Executive Summary

A Remedial Investigation (RI) has been conducted for the Greenwich High School (GHS) property, located at 10 Hillside Road in Greenwich, Connecticut. Previous environmental investigation work at the site by Diversified Technology Consultants (DTC) identified impacts to surficial soils. DTC also performed a Phase I Environmental site Assessment (ESA) which identified a number of Areas of Concern (AOCs). To address some of the areas of surficial soil impacts, interim remedial measures (IRMs) were performed and institutional controls were established. Following completion of the IRMs, AECOM Technical Services, Inc. (AECOM) initiated a RI of the site which was performed to:

- Evaluate the presence or absence of environmental impacts within AOCs and site wide and to evaluate the extent and degree of these impacts;
- Evaluate geologic and hydrogeologic conditions at the site;
- Develop a Conceptual site Model (CSM) that describes, explains, and provides an understanding of the nature and distribution of environmental impacts necessary to evaluate potential risks to human health and the environment; and
- Evaluate the potential for migration of the environmental impacts identified at the site.

Site Topography, Geology and Hydrogeology

The site is roughly bowl-shaped with a relatively flat central area that is surrounded by higher ground surface elevations on most sides (north, east, southwest and west). West Brothers Brook enters the site from the northwest corner and from there the surface water flows along a man-made channel past the GHS athletic fields and toward the southern end of the site. The southern portion of West Brothers Brook is controlled by a man-made dam resulting in a ponded area (Cider Mill Pond) upstream of the dam and south of the school buildings. In the southeastern corner of the site the ground surface slopes fairly abruptly along a narrow surface water drainage channel reaching its lowest point where West Brothers Brook exits the property on the downstream side of the dam.

The site topography has been modified over the years due to construction activities related to the High School and the athletic fields. Available records show that a relatively large wetland area once occupied the central portion of the site, beneath what are now athletic fields and a parking lot. The current drainage channel underlying West Brothers Brook along the western and southern portions of the former wetlands was constructed in the late 1960's when the former wetlands were filled, terminating their function as a wetlands.

Based on the site subsurface investigation activities, most of the subsurface material at the site consists of a silty, sandy till containing a mixture of gravel, cobbles and boulders. An extensive layer of peat and organic silt associated with the former wetlands and swamp deposits is found in the center of the site beneath the athletic fields and west parking lot. Non-native fill material, placed prior to construction of the high school, is also present in this former wetlands area.

The non-native fill generally consists of silty sand with gravels, cobbles and boulders and debris containing trace amounts of cinders, brick, glass, roots, wood, plastic, and rubber. The fill material was encountered at depths ranging anywhere from 0.5 to 14 feet below ground surface (ft bgs). The thickness of the fill material encountered varies greatly across the site.

Gneiss bedrock was encountered in numerous borings across the site, with depth to bedrock surface ranging from the ground surface to 59 ft bgs. Numerous bedrock outcrops are present on site, mainly

in the northeastern, eastern and southern portions. The bedrock surface is highly variable across the site with a bedrock depression beneath the athletic fields which is deepest beneath Fields 3 and 4.

Groundwater has been observed in the shallow overburden materials that include till, fill and swamp (peat or highly organic) deposits. Groundwater is also present within fractures of the shallow bedrock zone. Groundwater level measurements indicate the depth to groundwater is relatively shallow and the overall groundwater flow direction roughly mimics the topography. That is, flow is generally from the N-NW to the S-SE portions of the property. Groundwater enters the site as base flow from three upland areas to the north (northwest, north and northeast). Groundwater measurements indicate discharge towards the surface water channel of West Brothers Brook and groundwater mounding in the west-central portion of the site. Site groundwater primarily discharges from the site in the extreme southeast corner and via West Brothers Brook.

Regulatory Framework and Screening Criteria

The site is under the direct jurisdiction of the U.S. Environmental Protection Agency (EPA) pursuant to the Toxic Substances Control Act (TSCA) due to the detection of polychlorinated biphenyls (PCBs) in soil. Although the site is not under the direct jurisdiction of the CT Department of Energy and Environmental Protection (DEEP), the Town and DEEP as well as the CT Department of Public Health (DPH) are working together to reduce potential risk to human health and the environment posed by environmental impacts at the site.

To evaluate data from the RI activities, recommended screening criteria were established from several sources.

- Screening criteria for soil, groundwater and soil vapor were based on the DEEP Remediation Standard Regulations (RSRs) and additional screening criteria for PCBs in soil and groundwater were based on EPA regulations.
- Additional screening criteria for soil vapor were based on the EPA Vapor Intrusion Screening Level (VISL) Calculator.
- Screening criteria for human exposure to sediments and surface water were based on adjusted RSR soil criteria, modified to account for a limited exposure.
- Ecological-based sediment and surface water screening criteria were identified from the available literature.
- Screening criteria for ambient air were based on risk-based screening criteria developed for air.

Scope of Investigation Activities

RI activities consisted of sampling and testing soil, groundwater, sediment, surface water, ambient air and soil vapor. To date investigation activities at the site have included:

- More than 1200 soil samples from 260 soil borings and;
- 56 groundwater samples collected from 29 monitoring wells;
- 45 sediment samples;
- 26 surface water samples;
- 8 ambient air samples; and
- 5 soil vapor samples.

Depending on the specific chemicals of concern (COCs), samples were analyzed for one or more of the following analyses – volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, extractable total petroleum hydrocarbons (ETPH), metals, pesticides, herbicides, and cyanide. The results of these and previous investigation activities at the site were evaluated to identify COCs and to further delineate impacts at the site and within AOCs.

Conceptual site Model

The CSM, which summarizes the source(s) of contaminants, mechanisms of release, impacted media, and migration pathways has been refined based on the RI activities. Several potential contaminant sources have been identified at the site including the historic fill beneath the athletic fields, pesticide use on-site, and limited releases or petroleum hydrocarbons. These sources have affected on-site soil and groundwater. Identified impacts to sediment and surface water may be due to on-site sources but data collected to date indicates that off-site sources are likely contributors as well. A number of different COCs have been identified present in these sources including PCBs, ETPH, VOCs, polyaromatic hydrocarbons (PAHs), metals, and pesticides.

The primary potential migration pathways identified for COCs at the site include leaching of contaminants from impacted soils; groundwater transport through natural soils, fill and subsurface conduits; and surface water transport. Other possible, but less likely migration pathways include vapor migration through unsaturated soils and along subsurface utility corridors, and wind-blown dust and/or volatile air emissions from undeveloped portions of the site. In addition to the potential migration pathways, the mobility of contaminants through the environment depends on physical properties of the contaminant and properties of the media.

Findings

The main findings of the RI are as follows:

- Impacts to soil have been sufficiently delineated at the site to perform the next steps of site data analysis which include a Human Health Risk Assessment (HHRA) and a Feasibility Study (FS). The major areas of identified impacts to soil at the site include AOC 1 (approximately 11.4 acres in area with multiple COCs) and AOC 13 (approximately 5.8 acres with arsenic as the primary COC). Other areas of soil impacts are more limited in extent.
- Impacts to groundwater have been sufficiently delineated at the site to perform the next steps of site data analysis. However, additional data collection is needed to evaluate temporal trends in groundwater impacts and to further refine the CSM. Current analytical data indicate that impacts to groundwater exceeding screening criteria are limited to the central portion of the site where the greatest impacts to soil are also measured and are not migrating offsite.
- Impacts to sediments and surface water have been sufficiently delineated to perform the next step of site data analysis which includes a Screening-Level Ecological Risk Assessment (SLERA). However, analytical data indicate the potential for offsite sources (upstream) for impacts to sediments and surface water and this will likely need to be further evaluated. In addition, potential impacts to surface water from groundwater need to be further evaluated as do potential temporal trends in surface water impacts.
- Impacts to ambient air and soil vapor have been sufficiently evaluated at the site to perform the next steps of site data analysis. For PCBs, it is likely that blank contamination produced a significant high bias in the analytical data but these data will be used for further evaluation without adjustment for this likely contamination.