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Chapter 26

FLOATER/SINKER SITE ASSESSMENT COMPLICATED BY ASBESTOS

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ABSTRACT

This paper is a case study of how soil and groundwater investigations were conducted at a site containing building asbestos and having access limitations. While previous evaluations of site conditions utilized time-consuming conventional soil boring and monitoring well procedures, continuing investigation necessitated more advanced screening techniques. Since the principal site contaminants are hydrocarbons (both light and dense), Cone Penetration Testing (CPT) and Ultraviolet Induced Fluorescence (UVIF) technologies were chosen to evaluate subsurface conditions. The first round of CPT/UVIF testing indicated groundwater contamination may have extended under the plant buildings which led to building asbestos removal and structural demolition. The second round of CPT/UVIF field work completed in four days appears to have successfully delineated the hydrocarbon contamination.

Keywords: Cone Penetration Testing (CPT), Ultraviolet Induced Fluorescence (UVIF), asbestos, fuel oil, Dowtherm®, heat transfer fluid, LNAPL, DNAPL

1. BACKGROUND

Owens Corning (OC) previously manufactured a high-temperature pipe/equipment insulation product in Berlin, New Jersey. Prior to 1972 the calcium silicate insulation product contained 11% to 14% asbestos, making it an asbestos-containing material (ACM). The manufacturing plant closed in 1993 which triggered New Jersey's Industrial Site Recovery Act (ISRA) program

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within the Department of Environmental Protection (NJDEP). The Department directed that the Technical Requirements for Site Remediation (TRSR) be followed in evaluating site conditions and potential areas of environmental concern (AOCs).

The site is located within the New Jersey Pinelands Commission boundary and occupies approximately 45 acres consisting of production and warehouse buildings and other support structures which cover about 20 percent of the property. Another 5 percent of the property is paved with the remainder undisturbed woods. The water table under the plant buildings ranges from 10-15 feet bgs (below ground surface) and the soil lithology is sand, gravelly sand and silty sand extending more than 70 feet bgs. The site's topography includes some relief with the low spot near the center of the site. Storm water in this area is collected in an infiltration pond called the Lower Pond. When this pond filled, excess water was pumped to a second infiltration pond located at a higher elevation known as the Upper Pond. The former manufacturing process required curing and drying of the molded wet process pipe insulation material using curing ovens heated with heat transfer fluid with temperature ultimately maintained by natural gas firing and fuel oil backup.

Initial site investigation activities under the ISRA program identified soil and groundwater impacts related to the former manufacturing operations. Most of the identified impacts were primarily related to the historic use of Dowtherm® (a heat transfer fluid), fuel oil and various lubricants. Groundwater is affected by the Dowtherm® (sinker) and fuel oil (floater). Initially thirteen areas of concern (AOCs) were established around the site outside of the plant buildings. Subsequent investigations determined that no further action was warranted for eight of the thirteen AOCs. This paper will focus on investigative techniques for two of the AOCs addressed in the Remedial Action Workplan (RAW) namely: AOC #3 (former Dowtherm® storage and transfer area) and AOC #8 (the Lower Pond and adjacent alley). The site plan (Figure 1) shows the AOC and monitoring well locations in relation to the building footprint.

2. SUBSURFACE INVESTIGATION TECHNIQUES-THEN AND NOW

Numerous site investigations prior to 2003 indicated the presence of LNAPL (light non-aqueous phase liquid) in some soil and groundwater samples at AOC #3. The principal VOC (volatile organic compound) contaminant is benzene (from fuel oil). Also, limited direct investigation within the aquifer [one deep monitoring well (MW-11D) between AOC #3 and AOC #8] indicated the presence of DNAPL (dense non-aqueous phase liquid) in groundwater samples.

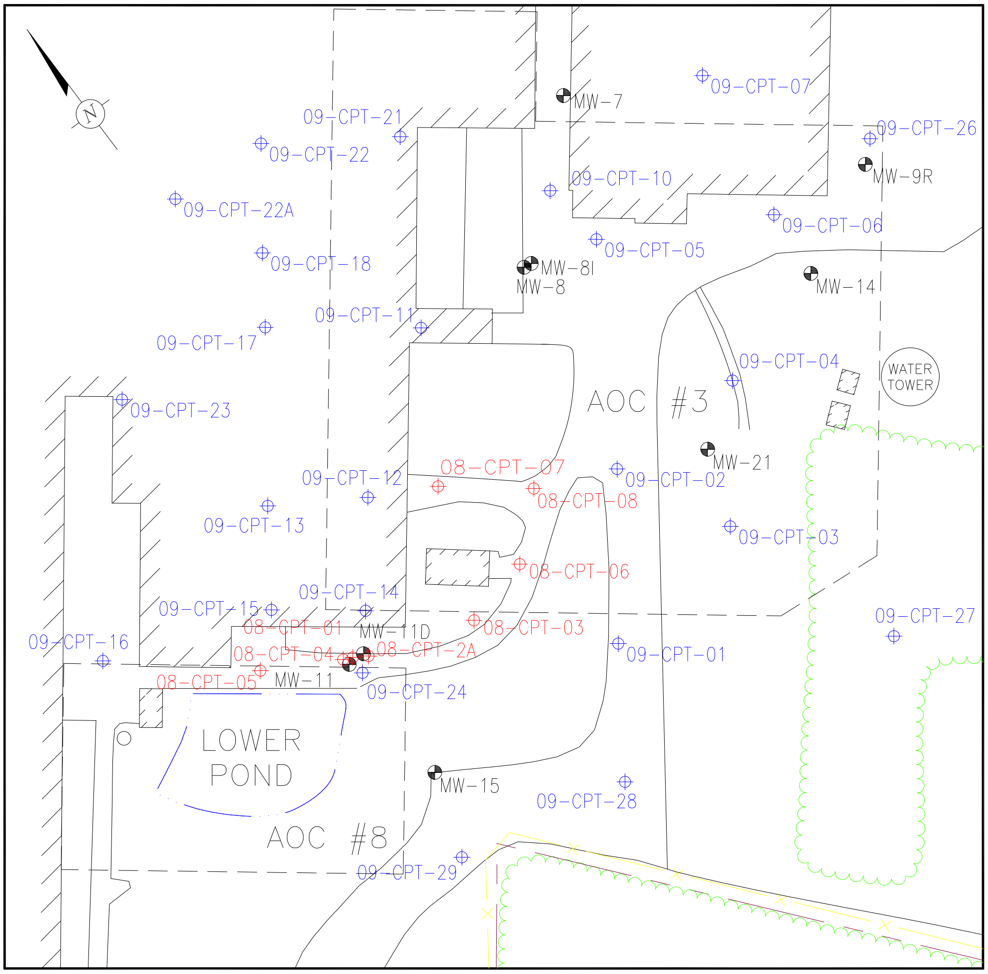

Figure 1. Site plan showing AOC, monitoring well and CPT/UVIF boring locations

The principal SVOC (semi-volatile organic compound) contaminants are diphenyl and diphenyl ether (from Dowtherm®) (New Jersey Department of Environmental Protection, 2003).

All previous subsurface investigations were conducted using traditional soil boring procedures. These include the collection and inspection of numerous soil/groundwater samples followed by costly laboratory analysis and data evaluation. Beginning in 2008 OC implemented more advanced screening technologies to accelerate data collection/analysis and to reduce sampling and analytical costs. Environmental consulting services are supplied by ARCADIS U.S., Inc. of Newtown, Pennsylvania.

Undertaking advanced screening technologies can help reduce or even replace extensive and costly soil sampling programs. The screening technologies have the unique advantage of providing essential information about the source and extent of contamination in real time. Advanced screening technologies can determine subsurface heterogeneity within the geologic formations. Also, the technologies can estimate the relative magnitude of contamination within underground formations.

2.1. Cone Penetration Testing

Cone Penetration Testing (CPT) is a technology that can be used to delineate soil types and permeability for unconsolidated formations to depths exceeding 100 feet. By eliminating traditional soil borings, costly waste disposal associated with soil cuttings can be eliminated. CPT measurements are derived by continuous penetration resistance as the CPT probe is driven to depth. Soil deformation is interpolated by measuring probe tip resistance, friction sleeve resistance and dynamic pore pressure. CPT provides real-time results and continuous logs of soil borings. In addition, since CPT soil borings interpret subsurface lithologies, possible biases and interpretation differences by field technicians/geologists are eliminated.

2.2. Ultraviolet Induced Fluorescence

Ultraviolet Induced Fluorescence (UVIF) utilizes fluorescent radiation to identify hydrocarbons present in soil and groundwater. UVIF technology incorporates a sensor that is deployed by direct push methods. High intensity ultraviolet light is emitted through a sapphire window in the side of the UVIF probe. The UV light is absorbed by hydrocarbons in the subsurface and re-emitted, or fluoresced, at a different wavelength. This fluorescence is captured by a fiber optic cable within the probe and transmitted to the surface. Since fluorescence intensity is proportional to hydrocarbon concentration, this technology is able to effectively delineate the presence and vertical extent of hydrocarbon-impacted soil in the borehole (Roux Associates Inc., 2007).

2.3. Combining Cone Penetration Testing With Ultraviolet Induced Fluorescence

The amalgamation of the cone penetrometer and the ultraviolet induced fluorescence module produces a powerful site characterization tool for geo-environmental investigations. The CPT/UVIF probe (Figure 2) combines the

UVIF module with the cone penetrometer to detect fluorescence and soil mechanical properties. As the UVIF module collects information on contaminant characteristics, the CPT probe characterizes the ground in terms of soil type, soil permeability, soil strength and phreatic surface. Therefore, at each test location an integrated vertical profile of contaminant location, relative contaminant concentration, soil stratigraphy and soil permeability are generated in real time on site. Having all of this information allows for on-site assessment and decision making resulting in optimization of the site investigation and ultimately a reduction in site characterization costs (ConeTec, 2006).

3. REMEDIAL INVESTIGATION RESULTS

3.1. CPT/UVIF Results in 2008

In the summer of 2008 the CPT/UVIF investigation technique was employed to evaluate the horizontal and vertical extent of DNAPL in the vicinity of MW-11D near the Lower Pond (AOC #8). The site plan (Figure 1) shows the 2008 CPT/UVIF sounding (boring) locations in red. In conjunction with the eight CPT/UVIF borings, soil samples were collected using direct push drilling at select intervals in two soil borings co-located with the CPT/UVIF borings. The samples were used to confirm select UVIF responses and to allow visual and analytical confirmation of soil impact. Each sample was visually inspected, logged and field screened with a photoionization detector (PID) prior to being submitted to the laboratory for analysis for diphenyl and diphenyl ether. Upon completion the boreholes were backfilled to comply with NJDEP requirements. Prior to initiating the drilling work, a utility locating service was used, in conjunction with site-specific information to clear the proposed drilling locations. During drilling, soil cuttings were containerized in 55-gallon steel drums and were shipped off-site for disposal/recycling.

CPT data confirmed soil lithology to be sand, gravelly sand or silty sand to a depth of 70 feet bgs. Groundwater is located at 10-12 feet bgs. UVIF data showed a hydrocarbon mixture (fuel oil and Dowtherm®) that straddles the water table between 10 and 15 feet bgs. UVIF data also confirmed the presence of a DNAPL zone approximately 50 feet bgs particularly near MW-11D. However, due to the close proximity of the plant buildings this series of borings did not completely determine the physical extent of the DNAPL associated with AOC #3. All available data indicated the groundwater contamination may have extended under the plant buildings. Conducting groundwater investigations from inside the buildings were stymied due to loose ACM insulation (walls, ceiling, etc.) falling down and low overhead room to maneuver field equipment. Therefore the buildings and equipment were abated for asbestos and the structures demolished by mid-2009 to facilitate continued field investigation.

3.2. Preliminary CPT/UVIF Results in 2009

In the summer of 2009 CPT/UVIF field work commenced to further delineate the extent of the DNAPL observed in MW-11D and LNAPL observed in the area directly east of the former manufacturing building. Thirty borings were advanced in areas identified as requiring further delineation. Fifteen of the borings were located in the previously existing building footprint. The site plan (Figure 1) shows the 2009 CPT/UVIF sounding (boring) locations in blue. As in 2008 in conjunction with the CPT/UVIF borings, a direct push drilling rig (i.e. Geoprobe®) was utilized to collect sixteen confirmatory soil lithology and analytical samples from 8 borings. The CPT/UVIF borings took four days to complete and the Geoprobe® samples covered two days.

CPT data shows top of groundwater at 9-12 feet bgs. UVIF data appears to complete the delineation of the LNAPL and DNAPL plumes. The data plots for Sounding (Boring) #10 (Figure 3) show typical CPT/UVIF borehole profiles. The UVIF profile shows hydrocarbon detections at the groundwater interface and at approximately 50 feet bgs. The "**qt**" plot represents cone tip resistance in tsf (tons per sq ft), the "**fs**" profile portrays sleeve friction in tsf, the "**u**" plot shows pore pressure in ft, the "**UVIF"** profile represents UVIF fluorescence intensity in volts and the "**SBT**" plot is the soil behavior type based upon computerized interpretation of the geo-physical parameters **qt, fs** and **u.**

4. POTENTIAL REMEDIAL APPROACH

Since the site is within the New Jersey Pinelands Commission boundary the soil/groundwater cleanup goal will be background conditions. A number of potential remedial strategies have been evaluated for OC to gain insight into an overall remediation plan for the site. Likely remediation scenarios include excavation with off-site disposal or on-site treatment and other aggressive source area in-situ stabilization/treatment options. Longer term remediation alternatives suggest air sparging and soil vapor extraction or chemical treatment.

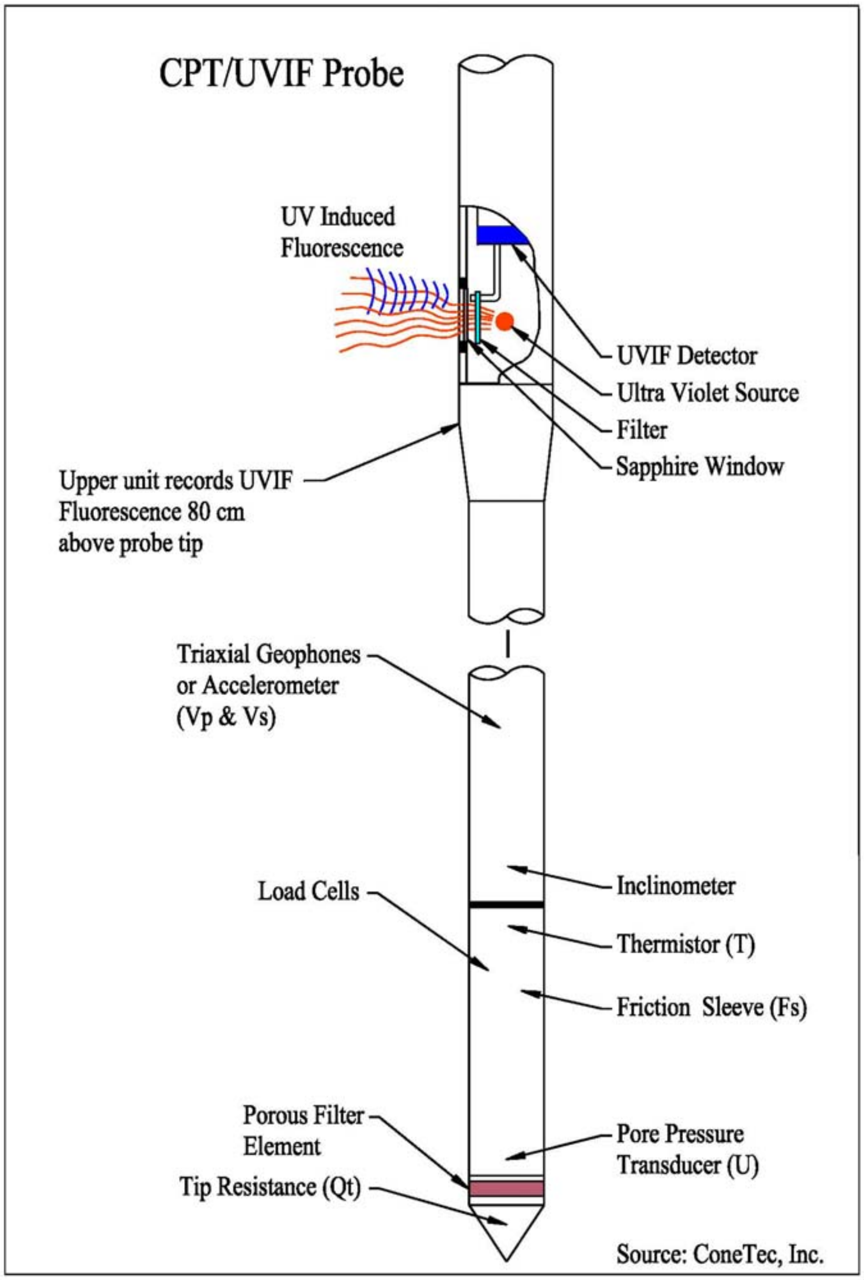

Figure 2. Details of cone penetrometer coupled to UVIF module

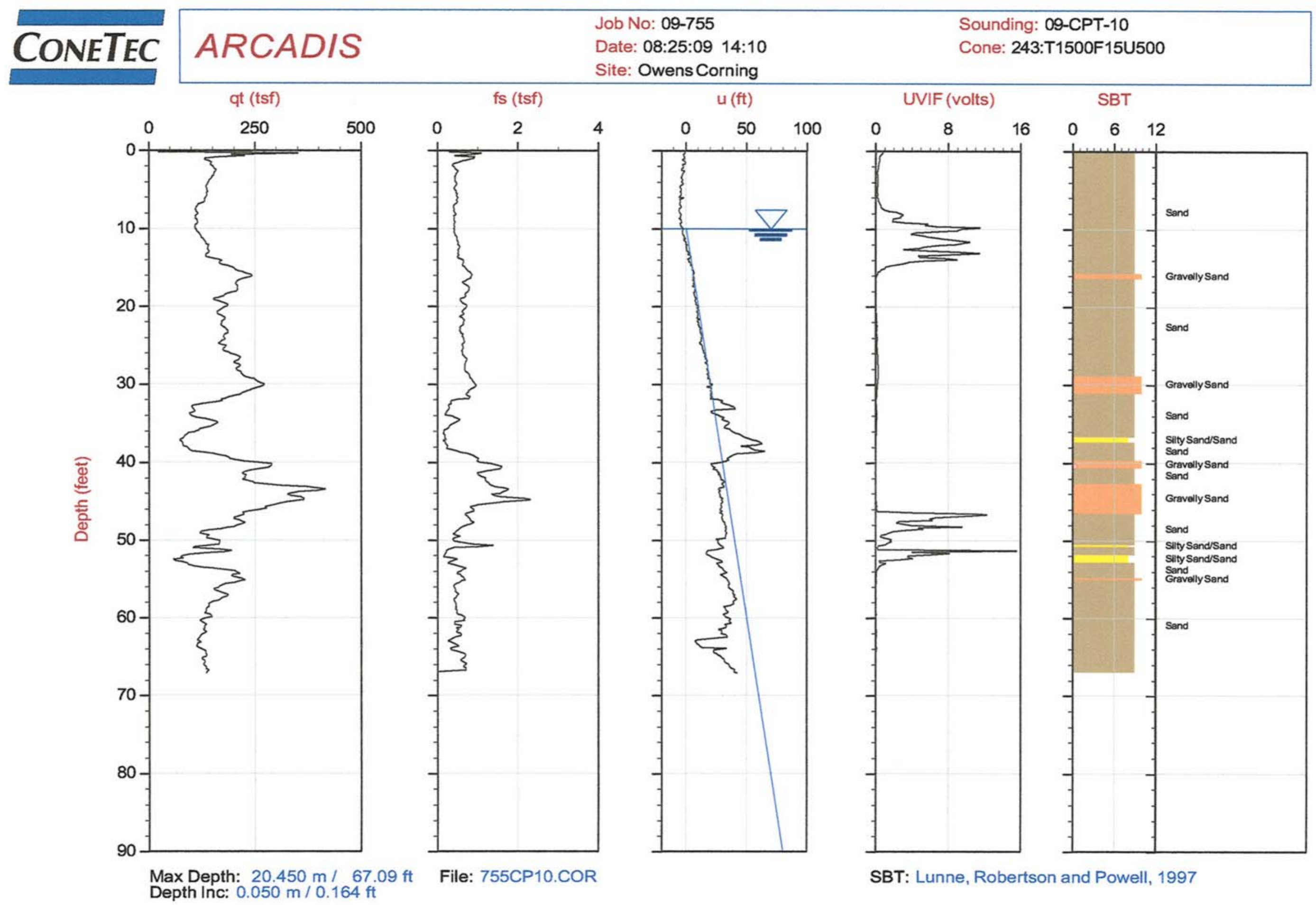

Figure 3. Typical CPT/UVIF borehole profiles

5. CONCLUSIONS

The implementation of CPT/UVIF soil investigation technology at an existing impacted site has allowed OC to rapidly delineate LNAPL and DNAPL contamination at varying elevations within the same location. The straight-forward operation i.e. direct-push drilling, no soil cuttings, real-time data and continuous interpretation of subsurface conditions were major reasons the CPT/UVIF approach was selected. The remedial investigation results demonstrate that CPT/UVIF technology provides essential subsurface information rapidly thus allowing field personnel the ability to manage remedial investigations more efficiently and at lower cost. Overall, the CPT/UVIF methodology provides significant visualization into site stratigraphy, is a useful tool to delineate hydrocarbon contamination and increases insight into contaminant migration. The application of advanced in-situ soil testing equipment with continuous data interpretation appears efficient, economical and a flexible method to achieve better soil/groundwater understanding and has a bright future with all stakeholders (owners, consultants and regulatory agencies).

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