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**SUPPLEMENTAL INVESTIGATION  
WORK PLAN  
NON-PUBLIC PROPERTIES STUDY AREA  
HAMDEN, CONNECTICUT**

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**Prepared for:**

**olin**  
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ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNER

## TABLE OF CONTENTS

	<b>Page</b>
1.0 INTRODUCTION .....	1-1
1.1 REGULATORY STATUS .....	1-1
1.2 CONCEPTUAL SITE MODEL .....	1-1
1.2.1 Summary of the Initial Investigation Findings .....	1-1
1.2.2 Supplemental Investigation.....	1-7
2.0 SCOPE OF STUDY.....	2-1
2.1 PURPOSE.....	2-1
2.2 APPROACH.....	2-1
2.2.1 Fill Perimeter Investigation.....	2-2
2.2.2 Investigation of Properties Outside the Known Fill Areas .....	2-3
2.2.3 Characterization of Bare Spots Within the Fill Areas .....	2-5
2.2.4 Pollutant Mobility Criteria Method .....	2-5
2.2.5 Groundwater Investigation.....	2-8
2.3 PROCEDURES.....	2-11
2.3.1 Sample Collection.....	2-11
2.3.2 Laboratory Analysis.....	2-12
2.3.3 Soil Borings and Soil Sampling.....	2-14
2.3.4 Monitoring Well Installation and Groundwater Sampling .....	2-15
3.0 REPORT DELIVERABLES .....	3-1
3.1 DATA EVALUATION .....	3-1
3.2 REPORTING .....	3-1
4.0 SCHEDULE.....	4-1

## FIGURES

	<b>Following Page</b>
Figure 1 - Public & Non-Public Study Areas Location Map.....	1-1
Figure 2 - Column Leaching Apparatus Schematic.....	2-8
Figure 3 - Project Schedule.....	4-1

## SHEETS

	<b>Back Pockets</b>
Sheet 1      Edge of Fill	
Sheet 2      Properties Reporting Suspected Fill or Debris	
Sheet 3      Proposed Monitoring Well Locations	

## TABLE OF CONTENTS

### APPENDICES

	<b>Page</b>
Appendix A – Consent Order .....	A
Appendix B - CTDEP Comment letter to Olin, June 10, 2003.....	B
Appendix C - CTDEP Appendix II Landfill Leachate Parameters.....	C

## 1.0 INTRODUCTION

### 1.1 REGULATORY STATUS

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The Hamden Middle School and surrounding area, located in Hamden, Connecticut (see Figure 1), is the subject of Order SRD-128 issued by the Connecticut Department of Environmental Protection (CTDEP) on July 10, 2001. The Consent Order (appendix A) separates the site into Public Properties and Non-Public Properties. The Non-Public Properties (NPP), which are the subject of this Work Plan, are defined by the Consent Order as encompassed within the areas outlined on Figure 1 and Sheets 1, 2, and 3. The Public Properties, which are also shown on Sheets 1, 2, and 3, are adjacent to the Non-Public Properties, are the responsibility of others under the Consent Order and are not subject to the scope of work described in this Work Plan.

### 1.2 CONCEPTUAL SITE MODEL

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#### 1.2.1 Summary of the Initial Investigation Findings

Between December 2000 and November 2002, the CTDEP conducted subsurface investigations of non-public properties in and around the Newhall Street area. During this period, the Town of Hamden compiled background information on this area as part of a Phase I environmental site assessment. In the summer of 2002, Olin conducted a voluntary Initial Investigation on portions of the Non-Public Properties. The results of the investigation is summarized in the “Initial Investigation Findings Report, Newhall Street Residential Area, Hamden Connecticut” (Report), dated December 2002.

#### Fill Areas

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The Initial Investigation identified and described five geographically separate areas of fill within the Non-Public Properties study area: Southwest Satellite Area, Morse Street Area, Newhall Street Area, Bryden Terrace Area, and Augur Street Area (Sheet 1, blue lines). The Morse Street, Newhall Street, and Bryden Terrace Areas are contiguous with fill underlying the public properties to the north, which are the subject of investigations by others. The thickness and extent of fill was estimated by interpolation between borings, from stereoscopic inspection of historic aerial photographs, or from field

exposures of fill and/or native soils and other topographic evidence and relationships. The extent of fill correlates with historical and anecdotal descriptions and photographs of filling in the site record.

### Geology and Hydrogeology

The fill directly overlies the regionally extensive and thick glacial Lake Connecticut deltaic sand deposit that underlies the southern Hamden/western New Haven area from upper Lake Whitney to Long Island Sound. The regional sand deposit pinches out against Prospect Hill to the east and Mill Rock Ridge to the north but is reportedly up to 300 feet thick under and southwest of the Southwest Satellite Area (Surficial Materials Map of Connecticut, Stone et al, 1992 and Quaternary Geologic Map of Connecticut and Long Island Sound Basin, Stone et al, 1998). Numerous borings within the Public and Non-Public Properties show that a layer of fines (silt, clay, organic matter) is present in the Bryden Terrace Area between the fill and the sand and continues under the adjacent Public Properties. Thin deposits of glacial till mantling sedimentary New Haven Arkose and basaltic West Rock Diabase bedrock underlie Prospect Hill and Mill Rock Ridge, respectively.

Shallow groundwater flow varies across the five study areas. Groundwater flow below the Bryden Terrace Area is to the west. Under the Newhall Street Area and Southwest Satellite Areas, groundwater flow is to the west-southwest and southwest, respectively. Given these flow directions, groundwater from beneath Rochford Field and Hamden Middle School flows under the Morse Street and Southwest Satellite Areas. However, because the Augur Street Area lies between the western terminus of Mill Rock Ridge and an adjacent wetland and surface watercourse, the groundwater beneath it presumably flows to the west and discharges to the wetland and watercourse.

A brief physical description of each of the fill areas follows (refer also to Sheet 1):

*Southwest Satellite Area*

The fill is present in three contiguous 14- to 20-foot deep elliptical, former topographic depressions. The water table is within the underlying sand about eight feet below the deepest portions of the fill.

*Morse Street Area*

The Morse Street Area consists of a northward sloping wedge of fill material composed mainly of sand, ash, slag, cinders, and peat up to at least 7.5 feet thick. Portions of this fill area were subject to US Environmental Protection Agency (USEPA) removal actions addressing the surficial soils up to 18 inches deep. The fill is underlain and surrounded on all sides but the north by native light brown to reddish brown sand with trace silt and gravel.

*Newhall Street Area*

The Newhall Street Area lies within a former, elongated north-south trending depression that originally measured up to 13 feet below the surrounding ground level. The material consists of interlayered or intermixed sand, gravel, ash, slag, cinder and peat overlying light brown to reddish brown sand with trace silt and gravel. The water table is in the underlying sand layer about 7 to 15 feet below the base of the fill.

*Bryden Terrace Area*

Filling at the Bryden Terrace area is contiguous to the north and northwest with the fill underlying Mill Rock Park and Rochford Field. The fill layer is thickest in the center (11 feet) and to the northwest (10.5 feet) and consists of brown to black sand with trace amounts of gravel, ash, brick, glass, wood, cinders, ceramic, concrete and asphalt. Unique to this area of fill is an underlying, native, gray to dark brown silt with trace organics, which are believed to be former wetland deposits, with the regional sand deposit underlying the silt. The water table is in the lowermost part of the fill and the upper part of the silt layer.

### *Augur Street Area*

The fill in the Augur Street Area lies within an elongated wedge along the eastern bank of the adjacent wetland and stream. The fill primarily consists of sand and gravel with only trace amounts of wood, concrete, brick, glass and ash up to 6.5 feet thick. It overlies native brown to reddish brown sand and gravel.

### Comparison with Applicable Criteria

The applicable criteria for the study area are specified in the CTDEP Remediation Standard Regulations (RSR). The Residential Direct Exposure Criteria (RDEC) and Pollutant Mobility Criteria (PMC) apply to soils at the site. The study area is classified as GAA, hence analytical results are compared to GAPMC. The RSRs also specify Groundwater Protection Criteria (GWPC), surface water protection criteria (SWPC), and groundwater volatilization criteria (GWVC).

### Comparison of Fill with Criteria

Olin analyzed 58 fill samples for metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and extractable total petroleum hydrocarbons (ETPH). The results show that 95% (54) of the 58 samples contain at least one analyte exceeding RDEC. With the exception of the Augur Street area, arsenic and lead are valid indicators of an area where the RDEC is exceeded as discussed below.

In their respective investigations, Olin and CTDEP analyzed 152 fill samples from the Non-Public Properties study area for arsenic and lead. Fifty-six of the samples exceed the RDEC for arsenic, and 64 exceed the RDEC for lead. Of the 152 samples, 79 exceed the RDEC for arsenic and/or lead. Although fewer samples were analyzed for additional metals, in every case where another metal exceeds RDEC, the sample also exceeds for arsenic and/or lead. Of the 37 Olin samples that exceed RDEC for organic compounds, 31 samples (84%) also exceed RDEC for arsenic or lead.

Olin and CTDEP analyzed 85 fill samples for SPLP arsenic and lead; fewer samples were analyzed for other SPLP metals. Six of the 85 samples exceed the GAPMC for arsenic,























Public Properties, the Non-Public Properties study area well network is designed to provide representative sampling from upgradient, within, and downgradient of the known fill areas and surrounding uncharacterized portions of the Non-Public Properties study area. The rationale for the location of the proposed monitoring wells is summarized below. Some wells serve more than one purpose:

#### Southwest Satellite Area

- Proposed well locations H2001 and K2001 are intended to monitor upgradient background groundwater quality.
- Proposed well locations H2002, J2001, and L2001 are intended to monitor groundwater quality beneath the thickest portions of the fill area.
- Proposed well locations H2003 and L2002 are intended to monitor downgradient groundwater quality.

#### Morse Street Area

- Existing wells within the southern portion of the Hamden Middle School property will be used to monitor upgradient background groundwater quality.
- Proposed well locations H2001 and K2002 are intended to monitor downgradient groundwater quality.

#### Newhall Street Area

- Proposed well locations E2001 and P2001 are intended to monitor upgradient background groundwater quality.
- Existing well NH-499-MW and proposed well locations E2002 and P2002 are intended to monitor groundwater quality beneath the thickest portions of the fill area.
- Existing wells HA-B108-MW and HA-B109-MW and proposed well locations K2001 and N2001 are intended to monitor downgradient groundwater quality.

#### Bryden Terrace Area

- Existing well location MRP-HA107-MW and proposed well location F2001 are intended to monitor upgradient background groundwater

quality.

- Existing well locations BT-113-MW, WIN-1067-MW, and MS-109-MW and proposed well locations C2001 and F2002 are intended to monitor groundwater quality beneath the fill area.
- Proposed well location E2001 is intended to monitor downgradient groundwater quality.

#### Augur Street Area

- Proposed well location T2001 is intended to monitor upgradient groundwater quality.
- Proposed well locations T2002 and T2003 are intended to monitor downgradient groundwater quality.

#### Uncharacterized Portion of the Study Area

- Proposed well locations located between the known fill areas (E2001, K2001, N2001, P2001, Q2001, R2001, and S2001) are intended to monitor groundwater quality that is upgradient, within, and/or downgradient of any fill area that may exist within their respective portions of the presently uncharacterized portions of Non-Public Properties.

The nine shallow and deeper well clusters will be installed with a nominal 20 feet of separation between the two well screened intervals to characterize the vertical hydraulic and substance concentration gradients. This vertical separation will be measured from the bottom of the shallower well sandpack interval to the top of the deeper well sandpack. In some instances it may be necessary to alter this nominal separation based on local field conditions. The presence of local confining layers in the native materials or shallow drilling refusal may necessitate deviations from the plan, which will be documented in the field notes and final investigation report.

A total of four quarterly rounds of groundwater monitoring will be performed. Two rounds of groundwater samples will be collected from the Non-Public Property wells in conjunction with groundwater sampling events at the Public Properties so that data are comprehensive and concurrent throughout the entire Site. The two events will be

collected three months apart. Two additional rounds of quarterly monitoring will be collected. Analytes not exceeding criteria in the first two samples will be dropped from the analytical list for the latter two sampling events.

The analytical program for the first two rounds will consist of the CTDEP Appendix II Landfill Leachate Parameters minus pesticides, herbicides, and PCBs. These analytes were not detected in the Initial Investigation groundwater grab samples nor in the four wells sampled by CTDEP and are substances that did not exist or were not commercially available during the filling of the Non-Public Properties. Therefore, they are not constituents related to or indicative of the placement of fill within the study area.

## **2.3 PROCEDURES**

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### **2.3.1 Sample Collection**

While collecting samples, sampling personnel will wear disposable gloves, which will be replaced between samples to prevent cross-contamination of samples. A new pair of gloves will be used to collect each sample. During field sampling, the sampler will record in ink all pertinent information in a field logbook. This log will include as a minimum, the following information:

- Purpose of sampling
- Location of sampling points
- Type of media being sampled (concrete, soil or water)
- Description of sampling points and sampling methodology
- Field observations
- Any field measurements made
- Signature of personnel responsible for observations

Sample labels will be used to prevent misidentification of samples. Gummed paper labels will be used and will include the following information:

Name of facility

- Sample identification number
- Analysis to be performed

- Initials of collector
- Preservative used, if any
- Date and time of collection

Labels will be filled out at the time of collection. Indelible ink will be used for filling out labels.

To maintain orderly records of sample possession from the time of sample collection to the time of arrival at the laboratory, a chain-of-custody form will be filled out at the time of sampling and will accompany every sample. The chain-of-custody form will contain the following information:

- Name of facility.
- Name of laboratory.
- Sample matrix.
- Sample identification.
- Name and signature of sample collector.
- Date of collection.
- Number of containers.
- Parameters requested for analysis, including analytical methods.
- Sample preservative, if any.
- Signature(s) of person(s) involved in the chain of possession.

Samples will be placed into the clean, pre-preserved sample containers supplied by the laboratory. The Quality Assurance Project Plan, which will be submitted to the CTDEP for approval under separate cover, will summarize the appropriate sample containers and preservation procedures. Samples will be shipped in containers and packaging that will prevent breakage, spillage and contamination and ensure proper cooling if necessary. Shipment of samples to laboratory will be by overnight delivery or the most expedient method in compliance with applicable DOT regulations. Alternatively, samples will be delivered directly to the laboratory by courier.

### **2.3.2 Laboratory Analysis**

We will use the following criteria to ensure that the analytical data are of sufficient

quality to allow reliable characterization of site conditions.

- Laboratory certified by the Connecticut Department of Health.
- Standard, USEPA approved where appropriate, laboratory analytical methods.
- Lower limits of analyte detection appropriate for comparison to RSR criteria.
- Field and laboratory quality assurance and quality control samples and procedures.

A laboratory that is certified by the Connecticut Department of Health will analyze the soil and groundwater samples using standard analytical methods. These methods will be as follows:

<u>Analytes</u>	<u>Method</u>
VOCs	USEPA Method 8260B
TPH	CT Extractable TPH method
SVOCs	USEPA Method 8270C
PAHs	USEPA Method 8270C
PCBs	USEPA Method 8082
Mercury	Soil: USEPA Method 7470A. Groundwater: USEPA Method 7471A
Other Metals	USEPA Method 6010B
SPLP	Extraction using USEPA Method 1312, leachate concentrations using appropriate methods listed above.

Unless high analyte concentrations or matrix interference require laboratory dilution of samples, the analytical detection limits for these and other analytes will be at or below the appropriate RSR criteria. Data quality assurance and control will be evaluated using field duplicate and blank samples and laboratory method blank, control, matrix spike, and duplicate samples. Duplicates of solid matrices will not be collected because of the difficulty in completely homogenizing a solid matrix. The selection of a competent laboratory using appropriate QA/QC procedures minimizes the risk of poor quality data. One field duplicate groundwater sample will be collected for every 20 groundwater samples per sampling round. Trip blank sample will accompany soil and groundwater samples for VOCs. Equipment blanks will be collected from decontaminated split-

spoons and well pumps.

CTDEP has indicated that a provision to screen for the presence of dioxins and furans in the fill material should be included in the Supplemental Investigation. Therefore, any sample where PCBs are detected will also be submitted for the *RapidScreen* in Soil for dioxin / furan assay (Triangle Laboratories). The analytical technique utilizes isotope dilution mass spectrometry. *RapidScreen* is a screening method that provides a positive or negative result for the Toxic Equivalency Quotient (TEQ) of a sample at some specified target point. Samples that give a positive result from the screening assay will be further analyzed by EPA Method 1613 for quantitative analysis of 17 dioxin / furan analytes.

### **2.3.3 Soil Borings and Soil Sampling**

Soil borings will be used for delineating the edge of fill areas or any isolated areas of filling. Shallow borings will be dug by hand auger; deeper borings will be advanced by a direct push method. Direct-push refers to tools and sensors that are "pushed" into the ground without the use of drilling to remove soil or to make a path for the tool. Percussion hammers and static vehicle weight combined with hydraulic cylinders push a hollow tube containing a sealed sampling tube (usually 4-feet long) into the ground to the desired depth. The sampling tubes provide a core of soil material for a specific depth. The boring advances step-wise, one tube length at a time until the desired boring depth is achieved. Direct-push techniques do not generate a large volume of potentially contaminated drill cuttings as conventional drilling methods do. This means that the field investigators and local residents are less likely to be exposed to any affected media that may be inadvertently brought to the surface.

Soil borings for installing the monitoring wells and collecting the bulk fill samples will be drilled in overburden using hollow-stem augers. No bedrock drilling is envisioned because of its extreme mapped depth over most of the area. All drilling locations will be marked in the field for utility clearance. "Call Before You Dig" will be contacted prior to

initiating drilling as required by law.

To log the borehole and obtain samples for laboratory analyses, split-spoon samples will be collected from discrete, 2-foot depth intervals at the depths specified by this scope of work. All soil samples will be screened with a photo-ionization detector (PID) with an 11.7 eV lamp immediately upon opening the split spoon. Elevated PID readings will be used to augment sample selection for laboratory analyses. Split-spoon samples for laboratory analyses will be collected from no more than one 2-foot depth interval. Samples for analyses will be placed directly into clean, laboratory-supplied containers and stored and shipped with ice in coolers to the laboratory.

Samples for VOC analyses will be collected using USEPA Method 5035. This field preservation method for VOCs uses two sets of three 40 ml vials, each set for soil presumed to contain low and medium concentrations of VOCs. The low concentration set contains magnetic stir bars for use by the laboratory. The medium concentration vials contain five ml of methanol and are pre-weighed by the laboratory. Approximately five grams of soil, measured with a calibrated sampling plunger device, is placed into each of these vials.

Augers, split-spoons, and other drilling and soil sampling equipment will be decontaminated as necessary to prevent cross-contamination between samples. The Augers will be pressure washed. Split-spoons and direct push drilling equipment will be washed with a soap solution and rinsed with tap water and deionized water between each use.

#### **2.3.4 Monitoring Well Installation and Groundwater Sampling**

Each monitoring well will be constructed in accordance with the draft CTDEP Water Management Bureau February 1990 guidelines. Typical water table and deeper monitoring well details are shown in the Quality Assurance Project Plan. The 10-foot-long screens and attached riser pipes will consist of 2-inch inside-diameter, schedule 40

PVC placed to the bottom of the borehole. The screens will have 0.010-inch-wide slots. A clean sand pack will be placed around and two feet above the top of the screen. About two feet of bentonite will be placed above the sand pack, and the remainder of the borehole will be filled with a bentonite/cement grout to grade.

Depending on their location, each well will be finished with either a locking, steel protector pipe cemented in place and sticking about two feet above grade, or with an 8-inch-diameter curb box mounted flush with grade. A locking expansion plug will be placed on each well riser pipe.

Following installation, each well will be developed to remove cuttings and drilling water from the well, sand pack, and surrounding formation until the groundwater is relatively sediment-free. Depending on well yield, development will be accomplished with pumps and/or bailers. After development, the wells will be left undisturbed for two weeks to allow hydraulic and chemical conditions around the well to equilibrate prior to sampling.

The top of each PVC riser pipe and the ground surface adjacent to each well will be surveyed to the nearest 0.01 foot relative to on-site benchmarks. In accordance with a February 14, 2002 communication with CTDEP, the wells will be located relative to the following standards:

Horizontal location: CT State Plane coordinates, NAD 1983.

Vertical elevation: WGS 1984 HAE.

Before sampling groundwater, water levels will be measured in all monitoring wells concurrent with measurements at the Public Properties by the other Respondents. The monitoring wells will be sampled in accordance with CTDEP standards using low-flow (<300 milliliters/minute) submersible pumps to minimize sample turbidity with the goal of achieving less than five NTUs and less than one-foot of water level drawdown. During well purging and sampling, the groundwater will be analyzed in the field for turbidity, pH, temperature, and specific conductance.

Groundwater samples will be collected from the pumps directly into pre-preserved, clean, laboratory-supplied containers and stored and shipped with ice in coolers to the laboratory.

## **3.0 REPORT DELIVERABLES**

### **3.1 DATA EVALUATION**

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All sampling locations will be added to the site map and used in conjunction with the analytical database. Malcolm Pirnie will examine the laboratory analytical reports to determine if the data are valid. Validated soil analytical data will be compared to the RDEC and GAPMC.

Groundwater elevation data from the monitoring well network will be used to determine the groundwater table gradient and inferred flow directions. The validated groundwater analytical data will be compared to background concentrations, the groundwater protection criteria (GWPC), surface water protections criteria where appropriate to the Augur Street Area, and the groundwater volatilization criteria (GWVC).

### **3.2 REPORTING**

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A Quality Assurance Project Plan (QAPP) will be submitted to CTDEP within 30 days after approval of the Work Plan. The purpose of the QAPP is to describe the investigation activities in sufficient detail such that the data generated will be of a known and acceptable level of quality and accuracy. The QAPP elucidates specific procedures to be used during sampling of relevant environmental matrices and analyses of data.

Two interim deliverables will be submitted to CTDEP per the approach described in section 2.2.2:

1. Recommendations for subsurface investigation following visual inspection of non-public properties outside the known fill areas.
2. Recommendations for analytical characterization following the subsurface investigation.

The Supplemental Investigation Report will be prepared that includes the following elements:

- Provides information on the investigation of the Non-Public Properties, including:

- Description and results of the investigation activities, including the first 2 rounds of groundwater monitoring.
- Figures and tables summarizing hydrogeologic information, sampling locations, field and analytical data, and comparison to RSR numerical criteria.
- Maps and cross-sections showing the stratigraphy, extent of contiguous and isolated fill, fill thickness contours, groundwater piezometric surface elevation and vertical gradient contours, and groundwater flow directions.
- Evaluates the alternatives for remedial actions to abate pollution in accordance with the RSRs, including but not limited to alternatives specified by CTDEP.
- States in detail the most expeditious schedule for performing each alternative.
- Lists all permits and approvals required for each alternative, including but not limited to any permits required under CGS sections 22a-32, 22a-42a, 22a-361, 22a-368, or 22a-430.
- Proposes a preferred alternative with supporting justification.
- Proposes a detailed remedial action plan (RAP) and schedule for performing the preferred remedial actions.

Following completion of the Supplemental Investigation Report, two additional reports for the third and fourth quarters of groundwater monitoring will be submitted to the CTDEP.

## **4.0 SCHEDULE**

Completion of the supplemental investigation, through the first two rounds of groundwater sampling, is estimated to take one year following receipt of a notice to proceed by CTDEP. Figure 3 provides the estimated schedule with Month 1 being the first month after the work plan and QAPP are approved by CTDEP. This schedule assumes access agreements with the Non-Public Property owners will be completed within one month. The schedule may be affected if sufficient access is not available. However, field work may begin as soon as sufficient number of access agreements and utility clearances are obtained, pending contractor availability. Installation of monitoring wells will begin as soon as possible in order to facilitate collection of the first two quarterly groundwater samples within the desired time frame. Data will be evaluated as they are received. To expedite the process, the investigation report and proposed remedial action plan will be finalized before data from the last two rounds of quarterly groundwater monitoring are received. Separate data reports for these events will be prepared within 45 days of receipt of the data. The date for submission of a monitoring plan for the site is contingent upon CTDEP approval of the RAP.

## **APPENDIX A – Consent Order**

A

**APPENDIX B - CTDEP Comment letter to Olin, June 10, 2003**

**B**

**APPENDIX C - CTDEP Appendix II Landfill Leachate Parameters**