/MSD will be used to measure the accuracy of organic analyte recovery from sample matrices. All MS/MSD will be site specific. For PCBs, metals, VOCs, SVOCs, and cyanide matrix spike/matrix spike duplicate pairs will be analyzed at a frequency of one every 20 samples.

The percent recovery (%R) and the relative percent difference (RPD) will be evaluated for MS/MSD data and compared with the acceptance criteria as stated in the appropriate EPA analytical method. When MS recoveries and RPDs are outside QC limits, associated MS blank and surrogate recoveries will be evaluated to attempt to verify the reason for deviation and determine the effects on the reported sample results. In addition, the percent relative standard deviation (%RSD) will be calculated for the unspiked sample, the MS and the MSD and will be considered a triplicate in determining overall precision of the analytical method. The unspiked sample results will be qualified according to the to USEPA Region I Data Validation Guidelines, Revisions December 1996 for any data that is outside acceptable control limits. Table 4-2 presents the estimated number of MS/MSD analyses for each applicable matrix and parameter.

5.9.9 Surrogates

Surrogates are compounds, which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by GC/MS and GC methods and is added to the sample prior to extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a spike specific basis.

If surrogate recoveries exceed specified QC limits, then the analytical results need to be evaluated thoroughly in conjunction with other control measures. Recoveries for surrogate compounds in samples, QC samples and blanks must be within the QC acceptance criteria as specified in the appropriate EPA analytical method. Samples with surrogate compounds outside acceptance will be qualified according to USEPA Region I Data Validation Guidelines, Revisions December 1996. Surrogate compounds will be selected utilizing the guidance provided in the analytical methods summarized in Table 5-2.

5.9.10 Calibration Standards

Compliance requirements for initial calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Calibration check standards will be analyzed as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If the results of the calibration check standard exceeds specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be re-analyzed

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the recommended analytical methods summarized in Table 5-1 or other appropriate method defined prior to commencing work. Calibration data will be evaluated based on USEPA Region I Data Validation Guidelines, Revisions December 1996. Data that does not meet acceptance criteria will be qualified accordingly.

5.9.11 Internal Standards

Instrument performance, stability and laboratory precision throughout an analytical sequence is monitored by the addition of internal standard compounds. Internal standard areas and retention times are monitored for organic analysis performed by GC/MS methods. Method specific internal standard compounds are spiked into all field samples, calibration standards and QC samples after preparation and prior to analysis. If the internal standard areas in one or more samples exceed the specified tolerances, then the instrument will be recalibrated and all affected samples reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods summarized in Table 5-1 and other methods deemed appropriate by the selected analytical laboratory prior to commencing work. Sample results with internal standard areas and/or retention time data outside control limits will be qualified based on USEPA Region I Data Validation Guidelines, Revisions December 1996

5.9.12 Reference Standards

Reference standards are standards of known concentration, and independent in origin from the calibration standards. Reference standards, are generally available through the USEPA, the National Bureau of Standards, or are specified in analytical methods. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series.

5.9.13 Performance Evaluation Program

Performance Evaluation Audit

Data for performance evaluation samples will be generated to provide information on the overall accuracy and bias of the analytical method and on laboratory performance. UTC/P&W will conduct a performance evaluation (PE) audit as part of the program following "USEPA Region I Performance Evaluation Program Guidance," July 1996 Revision. Based upon the criteria presented in Attachment H of the USEPA Region 1 PE program guidance document, only aqueous PE samples will be submitted for this program. An overview of the proposed PE audit program is as follows:

- LEA will coordinate PE sample acquisition with the selected vendor prior to initiating the RA program;

- Sample acquisition, handling, and analyses will be in general accordance with USEPA Region 1 guidance criteria; and
- It is estimated that a total of four PE soil samples will be submitted as part of the program.

All samples in a sample delivery group will be validated based upon a comparison between the vendor-certified performance evaluation (PE) results and the laboratory's reported results. PE samples will be evaluated for false negatives, false positives, and inaccurate target compound quantitation. The PE samples provide information on the magnitude and direction of quantitative bias for the laboratory method. Results that are outside the vendor-certified acceptance limits will be qualified according to USEPA Region I Data Validation Guidelines, Revisions December 1996.

5.10 Performance and System Audits

5.10.1 General

This section describes the performance and system audits that will be completed in the field and the laboratory during implementation of RA.

5.10.2 Audits

Field performance and systems audits that will be completed during this project are described in the subsection below. The results of all audits and reviews, along with recommendations for corrective action, will be given to the LEA Project Manager as soon as possible in order to assess the need for any corrective action.

Readiness Reviews

Readiness reviews will be conducted prior to commencing each phase of the project on an as-needed basis to ensure all components required for each phase are in place.

Surveillance

Surveillance of remedial activities will be conducted by the LEA Task Manager or other field personnel on-site on a daily basis. Activities should be documented in the field notes. Any deviations from the FSP or QAPP should be reported to the Project Manager as soon as possible.

Technical System Audit

A Technical System Audit (TSA) shall be performed by the LEA Project Manager or person designated by the Project Manager shortly after commencing remedial activities. The purpose of the TSA is to ensure that facilities, personnel, training, procedures and record keeping are in accordance with the QAPP. Performing this early in the project provides opportunity for corrective action.

Audit of Data Quality

An audit of data quality will be performed by the management team prior to final reporting. This will serve to reveal how the data were handled, what judgments were made, and whether uncorrected mistakes were made.

5.10.3 Performance Audits

The LEA Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibration to verify that measurements are taken according to established protocols. The QAM will review all field reports and communicate concerns to the Project Manager and/or Task Managers.

5.10.4 Internal System Audits

A field internal system audit is a qualitative evaluation of all components of field QA/QC. The system audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed.

5.10.5 Laboratory Audits

The analytical laboratory will perform internal audits consistent with applicable regulations. LEA reserves the right to conduct an on site audit of the laboratory prior to start of analyses for the project.

5.11 Data Assessment Procedures

The analytical data generated during the RA will be evaluated with respect to precision, accuracy, and completeness and compared to the data quality objectives set forth in this QAPP. A summary of recommended QC limits required to evaluate analytical performance is provided in Tables 5-2 and 5-3. Final QC limits will be established using the selected analytical laboratory's internal control limits.

Following the collection of field sampling and analytical data, various statistical analyses can be performed to determine the data usability and sensitivity of the data.

Data usability can be checked through standard data validation procedures, and statistical cross validation procedures. These procedures involve predicting a data value for one point, based on results from other points. The difference between the measured and predicted number can indicate an invalid result.
An assessment of data sufficiency involves the determination of whether the confidence intervals values are rigorous enough to satisfy regulatory or engineering requirements.

5.11.1 Data Precision Assessment Procedures

Field precision will be controlled through the use of experienced field personnel, properly calibrated instruments, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision analyses will be monitored through the use of matrix spike/matrix spike duplicate sample analyses and performance evaluation samples. The precision of data will be measured by calculation of the relative percent difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{A+B/2} \times 100$$

Where:

A = Analytical results from first duplicate measurement
B = Analytical results from second duplicate measurement.

5.11.2 Data Accuracy Assessment Procedures

The accuracy of field precision will be controlled by experienced field personnel, properly calibrated field instruments, and adherence to established protocols. The accuracy of field instruments will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of matrix spike, surrogate spikes, PE samples, and reference standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\text{Percent Recovery} = \frac{(A-X)}{B} \times 100$$

Where:

A = Value measured in spiked sample
X = Value measured in original sample
B = True value of amount added to sample or true value of standard.

This formula is derived under the assumption of constant accuracy between the original and spiked measurements. Recommended accuracy objectives for matrix spike recoveries are found in Tables 5-2 and 5-3. Final accuracy objectives for matrix spike recoveries will be determined by the selected analytical laboratory's internal control limits.

5.11.3 Data Completeness Assessment Procedures

Completeness of field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated:

$$\text{Completeness} = \frac{\text{Number of Valid Results}}{\text{Total Number of Results Generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90%. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

5.11.4 Internal Reporting

The QAM will review analytical concerns identified by the data review with the laboratory. Supporting data (i.e. historic data, related field or laboratory data) will be reviewed to assist in determining data quality, as appropriate. The QAM will incorporate results of assessments of data usability into a summary that will be submitted to the Project Manager and appropriate Task Managers.

5.11.5 RA Reporting

The summary report prepared by LEA will contain a QA/QC section summarizing the quality of data collected and/or used as appropriate to the project data quality objectives, which are discussed in this QAPP. The QAM will prepare the QA/QC summaries using reporting and memoranda documenting the data assessment and review.

5.11.6 Data Validation

A standardized data validation review process for judging the analytical quality and usefulness of data will be performed in accordance with the procedures set forth in the most current editions of the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses. Technical judgment on the validity of the laboratory results will be provided to determine the overall usability and legal defensibility. All confirmatory sample data obtained will be validated. Individual sample results will be accepted, rejected, or qualified. Validation decisions will be communicated to the end-user through a written data validation memorandum and all qualifiers applied to the individual sample results will be incorporated into the analytical database.

The following items will be reviewed when applicable:

- Data Completeness;
- Custody Documentation;
- Preservation and Holding Times;
- Instrument Performance;
- Initial and Continuing Calibration;
- Blanks;
- Field Duplicate Precision;
- Surrogate Compounds and Recoveries;
- Internal Standard Compounds, Recoveries and Retention Times;
- Matrix Spike Recoveries/Duplicate Correlations;
- Control Spike/Laboratory Control Spike;
- Performance Evaluation Assessment;
- Instrument Detection Limits (IDLs);
- ICP Interference Check Sample;
- Furnace Atomic Absorption Analysis;
- ICP Serial Dilution;
- Method Compliance; and
- Sample Result Verification.
- Overall Evaluation of Data

Project requirements are for full validation of 20% of the field samples within each data package.

5.12 Reports to Management.

Daily reports on remedial activities (verbal or written) will be given from field personnel to the LEA Project Manager or person designated by the Project Manager.

Laboratory reports will be given to the Project Manager as received.

Memorandums regarding data validation will be provided to the Project Manager after complete review of the laboratory data package by the data validation staff.

TABLES

Table 4-1

Willow Brook and Willow Brook Pond
East Hartford, Connecticut

Field Sampling Plan
Confirmatory Sampling Summary

Sample Type	Sample Media	Anticipated Number of Samples	Laboratory Analytical Methods (USEPA)
Confirmatory	Soil/Sediment	108	SW846-8082, Rev. December 1996(PCB)
Confirmatory	Soil/Sediment	74	SW-846-8260B Rev. December 1996 (VOC) SW-846-8270C Rev. December 1995 (SVOC) SW-846-1312 Rev. September 1994 (SPLP) SW-846-6010B Rev. December 1996 (ICP Metals) SW-846-7010 Rev. January 1998 (GFAA Metals) SW-846-7471A Rev. January 1998 (Mercury–Cold Vapor) SW-846-9012A Rev. December 1996 (Cyanide) TPH: EPA 418.1 or CT-ETPH*
Disposal/ Characterization (Possible Methods Required By Disposal Facility)	Soil/Sediment	24	SW846-8082, Rev. December 1996(PCB) SW-846-8260B Rev. December 1996 (VOC) SW-846-8270C Rev. December 1995 (SVOC) SW-846-1312 Rev. September 1994 (SPLP) SW-846-6010B Rev. December 1996 (ICP Metals) SW-846-7010 Rev. January 1998 (GFAA Metals) SW-846-7471A Rev. January 1998 (Mercury–Cold Vapor) SW-846-9012A Rev. December 1996 (Cyanide) TPH: EPA 418.1 or CT-ETPH*
Temporary Wastewater Treatment System Effluent	Wastewater	As Required By Permit	VOC: EPA-601 and 602 plus xylenes or EPA624 MTBE: EPA-602 or EPA-624 TPH: EPA 418.1 or CT-ETPH* Metals: EPA-200.7, 239.1 or 239.2 BNA: EPA-625 PAH: EPA-610 PCBs: EPA-608 Cyanide: EPA-335.1; 335.2

Notes:

1. Bottom samples are collected at a frequency of 1 sample per every 400 square feet of excavation bottom.
2. Samples are collected from an interval of 0 to 6 inches below post-remediation surface.
3. PCB = Polychlorinated Biphenyls
   VOC = Volatile Organic Compounds
   ICP = Inductively Coupled Plasma
   MTBE = Methyl tertiary butyl ether
   PAH = Polynuclear Hydrocarbons
   SVOC = Semi-Volatile Organic Compounds
   SPLP = Synthetic Precipitate Leachate Procedure
   TPH = Total Petroleum Hydrocarbons
   BNA = Base Neutral and Acid Extractables
   GFAA = Graphite Furnace Atomic Absorption Spectrometry
4. USEPA = United States Environmental Protection Agency
5. * CT-ETPH is performed by non-EPA method (*Analysis of Extractable Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detector* (ERI, 1999)).
6. Final TPH method will be determined after consultation with appropriate regulatory authorities and before start of work.

7.

Table 4-1

Willow Brook and Willow Brook Pond
East Hartford, Connecticut

Field Sampling Plan
Detailed Confirmatory Sampling Summary
by Remediation Area

AREA	Composite Samples		Grab Samples	
	PCB # Aliquots	PCB # Composites	PCB	Other Parameters
Wetland Area	44	11	46	46
Lower Willow Brook Pond Area	109	30		16
Oil Water Separator Area	8	2	12	12
Upper Willow Brook Pond Area	22	7		
SUB-TOTAL		50	58	
TOTAL	Total PCB Aliquots 183	Total PCB samples 108		Total Other Parameters 74

Notes:
1. Other Parameters: refer to analytical methods as described in Table 4-1, Confirmatory Sampling Summary for details.
2. One PCB aliquots sample will be collected per 400 square foot node. Approximately 4 aliquots will be combined to form 1 composite sample which represents a 1600 square foot area. In some cases, less than four samples may be composited but never will more than four samples be composited.
3. A total of 232 aliquots will be combined for a total of 69 PCB composite confirmatory samples.
4. A total 121 PCB confirmatory samples will consist of 69 composites and 52 grab samples.

Table 4-1

Willow Brook and Willow Brook Pond
East Hartford, Connecticut

Field Sampling Plan
Extraction Method Summary

Analytical Method	Matrix	Extraction Method (as applicable)
SW-846 Method 8082	Soil / Sediment	3545, 3550B, 3540C, 3541
SW-846 Method 8270C	Soil / Sediment	3550B, 3540C, 3541, 3545, 3545, 3560, 3561
SW-846 Method 8260B	Soil / Sediment	5030B, 5035
CT-ETPH	Soil / Sediment	3545, 3550B, 3540C, 3510C, 352C0
SW-846 6010B	Soil / Sediment	3050B, mercury 7471A, TCLP 1311, SPLP 1312

Table 4-3
Required Containers, Preservatives, and Analysis
Holding Times for Solid, Aqueous, and Vapor Samples

Fraction	Soil/Solid Sample Bottle	Preservative	Holding Time
TCL Volatiles	2-40 ml glass screw cap vials with Teflon septa	5 ml $NaHSO_4$, Cool to 4 C.	14 days
TCL Semivolatiles	1-16 oz. glass w/Teflon lined enclosure.	Cool to 4 C.	14 days till extraction/40 days to inject extract
TCL Organochlorine Pesticides/PCBs	from same 16 oz. above	Cool to 4 C.	14 days till extraction/40 days to inject extract
chloride, sulfate, ammonia, COD alkalinity	from same 16 oz. above	Cool to 4 C.	28 days 14 days
nitrate, nitrite, o-phosphate, BOD	from same 16 oz. above	Cool to 4 C.	48 hours
hexavalent chromium	from same 16 oz. above	Cool to 4 C.	48 hours
TAL metals plus Tin	from same 16 oz. above	Cool to 4 C.	28 days Hg & 180 days all other metals
Cyanides	from same 4 oz. above	Cool to 4 C.	14 days
Dioxins	1-4 oz. glass w/Teflon lined enclosure.	Cool to 4 C.	30 days till extraction/45 days to complete analysis
TOC	from same 16 oz. above	Cool to 4 C.	28 days
Total Petroleum Hydrocarbons (CT-ETPH)	from same 16 oz. above	Cool to 4 C.	14 days till extraction/40 days to inject extract
TPH (418.1)	from same 16 oz. above	Cool to 4 C.	28 days
Trip Blank, Field Blank or Aqueous Sample			
TCL Volatiles	2-40 ml glass screw cap vials with Teflon septa	HCl to pH <2, Cool to 4 C.	14 days
TCL Semivolatiles	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
TCL Organochlorine Pesticides/PCBs	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
TAL Metals plus Tin	1-1 liter HDP	HNO to pH<2	28 days Hg & 180 days all other metals
Cyanides	1-1 liter HDP	NaOH to pH >12, Cool to 4 C.	14 days
Dioxins	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	30 days extraction/45 days to complete analysis
Chloride, sulfate TDS, TSS alkalinity	1-1 liter HDP	Cool to 4 C.	28 days 7 days 14 days
nitrate, nitrite, o-phosphate, BOD	1-1 liter HDP	Cool to 4 C.	48 hours
hexavalent chromium	1-500 ml HDP	Cool to 4 C.	24 hours
ammonia, COD	1-1 liter clear glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
TOC	1-125 ml glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
Total Petroleum Hydrocarbons (CT-ETPH)	2-1 liter amber glass with Teflon lined cap	Cool to 4 C.	7 days extraction/40 days to inject
Total Petroleum Hydrocarbons (418.1)	2-1 liter amber glass with Teflon lined cap	HSO to pH<2, Cool to 4 C.	28 days
Fraction	**Air Sample Container/Media**	**Preservative**	**Holding Time**
TCL Volatiles	SUMMA Canister	None	14 days
TCL Semivolatiles	XAD-2/PUF Cartridges	Cool to 4 C	14 days extraction/40 days to inject
TAL Metals plus Tin	Quartz Filter	None	28 days Hg & 180 days all other metals
Total Suspended Particulate Matter	Quartz Filter	None	14 days

NOTES:

1 - Depending on how sample analyses are distributed between the laboratories, additional sample bottles may be required.

2 - Holding times are from the date of sample collection.

3 - CT-ETPH - "Analysis of Total Petroleum Hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detection"

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
67-64-1	Acetone	36-132	15	36-132	33-138	40	33-138
71-43-2	Benzene	50-150	15	50-150	42-167	40	42-167
75-27-4	Bromodichloromethane	19-146	15	19-146	45-453	40	45-453
75-25-2	Bromoform	29-141	15	29-141	42-153	40	42-153
74-83-9	Methyl bromide	13-174	15	13-174	34-164	40	34-164
78-93-3	Methyl ethyl ketone	35-153	15	35-153	46-146	40	46-146
75-15-0	Carbon disulfide	14-171	15	14-171	39-153	40	39-153
56-23-5	Carbon tetrachloride	52-151	15	52-151	42-168	40	42-168
108-90-7	Chlorobenzene	54-149	15	54-149	43-164	40	43-164
75-00-3	Chloroethane	16-167	15	16-167	31-160	40	31-160
67-66-3	Chloroform	56-152	15	56-152	46-160	40	46-160
74-87-3	Methyl chloride	30-170	15	30-170	25-175	40	25-175
124-48-1	Chlorodibromomethane	33-150	15	33-150	44-151	40	44-151
75-34-3	1,1-Dichloroethene	36-166	15	36-166	44-164	40	44-164
107-06-2	1,2-Dichloroethene	52-149	15	52-149	46-160	40	46-160
75-35-4	1,1-Dichloroethane	22-181	15	22-181	52-166	40	52-166
540-59-0	1,2-Dichloroethane (total)	53-149	15	53-149	43-167	40	43-167
78-87-5	1,2-Dichloropropane	36-164	15	36-164	46-163	40	46-163
10061-01-5	cis-1,3-Dichloropropene	47-140	15	47-140	45-153	40	45-153
10061-02-6	trans-1,3-dichloropropene	27-143	15	27-143	35-19	40	35-19
100-41-4	Ethylbenzene	54-157	15	54-157	45-172	40	45-172
591-78-6	Methyl butyl ketone	34-141	15	34-141	55-134	40	55-134
75-09-2	Methylene chloride	52-156	15	52-156	41-181	40	41-181
108-10-1	Methyl isobutyl ketone	45-119	15	45-119	54-128	40	54-128
100-42-5	Styrene	44-153	15	44-153	76-132	40	76-132
79-34-5	1,1,2,2-Tetrachloroethane	40-139	15	40-139	43-148	40	43-148
127-18-4	Tetrachloroethene	51-165	15	51-165	43-183	40	43-183
108-88-3	Toluene	49-156	15	49-156	44-170	40	44-170
71-55-6	1,1,1-Trichloroethane	1-144	15	1-144	45-166	40	45-166
79-00-5	1,1,2-Trichloroethane	48-142	15	48-142	44-156	40	44-156
79-01-6	Trichloroethene	36-159	15	36-159	42-169	40	42-169
75-01-4	Vinyl chloride	38-168	15	38-168	31-176	40	31-176
1330-20-7	Xylenes (total)	52-150	15	52-150	42-162	40	42-162

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
95-50-1	1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA
541-73-1	1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA
106-46-7	1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA
87-68-3	Hexachlorobutadiene	NA	NA	NA	NA	NA	NA
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
83-32-9	Acenaphthene	58-108	20	58-108	46-117	40	46-117
208-96-8	Acenaphthylene	50-112	20	50-112	43-116	40	43-116
120-12-7	Anthracene	59-104	20	59-104	41-121	40	41-121
56-55-3	Benzo[a]anthracene	61-111	20	61-111	48-124	40	48-124
205-99-2	Benzo[b]fluoranthene	55-114	20	55-114	40-134	40	40-134
207-08-9	Benzo[k]fluoranthene	50-126	20	50-126	41-134	40	41-134
191-24-2	Benzo[ghi]perylene	57-137	20	57-137	35-147	40	35-147
50-32-8	Benzo[a]pyrene	48-123	20	48-123	42-137	40	42-137
111-91-1	bis(2-Chloroehtoxy)methane	47-109	20	47-109	41-117	40	41-117
111-44-4	bis(2-Chloroethyl)ether	53-102	20	53-102	39-116	40	39-116
108-60-1	bis(2-Chloroisopropyl)ether	42-117	20	42-117	65-108	40	65-108
117-81-7	bis(2-Ethylhexyl)phthalate	55-122	20	55-122	45-132	40	45-132
101-55-3	4-Bromophenyl phenyl ether	60-106	20	60-106	46-123	40	46-123
85-68-7	Butyl benzyl phthalate	49-119	20	49-119	48-135	40	48-135
106-47-8	4-Chloroaniline	49-99	20	49-99	D.L.-123	40	D.L.-123
59-50-7	4-Chloro-3-methylphenol	58-111	20	58-111	48-117	40	48-117
91-58-7	2-Chloronaphthalene	55-105	20	55-105	45-117	40	45-117
95-57-8	2-Chlorophenol	56-101	20	56-101	43-114	40	43-114
7005-72-3	4-Chlorophenyl phenyl ether	54-108	20	54-108	49-117	40	49-117
218-01-9	Chrysene	58-115	20	58-115	48-12+6	40	48-12+6
132-64-9	Dibenzofuran	55-113	20	55-113	67-103	40	67-103
84-74-2	Di-n-butyl phthalate	54-115	20	54-115	43-126	40	43-126
53-70-3	Dibenz[a,h]anthracene	50-146	20	50-146	45-154	40	45-154
95-50-1	1,2-Dichlorobenzene	47-98	20	47-98	39-112	40	39-112
541-73-1	1,3-Dichlorobenzene	43-94	20	43-94	37-112	40	37-112
106-46-7	1,4-Dichlorobenzene	43-94	20	43-94	39-110	40	39-110
91-94-1	3,3-Dichlorobenzidine	52-112	20	52-112	19-117	40	19-117

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
120-83-2	2,4-Dichlorophenol	56-105	20	56-105	46-117	40	46-117
84-66-2	Diethyl phthalate	48-115	20	48-115	49-127	40	49-127
105-67-9	2,4-Dimethylphenol	52-94	20	52-94	33-113	40	33-113
131-11-3	Dimethyl phthalate	25-106	20	25-106	49-123	40	49-123
534-52-1	4,6-Dinitro-2-methylphenol	53-117	20	53-117	28-147	40	28-147
51-28-5	2,4-Dinitrophenol	43-131	20	43-131	9-167	40	9-167
121-14-2	2,4-Dinitrotoluene	56-118	20	56-118	48-126	40	48-126
606-20-2	2,6-Dinitrotoluene	56-106	20	56-106	47-122	40	47-122
117-84-0	Di-n-octyl phthalate	44-140	20	44-140	35-150	40	35-150
206-44-0	Fluoranthene	53-115	20	53-115	44-121	40	44-121
86-73-7	Fluorene	51-113	20	51-113	46-115	40	46-115
118-74-1	Hexachlorobenzene	63-108	20	63-108	44-126	40	44-126
87-68-3	Hexachlorobutadiene	30-85	20	30-85	41-117	40	41-117
77-47-4	Hexachlorocyclopentadiene	D.L.-132	20	D.L.-132	D.L.-125	40	D.L.-125
67-72-1	Hexachloroethane	35-83	20	35-83	39-110	40	39-110
193-39-5	Indeno(1,2,3-cd)pyrene	48-141	20	48-141	44-151	40	44-151
78-59-1	Isophorone	54-106	20	54-106	41-115	40	41-115
91-57-6	2-Methylnaphthalene	49-104	20	49-104	61-99	40	61-99
95-48-7	2-Methylphenol	47-87	20	47-87	58-114	40	58-114
91-20-3	Naphthalene	50-108	20	50-108	41-115	40	41-115
88-74-4	2-Nitroaniline	59-112	20	59-112	74-102	40	74-102
99-09-2	3-Nitroaniline	50-114	20	50-114	47-105	40	47-105
100-01-6	4-Nitroaniline	54-126	20	54-126	37-108	40	37-108
98-95-3	Nitrobenzene	54-106	20	54-106	42-116	40	42-116
88-75-5	2-Nitrophenol	65-112	20	65-112	44-122	40	44-122
100-02-7	4-Nitrophenol	17-68	20	17-68	42-146	40	42-146
86-30-6	N-Nitrosodiphenylamine	33-70	20	33-70	39-125	40	39-125
621-64-7	N-Nitrosodipropylamine	51-112	20	51-112	40-120	40	40-120
87-86-5	Pentachlorophenol	29-135	20	29-135	18-161	40	18-161
85-01-8	Phenanthrene	60-109	20	60-109	43-121	40	43-121
108-95-2	Phenol	28-58	20	28-58	36-121	40	36-121
129-00-0	Pyrene	58-118	20	58-118	46-130	40	46-130

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
120-82-1	1,2,4-Trichlorobenzene	45-100	20	45-100	42-114	40	42-114
95-95-4	2,4,5-Trichlorophenol	62-118	20	62-118	69-115	40	69-115
88-06-2	2,4,6-Trichlorophenol	50-108	20	50-108	46-118	40	46-118
86-74-8	Carbazole	40-137	20	40-137	35-133	40	35-133
309-00-2	Aldrin	59-120	20	59-120	62-120	40	62-120
319-84-6	alpha-BHC	69-120	20	69-120	59-120	40	59-120
319-85-7	beta-BHC	72-115	20	72-115	72-115	40	72-115
319-86-8	delta-BHC	62-120	20	62-120	68-110	40	68-110
58-89-9	gamma-BHC/Lindane	79-120	20	79-120	63-120	40	63-120
72-54-8	4,4-DDD	71-115	20	71-115	65-120	40	65-120
72-55-9	4,4-DDE	69-105	20	69-105	63-120	40	63-120
50-29-3	4,4-DDT	74-120	20	74-120	59-121	40	59-121
60-57-1	Dieldrin	77-120	20	77-120	55-123	40	55-123
959-98-8	Endosulfan I	72-110	20	72-110	57-120	40	57-120
33213-65-9	Endosulfan II	76-120	20	76-120	64-120	40	64-120
1031-07-8	Endosulfan sulfate	63-120	20	63-120	62-120	40	62-120
72-20-8	Endrin	73-120	20	73-120	64-124	40	64-124
7421-93-4	Endrin aldehyde	70-121	20	70-121	31-120	40	31-120
76-44-8	Heptachlor	64-120	20	64-120	45-120	40	45-120
1024-57-3	Heptachlor epoxide	80-120	20	80-120	71-126	40	71-126
72-43-5	Methoxychlor	76-120	20	76-120	39-129	40	39-129
8001-35-2	Toxaphene	NA	NA	NA	NA	NA	NA
12674-11-2	Aroclor-1016	NA	NA	NA	NA	NA	NA
11104-28-2	Aroclor-1221	NA	NA	NA	NA	NA	NA
11141-16-5	Aroclor-1232	NA	NA	NA	NA	NA	NA
53469-21-9	Aroclor-1242	75-120	20	75-120	69-115	40	69-115
12672-29-6	Aroclor-1248	NA	NA	NA	NA	NA	NA
11097-69-1	Aroclor-1254	NA	NA	NA	NA	NA	NA
11096-82-5	Aroclor-1260	77-120	20	77-120	71-119	40	71-119
5103-71-9	alpha-Chlordane	60-140	20	60-140	60-140	40	60-140
5103-74-2	gamma-Chlordane	60-140	20	60-140	60-140	40	60-140

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
53494-70-5	Endrin ketone	60-140	20	60-140	60-140	40	60-140
1-33-1	Total-TCDD	NA	NA	NA	NA	NA	NA
1746-01-6	2378-TCDD	60-140	50	57-128	60-140	50	55-136
1-33-2	Total-TCDF	NA	NA	NA	NA	NA	NA
51207-31-9	2378-TCDF	60-140	50	62-129	60-140	50	72-118
1-28-9	Total PeCDD	NA	NA	NA	NA	NA	NA
40321-76-4	12378-PeCDD	60-140	50	80-125	60-140	50	67-139
1-29-0	Total PeCDF	NA	NA	NA	NA	NA	NA
57117-41-6	123478-PeCDF	NA	NA	NA	NA	NA	NA
57117-31-4	123678-PeCDF	60-140	50	51-132	60-140	50	54-129
1-20-0	Total HeCDD	NA	NA	NA	NA	NA	NA
39227-28-6	123478-HeCDD	60-140	50	64-27	60-140	50	57-132
57653-85-7	123678-HeCDD	NA	NA	NA	NA	NA	NA
19408-74-3	123789-HeCDD	NA	NA	NA	NA	NA	NA
1-20-1	Total HeCDF	NA	NA	NA	NA	NA	NA
70648-26-9	123478-HeCDF	60-140	50	50-146	60-140	50	50-150
57117-44-9	123678-HeCDF	NA	NA	NA	NA	NA	NA
72918-21-9	123789-HeCDF	NA	NA	NA	NA	NA	NA
60851-34-5	234678-HeCDF	NA	NA	NA	NA	NA	NA
1-01-9	Total HpCDD	NA	NA	NA	NA	NA	NA
35822-46-9	1234678-HpCDD	60-140	50	60-131	60-140	50	50-138
1-02-0	Total HpCDF	NA	NA	NA	NA	NA	NA
67562-39-4	1234678-HpCDF	60-140	50	50-150	60-140	50	50-150
55673-89-7	11234789-HpCDF	NA	NA	NA	NA	NA	NA
3268-87-9	OCDD	60-140	50	50-147	60-140	50	50-149
39001-1-2	OCDF	60-140	50	50-150	60-140	50	50-150
7440-36-0	Antimony	75-125	20	75-125	75-125	20	75-125
7440-38-2	Arsenic	75-125	20	75-125	75-125	20	75-125
7440-39-3	Barium	75-125	20	75-125	75-125	20	75-125
7440-41-7	Beryllium	75-125	20	75-125	75-125	20	75-125

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
7440-43-9	Cadmium	75-125	20	75-125	75-125	20	75-125
7440-47-3	Chromium	75-125	20	75-125	75-125	20	75-125
7440-48-4	Cobalt	75-125	20	75-125	75-125	20	75-125
7440-50-8	Copper	75-125	20	75-125	75-125	20	75-125
7439-92-1	Lead	75-125	20	75-125	75-125	20	75-125
7439-97-6	Mercury	75-125	20	75-125	75-125	20	75-125
7440-02-0	Nickel	75-125	20	75-125	75-125	20	75-125
7782-49-2	Selenium	75-125	20	75-125	75-125	20	75-125
7440-22-4	Silver	75-125	20	75-125	75-125	20	75-125
7440-28-0	Thallium	75-125	20	75-125	75-125	20	75-125
7440-31-5	Tin	75-125	20	75-125	75-125	20	75-125
7440-62-2	Vanadium	75-125	20	75-125	75-125	20	75-125
7440-66-6	Zinc	75-125	20	75-125	75-125	20	75-125
7429-90-5	Aluminum	75-125	20	75-125	75-125	20	75-125
7440-70-2	Calcium	75-125	20	75-125	75-125	20	75-125
7439-89-6	Iron	75-125	20	75-125	75-125	20	75-125
7439-95-4	Magnesium	75-125	20	75-125	75-125	20	75-125
7439-96-5	Manganese	75-125	20	75-125	75-125	20	75-125
7440-09-7	Potassium	75-125	20	75-125	75-125	20	75-125
7440-23-5	Sodium	75-125	20	75-125	75-125	20	75-125
SA0001	Alkalinity (to pH 8.3)	75-125	20	75-125	75-125	20	75-130
SA0002	Total Alkalinity (to pH 4.5)	75-125	20	75-125	75-125	20	75-130
SA0003	Ammonia	75-125	20	75-125	75-125	20	75-130
SA0004	BOD	75-125	20	75-125	75-125	20	75-130
SA0006	Chloride	75-125	20	75-125	75-125	20	75-130
SA0007	COD	75-125	20	75-125	75-125	20	75-130
SA0008	Cyanide, Total	75-125	20	75-125	75-125	20	75-130
SA0011	Hexavalent Chromium	75-125	20	75-125	75-125	20	75-130
SA0012	Nitrate/Nitrite	75-125	20	75-125	75-125	20	75-130
SA0014	Orthophosphate	75-125	20	75-125	75-125	20	75-130
SA0018	Total Dissolved Solids	75-125	20	75-125	75-125	20	75-130

Table 5-3
RECOMMENDED MATRIX SPIKE AND LABORATORY CONTROL SAMPLE PRECISION AND ACCURACY OBJECTIVES

CAS#	Analyte Name	Aqueous			Solid/Soil		
		MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery	MS/MSD % Recovery	MS/MSD or LD % RPD	LCS% Recovery
SA0019	Total Organic Carbon	75-125	20	75-125	75-125	20	75-130
SA0023	Total Sulfate	75-125	20	75-125	75-125	20	75-130
SA0024	Total Suspended Solids	75-125	20	75-125	75-125	20	75-130

NOTES:
(1) Fractions: VOA - Volatile Organic Analytes; DAI - Direct Aqueous Injection; SV - Semivolatile Organics; OCP - Organochlorine Pesticides
OP - Organophosphorus Pesticides; H - Herbicides; DIOX/F - Dioxins/Furans; M - Metals; WC - Wet Chemistry; RAD - Radiological
(2) Fictitious CAS numbers created to represent the co-eluting isomers 3-methylphenol and 4-methylphenol.
(3) SVOC limits were rounded to whole numbers to reflect the accuracy of the laboratory (5/5/01).
TBD - PQL to be determined
SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods," third edition.
EPA - "Methods for Chemical Analysis of Water and Wastes," EPA 600-4/79-020.
(4) These are recommended values for recovery and RPD. The selected analytical laboratory's internal control limits will serve as the final limits for the project.

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
67-64-1	Acetone	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
75-05-8	Acetonitrile	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
107-02-8	Acrolein	VOA	SW846-8260B	5.0	ug/l	100.0	ug/kg
107-13-1	Acrylonitrile	VOA	SW846-8260B	0.5	ug/l	10.0	ug/kg
107-05-1	Allyl chloride	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
71-43-2	Benzene	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
75-27-4	Bromodichloromethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-25-2	Bromoform	VOA	SW846-8260B	4.0	ug/l	5.0	ug/kg
74-83-9	Methyl bromide (bromomethane)	VOA	SW846-8260B	10.0	ug/l	10.0	ug/kg
78-93-3	Methyl ethyl ketone (2-Butanone)	VOA	SW846-8260B	100.0	ug/l	100.0	ug/kg
75-15-0	Carbon disulfide	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
56-23-5	Carbon tetrachloride	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
108-90-7	Chlorobenzene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-00-3	Chloroethane	VOA	SW846-8260B	10.0	ug/l	10.0	ug/kg
67-66-3	Chloroform	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
126-99-8	Chloroprene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
74-87-3	Methyl chloride (Chloromethane)	VOA	SW846-8260B	10.0	ug/l	10.0	ug/kg
124-48-1	Dibromochloromethane	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
96-12-8	1,2-Dibromo-3-chloropropane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
74-95-3	Dibromomethane (methylene bromide)	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
106-93-4	Ethylene dibromide (EDB)	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
110-57-6	trans-1,4-Dichloro-2-butene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-71-8	Dichlorodifluoromethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-34-3	1,1-Dichloroethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
107-06-2	1,2-Dichloroethane	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
75-35-4	1,1-Dichloroethene	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
156-59-2	cis-1,2-Dichloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
156-60-5	trans-1,2-Dichloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
78-87-5	1,2-Dichloropropane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
542-75-6	1,3-Dichloropropene (total)	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
123-91-1	1,4-Dioxane	VOA	SW846-8260B	150.0	ug/l	150.0	ug/kg
100-41-4	Ethylbenzene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
97-63-2	Ethyl methacrylate	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
591-78-6	2-Hexanone	VOA	SW846-8260B	50.0	ug/l	50.0	ug/kg
78-83-1	Isobutyl alcohol	VOA	SW846-8260B	50.0	ug/l	50.0	ug/kg
126-98-7	Methacrylonitrile	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-09-2	Methylene chloride	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
74-88-4	Methyl iodide	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
80-62-6	Methyl methacrylate	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
108-10-1	4-Methyl-2-pentanone	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
1634-04-4	Methyl-tert-butyl ether	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
107-12-0	Propionitrile	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
100-42-5	Styrene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
630-20-6	1,1,1,2-Tetrachloroethane	VOA	SW846-8260B	1.0	ug/l	5.0	ug/kg
79-34-5	1,1,2,2-Tetrachloroethane	VOA	SW846-8260B	0.5	ug/l	5.0	ug/kg
127-18-4	Tetrachloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
108-88-3	Toluene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
71-55-6	1,1,1-Trichloroethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
79-00-5	1,1,2-Trichloroethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
79-01-6	Trichloroethene	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-69-4	Trichlorofluoromethane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
108-05-4	Vinyl acetate	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
96-18-4	1,2,3-Trichloropropane	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
75-01-4	Vinyl chloride	VOA	SW846-8260B	2.0	ug/l	10.0	ug/kg
1330-20-7	Xylenes (total)	VOA	SW846-8260B	5.0	ug/l	5.0	ug/kg
83-32-9	Acenaphthene	SV	SW846-8270C	10	ug/l	330	ug/kg
208-96-8	Acenaphthylene	SV	SW846-8270C	0.3	ug/l	330	ug/kg
98-86-2	Acetophenone	SV	SW846-8270C	10	ug/l	330	ug/kg
53-96-3	2-Acetylaminofluorene	SV	SW846-8270C	10	ug/l	330	ug/kg
92-67-1	4-Aminobiphenyl	SV	SW846-8270C	10	ug/l	330	ug/kg
62-53-3	Analine	SV	SW846-8270C	10	ug/l	330	ug/kg
120-12-7	Anthracene	SV	SW846-8270C	10	ug/l	330	ug/kg
140-57-8	Aramite	SV	SW846-8270C	10	ug/l	330	ug/kg
56-55-3	Benzo[a]anthracene	SV	SW846-8270C	0.6	ug/l	330	ug/kg
205-99-2	Benzo[b]fluoranthene	SV	SW846-8270C	0.08	ug/l	330	ug/kg
207-08-9	Benzo[k]fluoranthene	SV	SW846-8270C	0.3	ug/l	330	ug/kg
191-24-2	Benzo[ghi]perylene	SV	SW846-8270C	10	ug/l	330	ug/kg
50-32-8	Benzo[a]pyrene	SV	SW846-8270C	0.2	ug/l	330	ug/kg
100-51-6	Benzyl alcohol	SV	SW846-8270C	20	ug/l	670	ug/kg
111-91-1	bis(2-Chloroethoxy) methane	SV	SW846-8270C	10	ug/l	330	ug/kg
111-44-4	bis(2-Chloroethyl)ether	SV	SW846-8270C	10	ug/l	330	ug/kg
108-60-1	2,2'-oxybis(1-chloro-Propane)	SV	SW846-8270C	10	ug/l	330	ug/kg
117-81-7	bis(2-Ethylhexyl)phthalate	SV	SW846-8270C	2	ug/l	330	ug/kg
101-55-3	4-Bromophenyl phenyl ether	SV	SW846-8270C	10	ug/l	330	ug/kg
85-68-7	Butyl benzyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
86-74-8	Carbazole	SV	SW846-8270C	10	ug/l	330	ug/kg
106-47-8	4-Chloroaniline	SV	SW846-8270C	20	ug/l	670	ug/kg
59-50-7	4-Chloro-3-methyl phenol	SV	SW846-8270C	20	ug/l	670	ug/kg
91-58-7	2-Chloronaphthalene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-57-8	2-Chlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
7005-72-3	4-Chlorophenyl phenyl ether	SV	SW846-8270C	10	ug/l	330	ug/kg
218-01-9	Chrysene	SV	SW846-8270C	10	ug/l	330	ug/kg
132-64-9	Dibenzofuran	SV	SW846-8270C	10	ug/l	330	ug/kg
84-74-2	Di-n-butyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
117-84-0	Di-n-octyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
53-70-3	Dibenz[a,h]anthracene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-50-1	1,2-Dichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
541-73-1	1,3-Dichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
106-46-7	1,4-Dichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
91-94-1	3,3-Dichlorobenzidine	SV	SW846-8270C	20	ug/l	670	ug/kg
120-83-2	2,4-Dichlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
84-66-2	Diethyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
297-97-2	0,0-Diethyl-0-2-pyrazinyl	SV	SW846-8270C	10	ug/l	330	ug/kg
60-51-5	Dimethoate	SV	SW846-8270C	10	ug/l	330	ug/kg
60-11-7	p-(Dimethylamino)azobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
57-97-6	7,12-Dimethylbenz(a)anthracene	SV	SW846-8270C	10	ug/l	330	ug/kg
122-09-8	alpha,alpha,-Dimethylphenethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
119-93-7	3,3-Dimethylbenzidine	SV	SW846-8270C	10	ug/l	330	ug/kg
105-67-9	2,4-Dimethylphenol	SV	SW846-8270C	10	ug/l	330	ug/kg
131-11-3	Dimethyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
99-65-0	1,3-Dinitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
534-52-1	4,6-Dinitro-2-methylphenol	SV	SW846-8270C	50	ug/l	830	ug/kg
51-28-5	2,4-Dinitrophenol	SV	SW846-8270C	50	ug/l	830	ug/kg
121-14-2	2,4-Dinitrotoluene	SV	SW846-8270C	10	ug/l	330	ug/kg
606-20-2	2,6-Dinitrotoluene	SV	SW846-8270C	10	ug/l	330	ug/kg
117-84-0	Di-n-octyl phthalate	SV	SW846-8270C	10	ug/l	330	ug/kg
88-85-7	Dinoseb	SV	SW846-8270C	10	ug/l	330	ug/kg
122-39-4	Diphenylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
298-04-4	Disulfoton	SV	SW846-8270C	10	ug/l	330	ug/kg
65-50-0	Ethyl methanesulfonate	SV	SW846-8270C	10	ug/l	330	ug/kg
52-85-7	Famphur	SV	SW846-8270C	10	ug/l	330	ug/kg
206-44-0	Fluoranthene	SV	SW846-8270C	10	ug/l	330	ug/kg
86-73-7	Fluorene	SV	SW846-8270C	10	ug/l	330	ug/kg
118-74-1	Hexachlorobenzene	SV	SW846-8270C	0.077	ug/l	330	ug/kg
87-68-3	Hexachlorobutadiene	SV	SW846-8270C	10	ug/l	330	ug/kg
77-47-4	Hexachlorocyclopentadiene	SV	SW846-8270C	10	ug/l	330	ug/kg
67-72-1	Hexachloroethane	SV	SW846-8270C	3	ug/l	330	ug/kg
70-30-4	Hexachlorophene	SV	SW846-8270C	10	ug/l	330	ug/kg
1888-71-7	Hexachloropropene	SV	SW846-8270C	10	ug/l	330	ug/kg
193-39-5	Indeno(1,2,3-cd)pyrene	SV	SW846-8270C	10	ug/l	330	ug/kg
78-59-1	Isophorone	SV	SW846-8270C	10	ug/l	330	ug/kg
120-58-1	Isosafrole	SV	SW846-8270C	10	ug/l	330	ug/kg
91-80-5	Methapyrilene	SV	SW846-8270C	10	ug/l	330	ug/kg
56-49-5	3-Methylcholanthrene	SV	SW846-8270C	10	ug/l	330	ug/kg
66-27-3	Methyl methanesulfonate	SV	SW846-8270C	10	ug/l	330	ug/kg
91-57-6	2-Methylnaphthalene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-48-7	2-Methylphenol (o-Cresol)	SV	SW846-8270C	10	ug/l	330	ug/kg
108-39-4	3-Methylphenol ((m-Cresol)	SV	SW846-8270C	10	ug/l	330	ug/kg
106-44-5	4-Methylphenol (p-Cresol)	SV	SW846-8270C	10	ug/l	330	ug/kg
298-00-0	Methyl parathion	SV	SW846-8270C	10	ug/l	330	ug/kg
91-20-3	Naphthalene	SV	SW846-8270C	10	ug/l	330	ug/kg
130-15-4	1,4-Naphthoquinone	SV	SW846-8270C	10	ug/l	330	ug/kg
134-32-7	1-Naphthylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
91-59-8	2-Naphthylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
88-74-4	2-Nitroaniline	SV	SW846-8270C	50	ug/l	830	ug/kg
99-09-2	3-Nitroaniline	SV	SW846-8270C	50	ug/l	830	ug/kg
100-01-6	4-Nitroaniline	SV	SW846-8270C	50	ug/l	830	ug/kg
98-95-3	Nitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
56-57-5	4-Nitoquinoline-1-oxide	SV	SW846-8270C	10	ug/l	330	ug/kg
88-75-5	2-Nitrophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
100-02-7	4-Nitrophenol	SV	SW846-8270C	50	ug/l	830	ug/kg
55-18-5	N-Nitrosodiethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
62-75-9	N-Nitrosodimethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
86-30-6	N-Nitrosodiphenylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
621-64-7	N-Nitrosodi-n-propylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
924-16-3	N-Nitrosodi-n-butylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
10595-95-6	N-Nitrosomethylethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
59-89-2	N-Nitrosomorpholine	SV	SW846-8270C	10	ug/l	330	ug/kg
100-75-4	N-Nitrosopiperidenemethylethylamine	SV	SW846-8270C	10	ug/l	330	ug/kg
930-55-2	N-Nitrosopyrrolidine	SV	SW846-8270C	10	ug/l	330	ug/kg
99-55-8	5-Nitro-0-toluidine	SV	SW846-8270C	10	ug/l	330	ug/kg
56-38-2	Parathion	SV	SW846-8270C	10	ug/l	330	ug/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
608-93-5	Pentachlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
76-01-7	Pentachloroethane	SV	SW846-8270C	10	ug/l	330	ug/kg
82-68-8	Pentachloronitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
87-86-5	Pentachlorophenol	SV	SW846-8270C	1	ug/l	830	ug/kg
62-44-2	Phenacetin	SV	SW846-8270C	10	ug/l	330	ug/kg
85-01-8	Phenanthrene	SV	SW846-8270C	0.077	ug/l	330	ug/kg
108-95-2	Phenol	SV	SW846-8270C	10	ug/l	330	ug/kg
106-50-3	p-Phenylenediamine	SV	SW846-8270C	10	ug/l	330	ug/kg
298-02-2	Phorate	SV	SW846-8270C	10	ug/l	330	ug/kg
109-06-8	2-Picoline	SV	SW846-8270C	10	ug/l	330	ug/kg
23950-58-5	Pronamide	SV	SW846-8270C	10	ug/l	330	ug/kg
129-00-0	Pyrene	SV	SW846-8270C	10	ug/l	330	ug/kg
110-86-1	Pyridine	SV	SW846-8270C	10	ug/l	330	ug/kg
94-59-7	Safrole	SV	SW846-8270C	10	ug/l	330	ug/kg
3689-24-5	Sulfotepp	SV	SW846-8270C	10	ug/l	330	ug/kg
95-94-3	1,2,4,5-Tetrachlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
58-90-2	2,3,4,6-Tetrachlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
95-53-4	0-Toluidine	SV	SW846-8270C	10	ug/l	330	ug/kg
120-82-1	1,2,4-Trichlorobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
95-95-4	2,4,5-Trichlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
88-06-2	2,4,6-Trichlorophenol	SV	SW846-8270C	10	ug/l	330	ug/kg
126-68-1	0,0,0-Triethylphosphorothiote	SV	SW846-8270C	10	ug/l	330	ug/kg
99-35-4	1,3,5-Trinitrobenzene	SV	SW846-8270C	10	ug/l	330	ug/kg
15972-60-8	Alachlor	OCP	SW846-8082	2	ug/l	230.0	ug/kg
116-06-3	Aldicarb	OCP	SW846-8082	3	ug/l	1000.0	ug/kg
309-00-2	Aldrin	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
1912-24-9	Atrazine	OCP	SW846-8082	3	ug/l	200.0	ug/kg
319-84-6	alpha-BHC	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
319-85-7	beta-BHC	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
319-86-8	delta-BHC	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
58-89-9	gamma-BHC/Lindane	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
57-74-9	Chlordane	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
94-75-7	2,4-D	OCP	SW846-8082	70	ug/l	1400.0	ug/kg
72-54-8	4,4-DDD	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
72-55-9	4,4-DDE	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
50-29-3	4,4-DDT	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
60-57-1	Dieldrin	OCP	SW846-8082	0.002	ug/l	3.3	ug/kg
959-98-8	Endosulfan I	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
33213-65-9	Endosulfan II	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
1031-07-8	Endosulfan sulfate	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
72-20-8	Endrin	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
7421-93-4	Endrin aldehyde	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
53494-70-5	Endrin ketone	OCP	SW846-8082	0.1	ug/l	3.3	ug/kg
76-44-8	Heptachlor	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
1024-57-3	Heptachlor epoxide	OCP	SW846-8082	0.05	ug/l	1.7	ug/kg
72-43-5	Methoxychlor	OCP	SW846-8082	0.5	ug/l	17.0	ug/kg
122-34-9	Simazine	OCP	SW846-8082	4	ug/l	800.0	ug/kg
8001-35-2	Toxaphene	OCP	SW846-8082	1.0	ug/l	170	ug/kg
12674-11-2	Aroclor-1016	OCP	SW846-8082	0.5	ug/l	33	ug/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
11104-28-2	Aroclor-1221	OCP	SW846-8082	0.5	ug/l	67	ug/kg
11141-16-5	Aroclor-1232	OCP	SW846-8082	0.5	ug/l	33	ug/kg
53469-21-9	Aroclor-1242	OCP	SW846-8082	0.5	ug/l	33	ug/kg
12672-29-6	Aroclor-1248	OCP	SW846-8082	0.5	ug/l	33	ug/kg
11097-69-1	Aroclor-1254	OCP	SW846-8082	0.5	ug/l	33	ug/kg
11096-82-5	Aroclor-1260	OCP	SW846-8082	0.5	ug/l	33	ug/kg
7440-36-0	Antimony	M	SW846-6010B	6	ug/l	12	mg/kg
7440-38-2	Arsenic	M	SW846-7000A	4	ug/l	1	mg/kg
7440-39-3	Barium	M	SW846-6010B	200	ug/l	15	mg/kg
7440-41-7	Beryllium	M	SW846-6010B/7000A	4	ug/l	0.08	mg/kg
7440-43-9	Cadmium	M	SW846-7000A	5	ug/l	0.1	mg/kg
7440-47-3	Chromium (total)	M	SW846-6010B	10	ug/l	1	mg/kg
7440-48-4	Cobalt	M	SW846-6010B	50	ug/l	8	mg/kg
7440-50-8	Copper	M	SW846-6010B	25	ug/l	6	mg/kg
7439-92-1	Lead	M	SW846-7000A	3	ug/l	0.3	mg/kg
7439-97-6	Mercury	M	SW846-7470A/7471A	0.2	ug/l	0.15	mg/kg
7440-02-0	Nickel	M	SW846-6010B	40	ug/l	0.9	mg/kg
7782-49-2	Selenium	M	SW846-6010B/7000A	5	ug/l	0.8	mg/kg
7440-22-4	Silver	M	SW846-6010B	10	ug/l	3	mg/kg
7440-28-0	Thallium	M	SW846-7000A	5	ug/l	3	mg/kg
7440-31-5	Tin	M	SW846-6010B	250	ug/l	20	mg/kg
7440-62-2	Vanadium	M	SW846-6010B	50	ug/l	1	mg/kg
7440-66-6	Zinc	M	SW846-6010B	20	ug/l	15	mg/kg
7429-90-5	Aluminum	M	SW846-6010B	200	ug/l	46	mg/kg
7440-70-2	Calcium	M	SW846-6010B	5000	ug/l	76	mg/kg
7439-89-6	Iron	M	SW846-6010B	100	ug/l	30	mg/kg
7439-95-4	Magnesium	M	SW846-6010B	5000	ug/l	38	mg/kg
7439-96-5	Manganese	M	SW846-6010B	15	ug/l	3	mg/kg
7440-09-7	Potassium	M	SW846-6010B	5000	ug/l	76	mg/kg
7440-23-5	Sodium	M	SW846-6010B	5000	ug/l	76	mg/kg
7440-36-0	Antimony - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.006	mg/l
7440-38-2	Arsenic - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.05	mg/l
7440-39-3	Barium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	1	mg/l
7440-41-7	Beryllium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.004	mg/l
7440-43-9	Cadmium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.005	mg/l
7440-47-3	Chromium (total) - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.05	mg/l
7440-50-8	Copper - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	1.3	mg/l
7439-92-1	Lead - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.015	mg/l
7439-97-6	Mercury - SPLP/TCLP	M	1311/1312-7470A	N/A	N/A	0.002	mg/l
7440-02-0	Nickel - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.1	mg/l
7782-49-2	Selenium - SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.05	mg/l
7440-22-4	Silver - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.036	mg/l
7440-28-0	Thallium SPLP/TCLP	M	1311/1312-7000A	N/A	N/A	0.005	mg/l
7440-62-2	Vanadium - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	0.05	mg/l
7440-66-6	Zinc - SPLP/TCLP	M	1311/1312-6010B	N/A	N/A	5	mg/l
5289290-40-1	Total Petroleum Hydrocarbons	Phy	CT-ETPH	0.5	mg/l	50	mg/kg
5289290-40-0	Total Petroleum Hydrocarbons	Phy	EPA 418.1	0.5	mg/l	50	mg/kg

Table 5-1
RECOMMENDED PROJECT SPECIFIC PRACTICAL QUANTITATION LIMITS FOR CONSTITUENTS FOR WHICH ANALYSIS MAY BE CONDUCTED

CAS#	Analyte Name	Type	Project Quantitation Limits				
			Method	Aqueous	Units	Soil	Units
SA0001	Alkalinity (to pH 8.3)	WC	EPA 310.1	1	mg/l	5	mg/kg
SA0002	Total Alkalinity (to pH 4.5)	WC	EPA 310.1	1	mg/l	5	mg/kg
SA0003	Ammonia	WC	EPA 350.2	1	mg/l	20	mg/kg
SA0004	BOD	WC	EPA 405.1	2	mg/l	200	mg/kg
SA0006	Chloride	WC	EPA 300.0	0.2	mg/l	2	mg/kg
SA0007	COD	WC	EPA 410.2	7	mg/l	1250	mg/kg
SA0008	Cyanide, Total	WC	SW846 9012A	0.005	mg/l	0.1	mg/kg
SA0011	Hexavalent Chromium	WC	SW846 7196A	0.01	mg/l	4	mg/kg
SA0012	Nitrate/Nitrite	WC	EPA 300.0	0.1/0.1	mg/l	1.0/1.0	mg/kg
SA0014	Orthophosphate	WC	EPA 365.3	0.01	mg/l	1	mg/kg
SA0018	Total Dissolved Solids	WC	EPA 160.1	30	mg/l	NA	mg/kg
SA0019	Total Organic Carbon	WC	EPA 415.1/Kahn	1	mg/l	5	mg/kg
SA0023	Total Sulfate	WC	EPA 300.0	0.5	mg/l	5	mg/kg
SA0024	Total Suspended Solids	WC	EPA 160.2	9	mg/l	NA	mg/kg

NOTES:

(1) Fractions: VOA (Volatile Organic, DAI (Direct Aqueous Injection), SV (Semivolatile Organic), OCP (Organochlorine Pesticide), OP (Organophospohorus Pesticide, H (Herbicide), Diox/F (Dioxin/Furan), M (Metal), Phy (Physical), and WC (Wet Chemistry Parameter)

(2) Fictitious CAS number created to represent the coeluting isomers 3-methylphenol and 4-methylphenol.

(3) The following VOA compounds are considered poor purging compounds and the above stated detection limits may be difficult for most labs to achieve: acetone, acetonitrile, acrolein, MEK, carbon disulfide, t-1,4-dichloro-2-butene, 1,4-dioxane, 2-hexanone isopropyl alcohol, methacrylonitrile, MIBK. This may be of issue particularly if these compounds are contituents of concern.

(4) These are recommended quantitation limits. The final Practical Quantitation Limits will be at a concentration to comply with the appropriate Connecticut Remedial Standard Regulations criteria or the selected laboratory's lowest reporting limit, whichever is lower.

SW-846 - "Test Methods for Evaluating Solid Waste, Physical Chemical Methods," third edition.

EPA - "Methods for Chemical Analysis of Water and Wastes," EPA 600 4/79-020

CT-ETPH - "Analysis of Extractable Petroleum hydrocarbons (ETPH) Using Methylene Chloride Gas Chromatograph/Flame Ionization Detector"

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
TCL Pesticides/ PCB Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<QL for all compounds	<QL for all compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	Tetrachloror-meta-xylene decachlorobiphenyl	60-150% 60-150%	60-150% 60-150%
TAL Metals plus Tin	Lab blank, trip blank, or field blank	All TCL Compounds	<PRDL for all compounds	<PRDL for all compounds
	Laboratory Duplicate Precission	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Metals	Table 5-3	Table 5-3
All Wet Chemistry Parameters	Lab blank, trip blank, or field blank	All Parameters	<QL for all compounds	<QL for all compounds
	Laboratory Duplicate Precision	All Parameters	Table 5-3	Table 5-3
	Matrix Spike Recovery	All Parameters	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Parameters	Table 5-3	Table 5-3

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
	Surrogate Spike Recoveries	Nitrobenzene-d5	35-114%	23-120%
		2-Fluorobiphenyl	43-116%	30-115%
		p-Terphenyl-d14	33-141%	18-137%
		Phenol-d6	10-94%	24-113%
		Phenol-d5	10-115%	24-113%
		2-Fluorophenol	21-100%	25-121%
		2,4,6-Tribromophenol	10-123%	19-121%
		4,4-Dibromobiphenyl (Spiked onto cartridge before it is sent to the field.)	NA	NA

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
TCL Volatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<5X the QL or methylene chloride, and <QL for all other compounds	<5X the QL or methylene chloride, and <QL for all other compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Surrogate Spike Recoveries	4-Bromofluorobenzene Dibromofluoromethane Toluene-d8 Dichloroethane-d4	86-115% 86-118% 88-110% 80-120%	74-121% 80-120% 81-117% 80-120%
TCL Semivolatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<QL for all compounds	<QL for all compounds
	Matrix Spike Duplicate Precision	All TCL Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All TCL Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All TCL Compounds	Table 5-3	Table 5-3

Table 5-2
RECOMMENDED ACCURACY AND PRECISION DATA QUALITY OBJECTIVES

Parameter	Audit	Compounds	Aqueous Control Limits	Solid Control Limits
Dioxins/ Dibenzoflurans	Lab blank, trip blank, or field blank	All Compounds	<5X the QL or methylene chloride, and <QL for all other compounds	<5X the QL or methylene chloride, and <QL for all other compounds
	Matrix Spike Duplicate Precision	All Compounds	Table 5-3	Table 5-3
	Matrix Spike Recovery	All Compounds	Table 5-3	Table 5-3
	Laboratory Control Sample Recovery	All Compounds	Table 5-3	Table 5-3
	Recovery Standard Recovery	C13-1,2,3,4-TCDD	>40%	>40%

Notes:

QL = Quantitation limit; PRDL = Project required detection Limit; TCL = TargetCompound List; NA= Not Applicable

VOC and SVOC surrogate recoveries updated to reflect most current method specifications on 5/5/01

The compounds and control limits are recommended only. The final compounds and associated control limits will be supplied by selected analytical laboratory from internally generated control charts.

APPENDICES

Appendix A

Summary of Historical Analytical Results

Appendix B

Standard Operating Procedures

Appendix C

CTDEP General Permit for the Discharge of Groundwater Remediation Wastewater to the Sanitary Sewer

Appendix D

Willow Brook/Willow Brook Pond
Dust Control Plan

DUST CONTROL PLAN
FOR
UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
WILLOW BROOK AND WILLOW BROOK POND
EAST HARTFORD, CT

May 2001

Prepared for

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Comm. No. 88UT103

Table of Contents

		Page
1.	**INTRODUCTION**	**1-1**
2.	**OPERATIONAL CONTROLS**	**2-1**
2.1	Methods to Reduce Dust Creation	2-1
2.2	Methods to Control Dust	2-1
3.	**MONITORING**	**3-1**
4.	**NOTIFICATION AND CORRECTIVE ACTION PROCEDURES**	**4-1**

Attachments

Attachment A Dust and Wind Monitoring Daily Log Sheet

1. INTRODUCTION

This Dust Control Plan has been developed to outline the operational controls, monitoring requirements, and notification procedures to be implemented during the performance of the Willow Brook/Willow Brook Pond polychlorinated biphenyl (PCB) remediation project at the Pratt & Whitney (P&W) facility in East Hartford, Connecticut. As the project involves the excavation of wet soil and sediment, the generation of dust as a result of excavation and material handling activities is not anticipated to be a significant concern. This plan is organized to present the operational controls to be implemented during the project to minimize the generation of dust, to control the dust that is generated, to define monitoring requirements to ensure that abutting residents and P&W facility workers are not exposed to airborne particulate matter beyond applicable threshold levels, and to establish notification procedures and corrective actions to be implemented in the event applicable particulate thresholds are exceeded.

The action level for particulate matter in air (dust) established for this project is 150 μg/m~~10 mg/m~~^{3} in air based on a time-weighted-average over a single 1-hour period.~~ which represents the lower of the Occupation Health and Safety Administration (OSHA) permissible exposure level (PEL) of 15 mg/m^3 and the National Institute of Occupational Safety and Health (NIOSH) recommended exposure limit (REL) of 10 mg/m^3.~~

2. OPERATIONAL CONTROLS

The following describes the proposed measures to be implemented during the construction activities associated with the remediation of Willow Brook and Willow Brook Pond. LEA-Cianci, Inc. (LCI) will implement remediation activities under the direct supervision of Loureiro Engineering Associates, Inc. (LEA)

2.1 Methods to Reduce Dust Creation

The following are the methods to be employed to minimize the potential for dust generation:

1. All vehicle transport routes will be maintained through the use of a mechanical sweeper;
2. All entrance and exit points from areas of excavation will be provided with an anti-tracking pad of crushed stone;
3. Transportation and disposal vendor vehicles leaving the site will be pressure washed to remove particulate matter;
4. All stockpiled materials awaiting offsite disposal will be staged within designated stockpile areas;
5. All stockpiled material from by-pass channel excavation will either be covered or dust suppressants (Section 2.2) will be applied;
6. Stockpile areas will be constructed with wind screens along the western, eastern and northern limits (predominant wind direction during the construction period is from the south and southwest);
7. Stockpiled material will either be covered or dust suppressants (Section 2.2) will be applied.

2.2 Methods to Control Dust

LCI will provide either or both of the following means to perform active dust control throughout the planned remediation activities. One method will be through the use of a full-time water truck to apply water on an as-needed basis to all active work areas. The second method will be through a truck-mounted mechanical broadcast spreader to apply chemical dust suppressants (calcium chloride or sodium chloride) to active work areas. The two methods may be implemented either alone or in conjunction with one another on an as needed basis to ensure the

150 μg~~10 mg~~/m^3 standard for the project is not exceeded. Active work areas include all areas being excavated or restored, all vehicle transport routes, and all staging and stockpiling areas for contaminated soil or backfill materials for the construction of the engineered controls.

3. MONITORING

Dust monitoring and wind direction monitoring will be performed on a daily basis during the following period:

- Dust and wind direction monitoring to commence upon initiation of demolition, ~~or~~ excavation, or soil and sediment handling activities (material handling activities);
- Dust and wind direction monitoring to be discontinued upon completion of placement of all earthen materials associated with caps.

Wind direction monitoring will be performed through the use of a windsock to be strategically located within the limits of the project area (depicted as the Limits of Construction on Drawing 1-1 of the Remedial Action Work Plan). Real-time d~~D~~ust monitoring will be performed by affixing the particulate monitoring device at a location downwind of excavation activities at the site when: 1) precipitation has not occurred during the previous 24 hours; and 2) when work is being performed at the site. ~~walking the perimeter of the project area with a portable particulate monitor at a frequency of once per day when: 1) precipitation has not occurred during the previous 24 hours; and 2) when work is being performed at the site.~~ The individual responsible for performing the dust monitoring will manually record the maximum and time-weighted concentration at a frequency of not greater than once per hour during periods of material handling activities at the site.~~individual readings at a rate of once per every 500 feet of perimeter with individual locations biased to the locations at which material handling activities are occurring.~~

~~Dust monitoring will be performed on a more frequent basis if the above monitoring indicates an exceedance of the 10 mg/m^3 standard for the project.~~ Notification procedures and corrective actions are described in Section 4.0. The portable particulate monitor will be a direct read personal monitor and will be calibrated and maintained in accordance with the manufacturer recommended intervals. The dust monitor will be capable of monitoring particulate matter less than 10 microns in size, capable of storing individual readings for a single 24-hour period, and will be provided with a digital readout of maximum and time-weighted-average concentrations for a 1-hour period. At a minimum, the particulate monitor will be calibrated prior to each use. A daily log sheet for dust and wind monitoring is provided as Appendix A.

4. NOTIFICATION AND CORRECTIVE ACTION PROCEDURES

This section presents procedures to be implemented in the event daily monitoring indicates an exceedance of the 150~~0~~ µg~~mg~~/m^3 time-weighted average standard for the project at any one individual location along the downwind perimeter of the project area. ~~It should be noted, the standard for the project is based on an 8 hour time weighted average.~~ As a result, the procedures provided below are those that are necessary to correct the activities identified as resulting in the exceedance.

If during the hourly inspection and recording of particulate levels it is noted that the running time-weighted-average concentration of particulate matter exceeds 150 µ ~~daily dust monitoring, a single point reading exceeds the 10 m~~g/m^3 standard for the project, perform the following:

1. Remove the dust monitor from the sampling location and proceed to an upwind location and obtain a background measurement. If the working site particulate matter measurement is less than 100 µg/m^3 above the background level, return the monitor to the original monitoring location and continue with hourly readings. If the working site particulate matter measurement is greater than 100 µg/m^3 above the background level, perform the following tasks.

2. Immediately notify the onsite LCI Superintendent of the result via two-way radio or telephone;

~~2.~~3. Perform a visual inspection of the work area and identify the suspect activities generating dust;

~~3.~~4. Immediately proceed to the location of the suspected activities and inform workers to cease operations if operations are the cause of dust;

~~4.~~5. Immediately arrange for application of dust suppression materials as identified in Section 2.2;

~~5.~~6. Recommence project activities and repeat sampling at the original downwind sampling location where the exceedance was noted~~location of the exceedance~~; and

~~6.~~7. Repeat steps 3 though 6 ~~4 and 5~~, if necessary, until the particulate reading is less than the 150 ~~10 m~~µg/m^3 standard over a one-hour period.

Attachment A

Dust and Wind Monitoring
Daily Log Sheet

Willow Brook and Willow Brook Pond
PCB Remediation Project
Dust and Wind Monitoring Daily Log Sheet

Date: _____
Wind Direction: _____ Time: _____ a.m./p.m.

Dust Monitoring Inspector Name: _____

Inspector Signature:

Location Description (ex. 250 feet east of field office)	Time (ex. 10.15 am)	Reading (mg/m^3)

Dust Monitor Calibration Record:

Performed By: _____
Date: _____
Time: _____
Standard: _____
Instrument Reading: _____

Corrective Actions:

If during the hourly inspection and recording of particulate levels it is noted that the running time-weighted-average concentration of particulate matter exceeds 150 μ g/m^3 standard for the project, perform the following:

1. Remove the dust monitor from the sampling location and proceed to an upwind location and obtain a background measurement. If the working site particulate matter measurement is less than 100 $\mu g/m^3$ above the background level return the monitor to the original monitoring location and continue with hourly readings. If the working site particulat matter measurement is greater than 100 $\mu g/m^3$ above the background level, perform the following tasks.
2. Immediately notify the onsite LCI Superintendent of the result via two-way radio or telephone;
3. Perform a visual inspection of the work area and identify the suspect activities generating dust;
4. Immediately proceed to the location of the suspected activities and inform workers to cease operations if operations are the cause of dust;
5. Immediately arrange for application of dust suppression materials as identified in Section 2.2;
6. Recommence project activities and repeat sampling at the original downwind sampling location where the exceedance was noted; and
7. Repeat steps 3 though 6 , if necessary, until the particulate reading is less than the 150 $\mu g/m^3$ standard over a one-hour period.

REQUEST FOR VARIANCE
ENGINEERED CONTROL OF POLLUTED SOILS
UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
WILLOW BROOK AND WILLOW BROOK POND
EAST HARTFORD, CT

January 2001
Revised May 2001
Revised July 2001

Prepared for

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Table of Contents

		Page
1.	**INTRODUCTION**	**1-1**
1.1	Project Limits	1-1
1.1.1	Upstream of the Dam	1-2
1.1.2	Downstream of the Dam	1-2
1.2	Facility Background	1-4
1.3	Description of Site	1-4
1.4	Report Scope and Organization	1-5
2.	**CONTAMINANT DELINEATION INVESTIGATIONS**	**2-1**
2.1	Initial Site Characterization Investigation	2-1
2.2	Supplemental Site Characterization Investigation – Phase II	2-3
2.3	Supplemental Site Characterization Investigation – Phase III	2-4
2.4	Nature and Extent of Contamination	2-7
2.4.1	Soil and Sediment	2-7
2.4.2	Groundwater	2-7
2.4.3	Surface Water	2-7
3.	**EVALUATION OF REMEDIAL ALTERNATIVES**	**3-1**
3.1	Complete Excavation and Offsite Disposal	3-1
3.1.1	Demolition and Removal of Existing Structures	3-2
3.1.2	Contaminated Soil and Sediment Excavation and Offsite Disposal	3-3
3.1.3	Site Restoration	3-3
3.1.4	Capital Cost	3-4
3.2	Partial Excavation and Installation of Engineered Control	3-4
3.2.1	Demolition and Removal of Existing Structures	3-5
3.2.2	Contaminated Soil and Sediment Excavation and Offsite Disposal	3-6
3.2.3	Site Restoration	3-6
3.2.4	Capital Cost	3-7
3.3	Cost Comparison	3-8
4.	**DESIGN, MANAGEMENT AND ADMINISTRATIVE REQUIREMENTS**	**4-1**
4.1	Design of Engineered Control	4-1
4.2	Groundwater Monitoring	4-2
4.3	Maintenance of Engineered Control	4-2
4.4	Institutional Controls	4-3
4.5	Financial Assurance	4-3
4.6	Public Notice	4-3

5. CONCLUSIONS 5-1

FIGURES

1-1 Site Location Map
1-2 Existing Site Plan
3-1 Remediation Activities – Complete Excavation
3-2 Site Restoration – Complete Excavation
3-3 Proposed Willow Street Realignment
3-4 Remediation Activities – Partial Excavation and Engineered Control
3-5 Site Restoration – Partial Excavation and Engineered Control
3-6 Stream Channel Cap Detail
3-7 Composite Cap, Upper Pond and Lower Pond Cap Details
3-8 Wetland Restoration Area Detail

APPENDICIES

Appendix A Summary of Historical Analytical Results
Appendix B Detailed Construction Cost Estimate – Complete Excavation
Appendix C Detailed Construction Cost Estimate – Partial Excavation and Engineered Control
Appendix D Post Remediation Groundwater Monitoring Plan
Appendix E Post Remediation Maintenance and Monitoring Program

1. INTRODUCTION

Loureiro Engineering Associates, Inc. (LEA) was retained by United Technologies Corporation/Pratt & Whitney (UTC/P&W) to perform investigations and evaluation of remedial alternatives to address soil and sediments contaminated with polychlorinated biphenyls (PCBs) within and immediately surrounding Willow Brook and Willow Brook Pond at the UTC/P&W manufacturing facility in East Hartford, Connecticut. LEA completed a comprehensive subsurface investigation of the site during the period from December 1997 to April 1999. The results of the investigation form the basis upon which the proposed remediation, detailed herein, is based. The proposed remediation is also presented in detail in the document entitled *Remedial Action Work Plan - United Technologies Corporation, Pratt & Whitney, Willow Brook and Willow Brook Pond, East Hartford, CT* by Loureiro Engineering Associates, Inc., dated November 2000, revised May 2001. The Remedial Action Work Plan is incorporated herein by reference.

The selected remediation approach consists of the excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 milligram per kilogram (mg/kg or parts per million (ppm)). Following excavation, a geotextile, soil and rock cap will be installed over the entirety of Willow Brook Pond and the open channel of Willow Brook from Willow Brook Pond to Main Street. The exception to this approach is the wetland downgradient of the dam where excavation of PCBs at concentrations greater than the residential direct exposure criteria (RDEC) will be performed and the area backfilled and planted to restore the wetland.

Following remediation, the open channel of Willow Brook from the pond to Main Street will be restored to the current configuration. In response to a request by the Department of Environmental Protection (DEP) staff, the Willow Brook stream channel will be slightly modified between the dam that impounds Willow Brook Pond and Main Street to reduce the slope of the banks to control potential erosion and to modify the character of the channel bottom to create a low flow channel with pools and eddies. Willow Brook Pond will be restored to the current configuration. The proposed sediment cap will be installed throughout the pond bottoms. Due to the thickness of the cap (3-feet) and based on the proposed sediment removal volume, the final bathymetry within the ponds will be slightly modified to accommodate the proposed cap section.

1.1 Project Limits

The limits of the project are defined in two separate areas (upstream of the dam and downstream

of the dam) and each area in two separate parts. The limits of the project area upstream of the dam is defined in two parts, Willow Brook Pond and the area of the former oil/water separator and process water buildings. The project area downstream of the dam is defined in two parts, the stream channel of Willow Brook Pond and the wetland area. It is recognized that the potential exists that contamination may exist outside these project limits. However, the intent of this remediation project is to address soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. Measures to address contamination beyond those limits described below would be addressed in the future as separate projects.

1.1.1 Upstream of the Dam

Willow Brook Pond: With one exception, the lateral limit of the project area of Willow Brook Pond, inclusive of the small embayment west of the Process Water Facility and south of the lower section of Willow Brook Pond, is defined as the horizontal location of the ordinary water level (reference Figure 1-2). The single exception is the location east of the upper section of Willow Brook Pond in the vicinity of a single soil boring WT-SB-132 (see Appendix A). The project area encompasses this boring to the limits shown on Figure 1-2. Remediation, if necessary, beyond the limits shown will be performed as a separate project.

Former Oil/Water Separator: The lateral limits of the project area in the vicinity of the former oil/water separator is currently defined as the lateral limit of soils containing PCBs at concentrations greater than 25 ppm. However, it is recognized that the potential exists that PCBs and other constituents may exist in soils outside this lateral limit that would require remediation as part of the project. The current estimate of the lateral limits of the project in this area is depicted on Figure 1-2.

Process Water Buildings: The lateral limits of the project area in the vicinity of the process water buildings is defined as that area of disruption necessary to facilitate removal of the related subsurface structures (i.e. foundations, footings, etc.).

1.1.2 Downstream of the Dam

Stream Channel Cap: The lateral limit of the project area for the stream channel cap is the 10-year flood elevation (22.0 to 24.0 feet above mean sea level) as shown on Figure 1-2.

Wetland Area: The lateral limit of the project area for the wetland is currently defined to the south by the northern limit of the stream channel cap and to the north, east and west as the lateral limit of soils containing PCBs at concentrations greater than the RDEC. The lateral limits of these areas are also depicted on Figure 1-2.

As noted in Section 1 of the May 2001 revision to the November 2000 Remedial Action Work Plan, volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbons and select metals were also detected in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. These constituents are commingled with soil and sediment containing PCBs. These constituents will remain in place in those areas in which they are commingled with soil and sediment containing less than 25 ppm PCBs and will be rendered inaccessible with the geotextile, soil and stone cap.

In summary, the components of the remediation approach include:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;
- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;
- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;

- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and

- The implementation of two institutional controls consisting of 1) an environmental land use restriction (ELUR) to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

This particular alternative necessitates a variance to the criteria of the Remediation Standard Regulations (RSRs). In accordance with 22a-133k-2(f)(2)(A) and (B) of the Regulations of Connecticut State Agencies (RCSA), a request to use an engineered control must be submitted to the Commissioner of the Department of Environmental Protection (DEP) and must be accompanied by a detailed written report and plan. This report, coupled with the May 2001 revision of the November 2000 Remedial Action Work Plan, have been prepared to satisfy these requirements.

1.2 Facility Background

The UTC/P&W facility is located at 400 Main Street in East Hartford, Connecticut, and is approximately 1,100 acres in size. P&W initiated aircraft engine manufacturing operations in East Hartford in December 1929. Current site operations are conducted in a 6.5 million square foot complex and include administration and management, manufacturing, testing, research and development and ancillary services. All of these activities take place in the western portion of the 1,100-acre property. The Rentschler Airport and the Klondike Area occupy the eastern portion of the property. P&W previously used these two areas as an airport and a storage/testing area, respectively.

1.3 Description of Site

The Willow Brook and the Willow Brook Pond remediation area is about 4 acres in size. The site is within a mixed residential, commercial, and industrial area of East Hartford, Connecticut. Willow Brook is a small stream transecting the UTC/P&W facility from the northern portion of the Rentschler Airport through to the northwest portion of the current UTC/P&W operations complex. Willow Brook flows in a southwesterly direction in an open channel from the Rentschler Airport, is then hard-piped underground to the inlet of Willow Brook Pond, and continues from the pond as an open channel to a culvert under Main Street. From Main Street, Willow Brook flows in an open channel for a distance of approximately 2,500 feet to the confluence with the Connecticut River (see Figure 1-1). Willow Brook Pond is a man made water body located in the northern portion of the Site (See Figure 1-2). The pond, a single body

of water when first created, has been modified various times through the years. It is now comprised of two ponds subdivided by a culvert. Historically, basement dewatering, industrial waters and process wastewater were directed to the pond. Some of these discharges were routed through an oil/water separator. Currently, Willow Brook Pond serves as part of the non-contact cooling water re-circulation system serving the Site.

During routine draining of Willow Brook Pond in September 1997, an oil sheen was noticed seeping through the sediment. P&W reported the sheen to the United States Coast Guard and the DEP in accordance with discharge reporting requirements. Following the detection of PCBs in a sample, the DEP issued P&W a notice of violation (NOV), No. PCB 97-08, on November 7, 1997. In response to the NOV, UTC/P&W developed a sampling work plan and conducted three phases of remedial investigation from December 1997 to April 1999. These investigations identified the probable sources and provided the analytical data to sufficiently define the horizontal and vertical limits of contamination allowing development of a remediation plan.

1.4 Report Scope and Organization

The following sections of this report have been prepared to satisfy the requirements set forth in Section 22a-133k-2(f)(2)(A) and (B) of the RCSA. More specifically, the following sections address the following requirements:

- Demonstrating that the cost of remediating the polluted soil at this site is significantly greater than the cost of installing and maintaining an engineered control and conducting groundwater monitoring;
- Demonstrating that the significantly greater cost outweighs the risk to the environment if the engineered control fails to prevent mobilization or human contact with substances in the soil;
- Demonstrating that the engineered control is well designed and will isolate polluted soil;
- Demonstrating that plans for groundwater monitoring are adequate to ensure that any substance migrating from the subject area will be detected;
- Demonstrating that maintenance plans for the control are adequate and the integrity of the control will be maintained;
- Ensuring that an Environmental Land Use Restriction (ELUR) will be recorded limiting the future use and activities upon the subject area; and
- Ensuring that a surety will be posted to adequately cover the costs for five years of maintenance and monitoring.

The following is a general description of the contents of each of the following sections of the report.

- Section 2 presents a discussion summarizing the site characterization and identifies the areas for which remediation is warranted.

- Section 3 presents an evaluation of the alternatives considered to address the remediation of Willow Brook and Willow Brook Pond. The alternatives presented in this section include complete excavation and offsite disposal of all soil and sediment containing PCBs at concentrations greater than the RDEC and the selected alternative of partial excavation and offsite disposal and the use of an engineered control. The primary focus of Section 3 is presentation of a cost comparison as it is concluded that both alternatives are technically and administratively feasible.

- Section 4 presents a discussion of the design, management and administrative requirements that are necessary when implementing an engineered control. Specifically, this section details the design elements of the proposed engineered control, presents a general description of the planned maintenance and monitoring plan for the proposed engineered control and a statement of intent that financial assurance for the performance of maintenance and monitoring will be provided, and statements of intent to record an ELUR for the subject area and to provide adequate public notice of the planned engineered control.

- Section 5 presents conclusions regarding the use of an engineered control to address soil and sediment contaminated with PCBs, volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbons and select metals within and immediately surrounding Willow Brook and Willow Brook Pond.

2. CONTAMINANT DELINEATION INVESTIGATIONS

This section presents a summary of the three previous phases of investigation conducted at Willow Brook and Willow Brook Pond from December 1997 to April 1999. This information is also presented in the May 2001 revision of the November 2000 Remedial Action Work Plan, which has been submitted to DEP and the United States Environmental Protection Agency. A summary of the analytical results for the entire sampling program is included as Appendix A as a series of detailed site plans.

The investigations identified some probable sources and provided the analytical data to define the horizontal and vertical limits of contamination in sufficient detail to allow for the identification and evaluation of remedial alternatives. Appendix A contains an overview of the delineation of the extent of PCBs in soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond.

2.1 Initial Site Characterization Investigation

On February 13, 1998, LEA prepared a report entitled *Phase I: Report on PCB Investigation for Willow Brook and Willow Brook Pond Sediment.* The purpose of this report was to present the findings of the PCB investigation conducted on Willow Brook and Willow Brook Pond sediment in order to address the requirements of item (1) of the third paragraph of the NOV, No. PCB 97-08 issued by the DEP and dated November 7, 1997. The sampling was performed in accordance with the *Work Plan for Willow Brook and Willow Brook Pond PCB Investigation*, prepared by LEA and dated December 12, 1997, and approved by the DEP on December 22, 1997.

The report describes the field activities performed based on a predetermined sampling grid and presents the analytical results of the investigations. A Toxic Substances Control Act (TSCA) sampling grid was developed to specify the number and location of samples for the investigation in accordance with USEPA's guidance document entitled *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup.* Two separate sampling grids were prepared for the east and west surface water bodies of Willow Brook Pond. The sampling was performed in accordance with the approved Work Plan, with the exception that the pond was not drained in response to DEP's concerns about sediment disturbance. Detectable PCB values on the sediment samples collected ranged up to a maximum concentration of 617 ppm total PCBs at sampling point WT-SD-33, located immediately downgradient of the subsurface connector between the eastern and western surface water bodies comprising Willow Brook Pond. Relatively high PCB concentrations were also observed in sediment samples collected in the vicinity of this location in both water bodies. Relatively elevated PCB concentrations were also observed along Willow

Brook immediately downstream of Willow Brook Pond. A total PCB concentration of 327 ppm was observed in the sediment at location WT-SD-52. The results of the investigations indicated the presence of elevated PCB concentrations throughout Willow Brook Pond and in the section of Willow Brook between the pond and Main Street. The PCB concentrations observed beyond that point were below 1 ppm.

Selected sediment samples were also analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and the RCRA eight metals (arsenic, barium, cadmium, chromium, mercury, lead, silver, selenium) plus nickel and zinc.

Among the limited sediment samples analyzed for these parameters, elevated levels of SVOCs were detected in the sediment at location WT-SD-47 in the eastern water body of Willow Pond. Some of the highest SVOC concentrations reported in that sample included pyrene (480 mg/kg), phenanthrene (514 mg/kg), fluoranthene (537 mg/kg), chrysene (232 mg/kg), etc. Some of the highest metal concentrations observed in this location included lead (153 mg/kg), zinc (152 mg/kg), barium (37.7 mg/kg), and nickel (36.4 mg/kg), etc. The only VOC compounds identified in this location included trichloroethylene (23 mg/kg), tetrachloroethylene (11.6 mg/kg), 1,1,1-trichloroethane (9.7 mg/kg), and 1,1-dichloroethane (10 mg/kg). Generally lower SVOC and VOC concentrations were observed in the other locations samples.

Elevated TPH concentrations were observed at WT-SD-47 (1,160 mg/kg) and WT-SD-09 (4,340 mg/kg and 3,930 mg/kg in the duplicate). Relatively elevated metal concentrations were also observed at this location (zinc 772 mg/kg and 689 mg/kg in the duplicate, nickel 595 mg/kg and 593 mg/kg in the duplicate, lead 714 mg/kg and 691 mg/kg in the duplicate, chromium 490 mg/kg and 497 mg/kg in the duplicate).

It should be noted that no sediment was encountered in upstream accessible locations within the Willow Brook conduit to allow sample collection. Several manholes along the subsurface conduit were opened to confirm no sediment had accumulated within the conduit. Historical measurements have indicated non-detectable PCB levels in sediment samples collected from upstream brook locations, upstream of the conduit.

Based on the results obtained, additional investigations were determined to be necessary to better characterize the vertical extent of the contamination within Willow Brook and Willow Brook Pond and to identify potential nearby sources of contamination.

2.2 Supplemental Site Characterization Investigation – Phase II

In April 1998, LEA published a report entitled *Phase II: Report on Supplemental PCB Investigation for Willow Brook and Willow Brook Pond.* The purpose of this report was to present the findings of the supplemental PCB investigation conducted on Willow Brook and Willow Brook Pond. The supplemental soil and sediment sampling was performed to identify potential nearby sources of contamination and to provide information of the vertical extent of the contamination within Willow Brook and Willow Brook Pond. An overview of the results of the investigation is presented in the following paragraphs.

Southwestern Bank of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic sludge drying beds located to the south of Willow Brook Pond was a potential source. Four soil borings were installed at the southwestern bank of Willow Brook Pond downgradient of the historic sludge drying beds. The borings were advanced to a depth of 20 to 24 feet from the western bank of the pond. Low total PCB concentrations (up to about 2 ppm) were detected in the borings installed along the southwestern bank of Willow Brook Pond. These concentrations did not appear to be indicative of a source of PCB contamination.

Area of Former Oil Basin, Western Section of Willow Brook Pond: This area was investigated to determine if infiltration or seepage from historic operations in the pond area was a potential source. The existing oil-water separator is currently operating in this area. Four soil borings were installed in the vicinity of the area of the Former Oil Basin, the small embayment west of the Process Water Facility and south of the lower section of Willow Brook Pond. Two of these borings were installed on top of the bank immediately to the south of the area of the Former Oil Basin using a Geoprobe®. These soil borings were advanced and sampled to a depth of 20 to 24 feet. The other two were installed by hand auger techniques to a depth of 2 to 8 feet in the immediate proximity of the existing oil/water separator. PCBs were detected in the soils collected from the four soil borings. However, the highest total PCB concentrations were of the order of 1.3 ppm. These concentrations do not appear to be indicative of a source of contamination.

Former Oil/Water Separator: This area was investigated to determine if infiltration or seepage from historic operations in the Pond area was a potential source. Five soil borings were installed in the vicinity of the Former Oil/Water Separator in between the two sections of Willow Brook Pond to identify potential historic sources of PCB contamination. The soil borings were installed using a Geoprobe®. These soil borings were advanced and sampled to a depth of approximately 20 feet. Soil samples were collected every 2 feet and screened visually for the presence of oil.

Three samples were submitted for analysis from each boring. Elevated total PCB concentrations were observed in the soil samples from this location. The total PCB concentration observed in this area ranged up to 128 ppm (location WT-SB-88) at a depth of 10 to 12 feet. Free oil was also observed in this location. However, the oil was not extracted from the soil matrix for separate analysis. The highest PCB concentrations were observed at a depth of approximately 8 to 12 feet below ground surface corresponding approximately to the depth of the water and sediment within the pond, and the approximate level of the water table in the area. These concentrations and findings from this area are indicative of a probable source. It should be noted that the contamination might have originated from multiple sources.

Sediment Sampling: In-depth sampling was also performed within the eastern and western water body of Willow Brook Pond, and along Willow Brook in the vicinity of the wetlands area, and in the wetland area within UTC/P&W's property. These samples were collected to develop at-depth profiling information. It should be noted that only surface sediment samples were collected during the initial Phase I investigation. A 5-foot core was used for collection of the sediment and underlying soil samples during Phase II. Generally, one sediment and two soil samples of the underlying soil were selected from each sampling location. Detected total PCB concentrations within the two sections of Willow Brook Pond (east and west) ranged in concentrations up to 258 ppm in the upper 0- to 2-foot interval. The highest concentration was observed in location WT-SD-72 near the effluent point from Willow Brook Pond. Approximately 73.5 ppm of total PCBs were detected at a depth interval of 2 to 4 feet in location WT-SD-78, located at the eastern portion of Willow Brook Pond. Significantly lower and/or non-detectable levels were observed at greater depths. PCB concentrations remained at detectable levels at certain locations at depths up to 8 or 12 feet. Total organic carbon (TOC) concentrations up to 162,000 mg/kg were detected in sediment samples within Willow Brook Pond (location WT-SD-75 at a depth of 0 to 2 feet).

The total PCB concentrations detected in Willow Brook in the vicinity of the wetlands area and within the wetlands for surface samples (0 to 6 inches) varied in concentration up to 299 ppm (location WT-SD-92). The total PCB concentrations observed in the at-depth samples (1.5 to 2.0 feet) were significantly lower ranging from 2.6 ppm to 5.7 ppm.

Additional investigations were then proposed, focusing on the areas where the highest levels of PCB contamination were identified to further investigate and define the extent of contamination.

2.3 Supplemental Site Characterization Investigation – Phase III

In April 1999, LEA prepared a report entitled *Phase III: Report on PCB Investigation for Willow Brook and Willow Brook Pond.* The purpose of this report was to present the findings of

the third phase of PCB investigations in Willow Brook and Willow Brook Pond. During this phase, soil samples were collected from soil borings and monitoring wells installed in the vicinity of Willow Brook Pond. In addition, surface sediment and soil samples to depths of up to 6 feet were collected along the banks of Willow Brook. Soil/sediment samples were collected from the wetland area at Willow Arms and from other adjacent residential properties along the portion of Willow Brook, which lies downstream of Willow Brook Pond and to the east of Main Street. Groundwater sampling was also performed in monitoring wells installed at the perimeter of Willow Brook Pond.

Willow Brook Pond Perimeter Sampling: Twelve soil borings and eight monitoring wells were installed in the vicinity of Willow Brook Pond to assess the lateral extent of the contamination. The borings and monitoring wells were installed using a Geoprobe® to a depth of approximately 20 feet. Hand auger borings to an approximate depth of 12 feet were installed in locations inaccessible by the Geoprobe®. Soil samples were collected every 2 feet and screened visually for the presence of oil. Three samples were submitted for PCB analysis from each boring, including the most contaminated one, based on visual observations, and random ones corresponding approximately to the depth of contamination obtained during the previous investigation. Total PCB concentrations of 50.87 ppm were observed to the east of the eastern water body at Willow Brook Pond, along the reinforced concrete pipe that conveys flow from Willow Brook into Willow Brook Pond. Relatively elevated PCB concentrations up to 14.33 ppm were observed in the area of the Former Oil-Water Separator between the two sections of Willow Brook Pond. This is consistent with previous findings and assists in delineating the contamination in this area. Elevated concentrations of semi-volatile organic compounds (SVOCs) and select metals have been observed at some locations. The elevated compounds are consistent and appear to be co-located with the elevated PCB concentrations.

PCBs may have seeped into nearby soils at certain locations, for example at location WT-PZ-140 to the north of the larger water body of Willow Brook Pond (3.82 ppm). However, concentrations detected at depth are generally much lower or below detectable levels. The contamination was confirmed to be primarily contained within Willow Brook Pond.

Wetlands and Stream Bank Sampling: Soil/sediment samples were collected from several abutting residential properties along the segment of Willow Brook between Willow Brook Pond and Main Street. The samples were collected at different elevations along the bank of the brook to assess the lateral extent of contamination. Samples were also collected from the wetlands area at the Willow Arms property and from the adjacent portion of UTC/P&W's property. Surface soil/sediment samples were collected in a total of 28 locations. In seven of these locations, hand auger borings were advanced to approximately 6 feet to assess the vertical extent of

contamination. Relatively elevated PCB concentrations (up to 596.2 ppm) were observed within the wetland area. Relatively elevated SVOC and select metals concentrations were also observed within this area, and, as stated before, are consistent and co-located with elevated PCB concentrations. The total PCB concentrations typically decrease to less than 1 ppm at a depth of 4 to 6 feet below grade. Similar concentrations were observed in the wetland area within UTC/P&W property. Total PCB concentrations up to 21.77 ppm were detected from sediment within Willow Brook in the off-site properties (downstream of the wetland area). The PCB concentrations observed drop substantially at higher elevations along the bank of Willow Brook, indicating that the contamination is confined within the brook and the wetland. PCB concentrations decrease to less than 1 ppm prior to Main Street.

Groundwater Sampling: LEA personnel collected groundwater samples from the installed monitoring wells during two separate sampling events (December 4, 1998 and February 10, 1999). During the December 4, 1998 sampling event, samples were collected from WT-PZ-124, WT-PZ-129, WT-PZ-131, WT-PZ-134, WT-PZ-136, WT-PZ-139, WT-PZ-140, and WT-PZ-142 using a peristaltic pump and dedicated polyethylene tubing. PCBs were only detected at two locations, monitoring wells WT-PZ-136 [8.5 parts per billion (ppb)] and WT-PZ-139 (0.73 ppb). These wells are in the vicinity of locations where the highest PCB concentrations in soil have been detected.

The second round of groundwater monitoring was performed to supplement the first round in which certain analyses were not performed due to sample breakage while in transit to the laboratory and to provide additional monitoring data on all parameters detected during the initial round. During the February 10, 1999 sampling event, samples were collected from WT-PZ-124, WT-PZ-129, WT-PZ-131, WT-PZ-134, WT-PZ-136, WT-PZ-139, WT-PZ-140, and WT-PZ-142 using a peristaltic pump and dedicated polyethylene tubing. The data from the second round generally confirmed the results of the previous round as PCBs were detected at the same two locations. PCBs were detected in groundwater from monitoring wells WT-PZ-136 (7.9 ppb) and WT-PZ-139 (1.7 ppb).

Surface Water Sampling: Surface water samples were collected from two locations at Willow Brook Pond (at the pumps from the larger water body prior to entering the facility for non-contact cooling water use and at the dam) and from Willow Brook (downstream of Willow Brook Pond at the intersection with Main Street). No PCBs were detected in any of the surface water samples collected.

2.4 Nature and Extent of Contamination

2.4.1 Soil and Sediment

Overall and with consideration of the data collected to date, PCB concentrations are generally distributed in the brook and pond sediments gradually decreasing in concentration in the downgradient direction. This decrease trends from > 100 ppm in the pond and wetland areas to a concentration of < 1 ppm at Main Street. PCBs were also found in the soils between the two ponds, where the former oil/water separator was located. The vertical extent of PCB impacts has been defined by the sampling conducted, generally achieving non-detect or concentrations < 1 ppm at depths ranging from 4 to 6 feet below grade in the wetlands area and 14 to 16 feet below grade in the area between the eastern and western section of the pond. Soil samples collected along and up the banks of the brook and ponds define the horizontal limits of PCB to non-detect or concentrations of < 1 ppm. Appendix A contains drawings depicting the extent of PCB impact in the Willow Brook and Willow Brook Pond area. SVOCs and select metals are co-located with the elevated PCB concentrations.

2.4.2 Groundwater

Groundwater samples collected during the investigations identified only two locations where PCBs were detected in groundwater at concentrations exceeding the analytical reporting limits (WT-PZ-136 and WT-PZ-139). Well WT-PZ-136 is located in the immediate vicinity of the former oil/water separator and locations of high PCB content in soil. Well WT-PZ-139 is adjacent to an area of elevated PCB in soils.

2.4.3 Surface Water

Surface water sampling from Willow Brook and Willow Brook Pond was performed on February 6, 1998. Samples were collected from Willow Brook Pond at the pumps pumping from the larger water body and dam and from Willow Brook downstream of Willow Brook Pond at Main Street. No PCBs were detected in any of the surface water samples collected.

3. EVALUATION OF REMEDIAL ALTERNATIVES

As stated in Section 2, an adequate level of investigation has been performed to allow for the identification and evaluation of alternatives to address soil and sediment contaminated with PCBs, semi-volatile organic compounds, petroleum hydrocarbons and select metals within and immediately surrounding Willow Brook and Willow Brook Pond. For the purposes of this request, the following section presents an evaluation of two alternatives to address the identified contamination. The alternatives presented are:

1. The complete excavation and removal of contaminated soil and sediment exceeding the RDEC for PCBs within the Willow Brook Pond project limits as defined in Section 1.1;

2. The excavation and offsite disposal of soil and sediment from within and immediately surrounding Willow Brook and Willow Brook Pond that contains PCBs at concentrations greater than 25 ppm (the RDEC in a 1-acre wetland and in the southwestern portion of the lower section of Willow Brook Pond) and the placement of an engineered control over the entirety of the Willow Brook and Willow Brook Pond (with the exception of the 1-acre wetland) within project limits as defined in Section 1.1.

3.1 Complete Excavation and Offsite Disposal

The proposed construction activities involve:

- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;

- The removal and offsite disposal of an oil/water separator and the excavation and offsite disposal of soil containing concentrations of PCBs in excess of the RDEC and, SVOCs, TPH and select metals in excess of commercial/industrial direct exposure criteria (IDEC) and GB pollutant mobility criteria (GBPMC) in the vicinity of the oil/water separator;

- The excavation and offsite disposal of approximately 36,800 cubic yards of soil and sediment containing total PCBs at concentrations greater than the RDEC from within and immediately surrounding the Willow Brook and Willow Brook Pond;

- The placement of granular backfill within excavation areas to restore the site to existing grade;

- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and

- The implementation of an institutional control consisting of an ELUR to ensure the affected area will not be used for residential purposes.

The following parts of this section describe in general each of the anticipated construction activities necessary to complete under this alternative. Figure 3-1 presents the approximate limits of the planned excavation. Figure 3-2 presents the planned surface restoration activities.

3.1.1 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Figure 3-1). A list and description of the primary structures to be demolished are as follows:

- Five buildings and components associated with the process water facility; and

- The abandoned underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Prior to demolition, a complete survey of the structures and their components will be performed. The survey is necessary to determine decommissioning, demolition, and disposal requirements. UTC/P&W will be responsible for shutdown and removal of components they intend to reuse from the process water facility.

Process Water Buildings: Demolition of the process water buildings will extend to a depth necessary to achieve the project objectives of removal of soil and sediment containing total PCBs in excess of the IDEC in inaccessible locations and RDEC in accessible locations. Other related structures, such as pilings, erosion structures, etc., will also be demolished and removed to a depth necessary to achieve the project objectives. Pipes and utilities connected to these buildings will be abandoned during the demolition activities or during the soil and sediment removal phase of the project.

Former Oil/Water Separator: A buried oil/water separator is located between the upper and lower sections of Willow Brook Pond. This structure and surrounding soils are contaminated with PCBs. The oil/water separator, its contents, and the impacted soil containing PCBs at concentrations greater than 1 ppm surrounding the structure will be completely removed and disposed of at an offsite location during the project. Prior to removal of the structure, the oil/water separator will be exposed and any remaining contents will be removed, characterized, and disposed of at an offsite location.

3.1.2 Contaminated Soil and Sediment Excavation and Offsite Disposal

It is anticipated that approximately 36,800 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. In general, soil and sediment excavated, as part of the remediation will be stockpiled in a staging area and stabilized with clean sand to eliminate free-draining water. Details of stream flow management during construction, dewatering and excavation methods have been presented in Section 2.3 of the May 2001 revision of the November 2000 Remedial Action Work Plan.

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Figure 3-1. Based on the prior investigations, it is anticipated that an average of 4 feet of sediment will be removed from the pond and brook and up to 6 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bulldozers, and loaders. It is likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

3.1.3 Site Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The site restoration involves the backfilling of Willow Brook and Willow Brook Pond to match existing grades, the placement of a 6-inch thick layer of 4-inch stone within Willow Brook Pond, and the placement of a 12-inch thick layer of 6-inch stone within the Willow Brook stream channel. The wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of process gravel, and 12-inches of wetland soil. The wetland will be planted with native wetland plants. It is anticipated that restoration activities for areas outside the waterway and wetland will consist of the installation of paved parking areas or grassed areas. Planned final site restoration under this alternative is presented in Figure 3-2.

The future site use options may consist of the following:

- Additional automobile and/or truck parking; and
- Relocation/rerouting of Willow Street to the northern portion of the property as indicated on Figure 3-3.

3.1.4 Capital Cost

Provided, as Appendix B, is a detailed estimate of the capital cost for the implementation of the completed excavation and offsite disposal alternative. As detailed in Appendix B, the cost for the implementation of this alternative is $9,265,888. The cost for a single year of post-remediation groundwater monitoring is estimated at $20,000. This is based on the collection of groundwater samples from six locations on a quarterly basis, the analysis of the groundwater samples for volatile organic compounds, the RCRA 8 metals plus copper, nickel, and zinc, extractable petroleum hydrocarbons, and PCBs, and the preparation of a single annual report evaluating the groundwater monitoring data from the four previous quarters. For the purposes of evaluation of overall costs of this alternative, it has been assumed the groundwater monitoring will be performed for a period of 5 years. The estimated present worth cost of the groundwater monitoring program (assuming an interest rate of 4 percent) is $89,000 bringing the total cost of this alternative to $9,354,888.

3.2 Partial Excavation and Installation of Engineered Control

This alternative has been presented in detail in the May 2001 revision to the November 2000 Remedial Action Work Plan. The proposed construction activities involve:

- The excavation and installation of a temporary lined by-pass channel with inlet and outlet structures;
- The demolition of the existing process water facility building structures and the offsite disposal of construction demolition debris;
- The removal and offsite disposal of the former oil/water separator located between upper and lower Willow Brook Pond and the excavation and complete removal of the structure with offsite disposal of impacted soil and concrete and the placement of an engineered control to achieve compliance with the variance provisions in the RSR;
- The excavation and offsite disposal of approximately 8,500 cubic yards of soil and sediment containing total PCBs at concentrations greater than 25 ppm from within and immediately surrounding Willow Brook and Willow Brook Pond;
- The excavation and offsite disposal of approximately 1,500 cubic yards of soil and sediment containing PCBs at concentrations between 1 and 25 ppm from within and immediately surrounding the wetland area located north of Willow Brook;

- The excavation and offsite disposal of approximately 2,500 cubic yards of soil and sediment from within the open channel of Willow Brook to allow for the installation of the geotextile, soil, and stone cap within the stream channel;

- The placement of a geotextile, soil and stone cap (engineered control) over the entirety of the excavated area (with the exception of an approximately 1-acre wetland described below) to isolate sediment containing less than 25 ppm total PCBs commingled with semi-volatile organic compounds, petroleum hydrocarbons, and select metals to achieve compliance with the variance provisions in the RSR;

- The restoration of an approximately 1-acre wetland located downstream of the Willow Brook Pond Dam; and

- The implementation of two institutional controls consisting of 1) a ELUR to ensure the affected area will not be used for residential purposes and to prohibit excavation; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond.

3.2.1 Demolition and Removal of Existing Structures

As part of the remedial activities, select buildings and other structures will be demolished (see Figure 3-4). A list and description of the primary structures to be demolished are as follows:

- Five buildings and components associated with the process water facility; and

- The former underground oil/water separator located between the upper and lower sections of Willow Brook Pond.

Process Water Buildings: Upon completion of the building and related structure demolition activities, the remaining soil will be evaluated and remediated, if necessary, to meet the industrial/commercial direct exposure criteria in all inaccessible locations and the RDEC within the accessible soil (within 4-feet of the final ground surface).

Former Underground Oil/Water Separator: The activities to be carried out under this alternative are, with one exception, identical to those presented for the complete excavation alternative. The single exception is with regard to the extent of removal activities. Under this alternative, soil and sediment containing total PCBs in excess of 25 ppm will be removed, rather than the RDEC limit established for the complete excavation alternative.

3.2.2 Contaminated Soil and Sediment Excavation and Offsite Disposal

It is anticipated that approximately 12,500 cubic yards of contaminated soil and sediment will be excavated and disposed of at an offsite location during the project. In general, soil and sediment excavated, as part of the remediation will be stockpiled in a staging area and stabilized with clean sand to eliminate free-draining water. Details of stream flow management during construction, dewatering and excavation methods have been presented in Section 2.3 of the May 2001 revision of the November 2000 Remedial Action Work Plan.

The excavation program will advance from upstream to downstream within Willow Brook Pond and the Willow Brook streambed. The approximate horizontal limits of the soil and sediment removal activities are presented on Figure 3-4. Based on the prior investigations, it is anticipated that an average of 2 to 3 feet of sediment will be removed from the pond and brook and up to 6 feet within the wetland area. Soil from depths of up to 16 feet will be excavated in the vicinity of the oil/water separator. Confirmatory soil samples collected during the remediation will provide the final horizontal and vertical limits of excavation. The soil and sediment excavation will be accomplished through the use of track-mounted excavators, bulldozers, and loaders. It is likely that some or all of the equipment will be of a low ground pressure configuration to allow operation within the pond and stream channel.

3.2.3 Site Restoration

Following the excavation and demolition activities, Willow Brook and Willow Brook Pond will be restored. The planned restoration activities are described in detail below and depicted on Figure 3-5. The site restoration involves the installation of 3 types of caps (engineered controls) over soil and sediments remaining following excavation and removal of those containing total PCBs at concentrations greater than 25 ppm. The cap details were derived based on the anticipated stream flow velocities and considered the ultimate use of the area as a combined wetland, pond, and stream channel. The base of each cap consists of a non-woven geotextile, a 9-inch layer of organic rich soil, and a non-woven geotextile. This layer is referred to below as an organic-rich layer. This organic-rich layer is included as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. Each engineered control is described below and are depicted on Figures 3-6 through 3-8.

- Within Willow Brook Pond, a 36-inch soil and stone cap is proposed (refer to Figure 3-6). The cap will consist of a 9-inch organic rich layer, 21 inches of process gravel, and a 6-inch layer of 4-inch stone. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.

- Within Willow Brook (downstream of the dam), a 36-inch soil and stone cap is proposed (refer to Figure 3-7). The cap will consist of a 9-inch organic rich layer, a 15-inch layer of modified riprap and a 12-inch layer of cobbles, gravel and coarse sand. The 15-inch layer of modified riprap extends the width of the channel bottom and transitions into a 24-inch layer of intermediate riprap on the side slopes of the channel banks. The 24-inch layer of modified riprap extends up the channel banks to the elevation of the 10-year flood. The riprap channel lining has been designed to withstand the erosive forces anticipated in the stream channel following completion of the construction project.

- The area of the underground oil/water separator will be provided with a composite cap (refer to Figure 3-7). The composite cap will consist of a 40-mil flexible membrane liner, a geotextile drainage layer, 30-inches of granular backfill, and a 6-inch loam and seed layer.

In addition to the above, the wetland north of Willow Brook will be restored by providing a soil and wetland sediment cap consisting of 24 inches of granular fill, and 12-inches of wetland soil. The wetland will be planted with native wetland plants (refer to Figure 3-8).

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the proposed remedy. The institutional controls consist of 1) a ELUR to ensure the affected area will not be used for residential purposes and to prohibit excavation and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 3-5).

In the event that redevelopment of this area involves a bike path or roadway, UTC/P&W will remediate the areas directly beneath those uses to the RDEC.

3.2.4 Capital Cost

Provided, as Appendix C, is a detailed estimate of the capital cost for the implementation of the partial excavation and installation of engineered control alternative. As detailed in Appendix C, the capital cost for the implementation of this alternative is $5,846,260. The post-remediation groundwater monitoring program to be implemented following the construction of this alternative is detailed in Appendix D. The cost for the implementation of a single year of post-remediation groundwater monitoring is estimated at $26,000.

In addition, under this option it will be necessary to maintain the engineered control. The costs for maintaining the engineered control are those associated with:

- Regular mowing and maintenance of the area surrounding Willow Brook and Willow Brook Pond (assumed to be 3 acres mowed 20 times per year);

- Annual visual inspection of the stream channel of Willow Brook to ensure the rip-rap channel lining has not been impacted; and

- Annual inspection, via probing, of the bottom of Willow Pond to ensure the stone layer has not been eroded.

It has been anticipated that onsite UTC/P&W maintenance personnel and existing landscape contractors will be engaged for the purposes of performing the above maintenance activities. The annual cost for the implementation of the above maintenance program, including the preparation of an annual report documenting the maintenance activities, is estimated to be $3,500.

For the purposes of evaluation of overall costs of this alternative, it has been assumed the maintenance and groundwater monitoring will be performed for a period of 30 years. The estimated present worth cost of the maintenance and groundwater-monitoring program (assuming an interest rate of 4 percent) is $505,040 bringing the total cost of this alternative to $6,351,300.

3.3 Cost Comparison

In accordance with Section 22a-133k-2(f)(2)(A)(iv) of the RCSA, a determination must be made that the "cost of remediating the polluted soil at such release area is significantly greater than the cost of installing and maintaining an engineered control for such soil and conducting ground-water monitoring at such release area in accordance with subsection (g) of section 22a-133k-3". The cost for the complete excavation and offsite disposal alternative is approximately $9,354,888. The cost for the implementation of the partial excavation and offsite disposal and engineered control alternative inclusive of operation and maintenance is approximately $6,351,300. Based on the discussions above and the detailed evaluation of costs for each alternative, it is concluded that the complete excavation alternative is significantly more expensive than the partial excavation and engineered control alternative and the additional cost is not commensurate with environmental benefit.

4. DESIGN, MANAGEMENT AND ADMINISTRATIVE REQUIREMENTS

This section details design, management and administrative requirements set forth in Section 22a-133k-2(f) of the RCSA. Specifically, this section provides a direct regulatory citation and the activities that will be undertaken to satisfy that requirement.

4.1 Design of Engineered Control

In accordance with Section 22a-133k-2(f)(2)(B)(i)(aa) of the RCSA "The proposed engineered control is designed and will be constructed to physically isolate polluted soil and to minimize migration of liquids through soil, to function with minimum maintenance, to promote drainage and minimize erosion of or other damage to such control, and to accommodate settling and subsidence of the underlying soil so as to maintain the control's structural integrity and permeability".

The engineered control to be installed as part of this project consists of two sub aqueous caps (see Figure 3-6 for Willow Brook and Willow Brook Pond cap details) and a cap to be installed in the area of the former oil water separator. Each of the caps has been designed to physically isolate polluted soils by providing a minimum separation distance of 36 inches. The cap to be installed in the vicinity of the former oil water separator has also been designed to minimize infiltration of precipitation to the underlying polluted soil. With regard to Willow Brook and Willow Brook Pond, the caps are sub aqueous and, in an effort to minimize the potential for alteration of the current hydrology of the area, are permeable. The caps for Willow Brook and Willow Brook Pond have been designed to include a 9-inch organic-rich layer. This organic rich layer was added as a contingency to mitigate any potential for PCBs to migrate vertically upward through the proposed soil and rock cap. This layer will act as a sorbent media to minimize the potential for underlying groundwater that is in contact with contaminated soils to pass through the control and impact the overlying surface water.

By design, each of the caps comprising the engineered control will function with minimal maintenance. The cap installed in the vicinity of the former oil/water separator will require frequent mowing during the growing season. The cap within Willow Brook and Willow Brook Pond will, by design, require no maintenance unless repairs are necessary based on observations during annual inspections.

With regard to promoting drainage and minimizing erosion, the cap installed in the vicinity of the former oil/water separator will be designed to promote runoff and minimize run on. The cap will be vegetated to minimize the potential for erosion. With regard to the sub aqueous caps,

each have been designed to minimize the potential for erosion. The cap to be installed in Willow Brook has been designed to include a 24-inch layer of modified riprap extending up the channel banks to the elevation of the 10-year flood to counteract erosive forces within the stream channel. The cap to be installed in Willow Pond has been designed to include a 4-inch stone layer. As the flow velocity in Willow Brook Pond is extremely low and is controlled by the dam at the outlet to the pond, the stone lining will provide adequate protection against erosion.

With regard to accommodating settling and subsidence of the underlying soil, each of the proposed caps is flexible in nature. The cap to be installed in the vicinity of the former oil/water separator contains as its low-permeability component, a 40-mil high-density polyethylene liner. Additionally, the sub grade for this cap will be prepared to promote runoff and minimize the potential for ponding. The sub aqueous caps are composed of earthen materials and will accommodate subsidence of underlying soils. However, with regard to the sub aqueous caps, subsidence is not considered as significant factor in the design of the control as it will have no detrimental affect on the ability of the control to preclude direct human contact with the underlying contaminated soil.

4.2 Groundwater Monitoring

In accordance with 22a-133k-2(f)(2)(B)(ii) of the RCSA, "plans for ground-water monitoring at the subject release area are adequate to ensure that any substance migrating there from will be detected". Appendix D contains a proposed post-remediation groundwater monitoring program to be implemented following the installation of the engineered control.

4.3 Maintenance of Engineered Control

In accordance with 22a-133k-2(f)(2)(B)(iii) of the RCSA, "plans for maintenance of the subject release area are adequate to ensure that the structural integrity, design permeability, and effectiveness of the engineered control will be maintained; such plans shall include without limitation measures to prevent run-on and run-off of storm water from eroding or otherwise damaging the engineered control and measures to repair such control to correct the effects of any settling, subsidence, erosion or other damaging events or conditions". Appendix E contains a proposed post remediation maintenance and monitoring program to be implemented following the installation of the engineered control. The post remediation maintenance and monitoring will continue for the life of the engineered control.

4.4 Institutional Controls

In accordance with 22a-133k-2(f)(2)(B)(iv) of the RCSA, "an environmental land use restriction is or will be in effect with respect to the parcel at which the subject release area is located, which restriction ensures that such parcel will not be used in a manner that could disturb the engineered control or the polluted soil".

Following restoration activities, UTC/P&W will implement two institutional controls to ensure the long-term protectiveness of the engineered control. The institutional controls consist of 1) environmental land use restrictions to ensure the affected area will not be used for residential purposes and to ensure that activities that could disturb the engineered control will not be performed; and 2) installation of a fence around the entire area to preclude access to Willow Brook and Willow Brook Pond (refer to Figure 2-2).

4.5 Financial Assurance

In accordance with 22a-133k-2(f)(2)(B)(vi) of the RCSA, "...the owner of the subject parcel shall demonstrate that he has posted or will post a surety in a form and amount approved in writing by the Commissioner, which surety during the first year after installation of the engineered control shall be equal to the cost of one year's maintenance and monitoring of the engineered control, and which in each subsequent year shall be increased in amount by adding an amount equal to the cost of one year's maintenance and monitoring, until the total amount of such surety is equal to the cost of five years of maintenance and monitoring, which amount shall be maintained in effect for the next twenty-five years or for such other period as may be required by the Commissioner." UTC proposes to demonstrate financial assurance for the maintenance and monitoring of the engineered control by performing the RCRA TSDF financial test specified in 40 CFR section 264.143(e), substituting the costs of maintaining and monitoring UTC's proposed control (as specified in RCSA section 22a-133k-2(f)(2)(B)(vi)) for the closure, post-closure and other RCRA financial test costs (as specified in the RCRA financial test). UTC's first demonstration will be submitted within 30 days after the construction of the engineered control is completed. UTC shall maintain this financial assurance for a period of twenty-five years after the construction of the engineered control is completed or any shorter period approved by the Department and, during this period, shall make the proposed demonstrations annually, on or before the anniversary of the first submission.

4.6 Public Notice

In accordance with 22a-133k-2(f)(2)(A)(iv) of the RCSA, UTC/P&W plans to public notice the proposed use of an engineered control by two of the following three methods "(i) by publication

in a newspaper of substantial circulation in the affected area; (ii) by placing and maintaining on the subject parcel, for at least thirty days, in a legible condition a sign which shall be not less than six feet by four feet which sign shall be clearly visible from the public highway; or (iii) by mailing notice to the owner of record of each property abutting the subject parcel at his address on the most recent grand tax list of the municipality or municipalities in which such properties are located." In providing public notice, UTC/P&W will follow all requirements of Section 22a-133k-2(f)(2)(A)(iv) of the RCSA.

5. CONCLUSIONS

The comprehensive subsurface investigations resulted in sufficient information to allow for a thorough evaluation of alternatives to address contaminated soil and sediment in and immediately surrounding Willow Brook and Willow Brook Pond at the UTC/P&W facility in East Hartford, Connecticut. The alternatives considered herein included: limited excavation and offsite disposal in conjunction with an engineered control; and complete excavation and offsite disposal. Based on the evaluation detailed in Section 3 of this report, it was concluded that limited excavation and offsite disposal in conjunction with an engineered control is the most appropriate alternative to address the contaminated soil and sediment. To implement this alternative, UTC/P&W has submitted the necessary applications to obtain approvals from the Town of East Hartford Inland Wetlands Commission (approval granted April 24, 2001), Town of East Hartford Planning and Zoning Commission, the Department of Environmental Protection, the United States Army Corps of Engineers. As noted, a Remedial Action Work Plan detailing the selected alternative has been presented to the United States Environmental Protection Agency and the Department of Environmental Protection for review.

From the evaluation presented herein, it is concluded that the cost for complete excavation of the polluted soil at such release area is significantly greater than the cost of installing and maintaining an engineered control for such soil and conducting ground-water monitoring at such release area in accordance with subsection (g) of section 22a-133k-3. As detailed in Section 3, the cost for remediating the polluted soil by complete excavation, inclusive of 5 years of post-remediation groundwater monitoring is $9,354,888. The cost for partial excavation and offsite disposal in conjunction with an engineered control, inclusive of 30 years of maintenance and groundwater monitoring is $6,351,300.

In conclusion, the significantly greater cost of implementing a complete excavation alternative in comparison to the partial excavation and engineered control alternative (over 47 percent) is not commensurate with the benefits to human health and the environment. Specifically:

- **Risk to the environment if the engineered control fails to prevent the mobilization of contaminants in soil:** Investigations performed to date have resulted in the collection of data that substantiate the conclusion that the PCBs in soil represent an insignificant risk to groundwater as a result of mobilization in groundwater. PCBs were detected in only two locations in groundwater in the immediate vicinity of the elevated PCB concentrations in either soil or sediment. These areas would be addressed by excavation of source areas (contaminated soil and the former oil/water separator) during the implementation of the partial

excavation and offsite disposal and engineered control alternative described herein. Additional information was submitted to the DEP on April 27, 2001 that further supports this conclusion. Furthermore, groundwater monitoring will be performed around the periphery of Willow Brook and Willow Brook Pond following the installation of the engineered control to confirm that PCBs are not migrating in groundwater.

- **Risk to the environment as a result of mobilization to surface water (transport of contaminated sediment via groundwater to surface water):** This is considered an unlikely event. However, each of the sub aqueous caps is designed with a 9-inch organic layer to prevent the migration of contaminated soil through the cap section and, as detailed in Appendix D, monitoring will be performed to confirm its effectiveness. In the event the engineered control was to be eroded, the potential for soil and sediment containing residual concentrations of PCBs to be transported via surface water would exist. The potential for transport of sediment from the pond is considered very low due to the low surface water velocities within the water body. The potential for transport of sediment from Willow Brook is considerably higher in comparison to Willow Pond as surface water velocities within the brook are considerably higher. However, following remediation, the average concentration of PCBs that will remain in soil and sediment within Willow Brook and Willow Brook Pond would be approximately 5 ppm. The average concentration that would remain in Willow Brook alone is approximately 4 ppm. Though the potential for the transport of contaminated soil and sediment would exist in the event the engineered control were to be eroded, the overall risk to the environment in comparison to the risk that exists today would be significantly decreased as a result of the intended remediation approach which would result of the excavation of the most contaminated soils and sediments.

- **Risk to human health if the engineered control fails to prevent human exposure to such substance:** The engineered control has been designed to have a total thickness of 36 inches. The stone surface on each of the sub aqueous caps minimizes the potential for erosion and the potential for thinning of the cap to a point where direct human contact could be a potential. The cap installed in the vicinity of the former oil/water separator will include a flexible membrane liner and will be designed and constructed in a manner minimizing the potential for erosion. Following installation, the maintenance program detailed in Appendix E will further ensure the future integrity of the engineered control. However, in the

event that the engineered control was to be eroded, the potential for human exposure to contaminated soil and sediment would exist. As noted in previous sections, following remediation ELURs to ensure the affected area will not be used for residential purposes and to prohibit excavation of soil and sediment will be recorded for the entirety of the project area. Following remediation, the average concentration of PCBs that will remain in soil and sediment would be approximately 5 ppm. This concentration is one-half of the default numeric commercial/industrial direct exposure criteria established in the RSR.

Appendix D

Post Remediation Groundwater Monitoring Plan

United Technologies/Pratt & Whitney
Post Remediation Groundwater Monitoring Plan
Willow Brook and Willow Brook Pond

The following is a description of the planned groundwater monitoring to be implemented following the remediation of contaminated soil and sediment within and immediately surrounding Willow Brook and Willow Brook Pond. The groundwater monitoring will be performed in accordance with subsection (g)(2) of Section 22a-133k-3 of the RCSA.

This groundwater monitoring program has been designed to determine:

- The effectiveness of soil remediation in preventing further pollution of ground water by substances from the release area;
- The effectiveness of any remediation taken to eliminate or minimize identified health or safety risks associated with such release; and
- Whether applicable surface-water protection criteria and volatilization criteria have been met.

New Well Installation

During construction, it is likely that a number of existing groundwater monitoring wells will be impacted. Following implementation of remedial activities, groundwater monitoring wells will be installed at the 12 locations depicted on the attached Site Plan. Nine of the groundwater monitoring wells will be installed around the periphery of Willow Brook and Willow Brook Pond and three wells will be installed within Willow Brook and Willow Brook Pond. Each of the nine wells will be small-diameter monitoring wells constructed using the Geoprobe® Pre-Pack monitoring well construction materials. The pre-pack construction consists of three foot-long sections of ½ inch inside diameter, 0.010-inch slotted Schedule 80 PVC screen with a 1.5-inch diameter filter pack held in place by stainless steel mesh. The pre-pack screen sections may be joined to provide screen length multiples of three feet. A ½-inch diameter Schedule 80 PVC riser connects the screen to the surface.

Screen lengths for the nine monitoring wells to be installed along the periphery of Willow Brook and Willow Brook Pond will be nine feet, with approximately 5 to 7 feet placed below the water table. After the screen and riser are installed, one to two feet of sand will be placed above the screen to prevent the bentonite seal from leaking downward into the screened interval. A bentonite seal will be placed from the top of the sand cap to the surface. Emplacement of the sand cap and the bentonite seal will be performed while slowly retrieving the casing, allowing the native formation material to collapse around the backfill material.

Screen lengths for the three wells to be installed within the limits of Willow Brook and Willow Brook pond will be one foot. The screen section will be installed so that the screen will partially penetrate the granular fill portion of the cap section to allow for the collection of a sample that is representative of soil water above the organic-rich layer within the cap. These wells are being proposed to allow for the collection of data to confirm that the organic-rich layer is preventing the upward migration of PCBs through the cap. These three monitoring wells will be installed during the installation of the caps.

All wells will be installed in general conformance with LEA's SOPs entitled, *Standard Operating Procedure for Installing and Developing Monitoring Wells and Piezometers* and *Geoprobe® Probing and Sampling.*

Well Development

All post remediation groundwater monitoring wells will be developed to ensure that an adequate hydraulic connection exists between the well and the aquifer. Prior to development, measurements of total depth and water level will be made at each well. Development will be conducted in general conformance with the LEA SOP entitled, *Standard Operating Procedure for Installing and Developing Monitoring Wells and Piezometers.* Development water will be placed into DOT-approved 55-gallon containers for offsite disposal at a licensed disposal facility.

Monitoring wells will be developed by over-pumping using a peristaltic pump to draw down the well, followed by physical surging. After surging, the well will be pumped to remove accumulated sediment. The cycle will be repeated until the well produces clean water or until the physical parameters (temperature, pH, specific conductance) stabilize. Further development by over-pumping or surging will be performed as necessary to stabilize the field parameters.

Groundwater Monitoring Implementation Schedule

Groundwater samples will be collected from each of the 12 groundwater monitoring wells on a quarterly basis for a period of not less than two years. If, following the two years of quarterly groundwater monitoring, it is determined that the area is in compliance with the requirements of subsection (f) of Section 22a-133k-3 of the RCSA, groundwater monitoring will be discontinued. If the area is not in compliance with the requirements of subsection (f) of Section 22a-133k-3 of the RCSA, groundwater monitoring will be continued for a period of time until the results of four

consecutive quarterly sampling events indicate compliance with the surface water protection and commercial/industrial volatilization criteria.

Groundwater Sampling and Analysis

All groundwater samples will be collected and preserved, as appropriate, in accordance with the LEA SOP entitled, *Liquid Sample Collection and Field Analysis*. Prior to sampling each groundwater monitoring well noted above, the depth to water and total depth of each well would be recorded. From this information the total volume of water contained in each monitoring well will be calculated. The water will be purged initially and parameters such as pH, temperature, and specific conductance will be recorded. Once the initial volume of water is removed, the monitoring well will be purged a minimum of three times the standing water volume or until all standing water is evacuated. Samples will be collected using a peristaltic pump equipped with dedicated polyethylene tubing. A section of tubing equipped with a check valve will be used for the collection of samples to be analyzed for volatile organic compounds (VOCs). Samples collected for metals will not be filtered prior to analysis. All sampling containers will be sealed, placed in a cooler, and shipped to a laboratory selected by UTC/P&W under chain-of-custody procedures for the following analyses:

- Volatile Organic Compounds
- The RCRA 8 metals plus copper, nickel, and zinc;
- Extractable petroleum hydrocarbons; and
- Polychlorinated biphenyls.

Trip blanks, equipment blanks, and duplicate/replicate samples will be submitted for analysis for quality assurance/quality control (QA/QC) purposes. In addition, on an annual basis, one performance evaluation sample will be submitted to the analytical laboratory.

Water-Level Measurements

Water level measurements will be performed. Both groundwater and surface water level measurements will be obtained. Surface water elevations will be obtained from stream gauges to be installed in Willow Brook and Willow Brook Pond. All water levels will be recorded to the nearest 0.01-foot using an electronic water level indicator. Between measurements the water level indicator will be decontaminated to prevent cross-contamination. Based on the data

collected from the shallow monitoring wells and piezometers, contour maps showing groundwater elevation and flow direction will be developed.

Surface Water Sampling

If during the performance of groundwater sampling, polychlorinated biphenyls (PCBs) are detected at concentrations in excess of the surface water protection criteria in groundwater samples collected from the four groundwater monitoring wells installed in the granular fill portion of the cap, surface water samples will be collected to verify that PCBs are not present in surface water at concentrations in excess of the ambient water quality criteria. The surface water samples would be collected at a depth not greater than 4 inches above the top of the cap section in the immediate vicinity of the well or wells for which the exceedance of the surface water protection criteria was noted. Surface water samples would be collected within one month of receipt of analytical data indicating an exceedance of surface water protection criteria in the above-mentioned wells.

Reporting

On an annual basis, the results of the quarterly sampling will be summarized in a single report. The report will contain a description of the sampling activities, an evaluation of the analytical results including a discussion of any observed trends, a site location plan, groundwater contour maps for each of the four quarterly sampling events, and tabular presentations of the data. Following the completion of the second year of groundwater monitoring, the annual report will include a discussion regarding the compliance status with respect to the requirements of the surface water protection criteria and commercial/industrial volatilization criteria in the RSR. If the site is determined to be in compliance, the report will also contain a discussion regarding the cessation of groundwater monitoring. If the site is determined to not be in compliance, the report will contain a discussion regarding the continuation of groundwater monitoring.

Each annual report will be submitted to the DEP and the USEPA for review.

Appendix E

Post Remediation Maintenance Program

United Technologies/Pratt & Whitney
Post Remediation Maintenance and Monitoring Program
Willow Brook and Willow Brook Pond

This post-remediation maintenance program for the engineered control has been developed to ensure that the structural integrity, design permeability, and effectiveness of the engineered control will be maintained. This maintenance program describes:

- Measures to be taken to periodically inspect the engineered control;
- Measures to be taken to prevent run-on and run-off of stormwater from eroding or otherwise damaging the engineered control; and
- Measures to be taken to correct the effects of any settling, subsidence, erosion or other damaging events or conditions.

The engineered control has been designed to require a minimal amount of maintenance. The required maintenance tasks are presented below.

- Regular mowing and maintenance of the area surrounding Willow Brook and Willow Brook Pond (assumed to be 3 acres mowed 20 times per year);
- Visual inspection of the stream channel of Willow Brook to ensure the rip-rap and stone layer channel protection has not been impacted;
- Inspection, via probing at up to 20 locations, of the bottom of Willow Pond to ensure the stone layer has not been eroded;
- Inspection of the engineered control installed in the vicinity of the former oil/water separator; and
- Preparation of a report documenting the inspection and the required maintenance tasks have been completed and the completion of any repairs performed in response to findings from inspections. The annual reports will be maintained by UTC/P&W.

Annual Inspections and Corrective Actions

The engineered control and the area surrounding the engineered control will be inspected on an annual basis by a representative of United Technologies Corporation/Pratt & Whitney Division in the following areas:

1. Signs of erosion

2. Signs of settling
3. Loss of vegetative cover
4. Undesirable growth
5. Signs of ponding and run on
6. Condition of fencing and gates
7. Condition of rip-rap in Willow Brook stream channel
8. Condition of stone layer in Willow Brook
9. Burrowing animals
10. Monitoring well network

The results of these inspections will be summarized in the Final Cover Inspection Form presented as Exhibit 1. If any deficiencies are noted, the appropriate corrective actions will be taken as described in the following paragraphs.

Any erosion damage to vegetated surfaces will be corrected during the growing season (April through September) by reapplying the appropriate soil layers and reseeding the damaged areas. Similarly, any damage related to settling would be repaired in the same manner. Erosion to sub aqueous caps or rip-rap along the Willow Brook stream channel would be corrected within one month of the inspection by installation of additional stone or rip-rap.

Loss of vegetative cover will be repaired by reseeding, replanting, fertilizing and watering as necessary until plant growth is re-established. Reseeding and replanting will be performed during the growing season (April through September). In addition, any undesirable plant growth that could affect the integrity of the engineered control (i.e. small trees, saplings, shrubs) would be manually removed as soon as detected, and the cover system would be repaired as described previously for erosion damage.

If any burrowing animals were found to be living in the area of the engineered control, appropriate measures would be taken to remove the animals from the site. The synthetic components of the engineered control in the vicinity of the oil water separator will also be inspected to verify that no damage has taken place. Any holes made by burrowing animals would be filled with topsoil and reseeded. Damage to the synthetic liner will be repaired by patching in accordance with the manufacturer's requirements.

Any damaged fence or gates will be repaired.

Any deficiencies found will be corrected within 4 weeks from the time of discovery or as soon as practicable if weather conditions prohibit correction within 4 weeks.

Inspections Following Significant Precipitation Events and Corrective Actions

The engineered control and the area surrounding the engineered control will be inspected on an annual basis as described above, and following the occurrence of a precipitation event resulting in greater than or equal to 2 inches of rainfall over a 24-hour period. The inspection would be performed by a representative of United Technologies Corporation/Pratt & Whitney Division in the same areas as described for the annual inspection above. Documentation of the inspection and corrective actions would be in accordance with the procedures outlined above for annual inspections.

Inspections During Regular Maintenance Activities

During the performance of regular maintenance activities such as mowing, or other landscaping tasks, representatives of United Technologies Corporation/Pratt & Whitney Division will be instructed to report any and all compromising conditions observed within the engineered control areas to an appropriate party. Documentation of the follow-up inspection and corrective actions implemented would be in accordance with the procedures outlined above for annual inspections.

Reporting

On an annual basis, a report will be generated documenting all inspection, maintenance and corrective actions completed during the previous calendar year. The report will be completed by January 31. United Technologies Corporation/Pratt & Whitney Division will maintain the annual reports.