On behalf of our client, Toll Brothers, Inc., BrightFields, Inc. has prepared this summary of the proposed remedial action (PRA) to present the approach for remediation at the Delaware National/Former Hercules Country Club Golf Course site in Wilmington, Delaware.

INTRODUCTION

The majority of the proposed cleanup site was previously used as a nine-hole golf course on Hercules Road, separate from the active section of the 18-hole Delaware National Country Club golf course along Lancaster Pike at the intersection with Hercules Road. The former golf course has subsequently grown over and appears as an open field. The remaining portion of the lot is an unoccupied wooded area. Toll Brothers, Inc. plans to construct approximately 160 single family residential units with accompanying common areas on the property.

SITE DESCRIPTION AND HISTORY

The subject property is located on Hercules Road, approximately 2,000 feet west of the Newport Gap Pike (State Route 41) and south of Lancaster Pike (State Route 48) in Wilmington, Delaware (Figure 1). The site is composed of two tax parcels. The northern parcel was formerly used as a nine-hole golf course and covers an area of approximately 101 acres (tax parcel ID# 08-026.00-052 [Lot 5]). The parcel has been maintained as a golf course since 1947. The southern parcel is unoccupied and wooded and is approximately 61 acres (tax parcel ID# 08-033.00-001 [Lot 10]). The surrounding land is generally residential. The Hercules Research Center is adjacent to the site, occupying approximately 45 acres, the majority of which is used for development and research chemistry studies for Hercules. The Research Center, which consists primarily of research and product development laboratories, has been the subject of a separate RCRA Corrective Action Cleanup regulated by DNREC’s Solid and Hazardous Waste Management Branch.

The site generally slopes toward the south. Surface water drainage discharges into Hyde Run and its tributaries on the western side of the property and into an unnamed tributary of Red Clay Creek on the eastern side.

The nearest designated New Castle County Water Resource Protection Area (WRPA), including wellheads or groundwater protection areas, is approximately 750 feet from the site (non-transient, non-community wells). The nearest surface water supply intake is greater than two miles from the site. Based on DNREC’s December 1999 HSCA Remediation Standards Guidance, the site is not within a Critical Water Resource Area.
ENVIRONMENTAL INVESTIGATION

In October 2004, BrightFields, Inc. (BrightFields) reported on a Remedial Investigation (RI) and Feasibility Study of the site. DNREC staff provided comments on the draft RI including requests for additional sampling and analysis which was subsequently performed by BrightFields. The RI process has involved multiple investigations for more data. In correspondence dated February 20, 2007 DNREC stated that the RI “meets the substantive requirements for a Remedial Investigation under the provisions under the Delaware Hazardous Substance Cleanup Act (HSCA) and Regulations pursuant thereto.” The study incorporated the findings of a sampling event performed by TriState Environmental Management Services, Inc. (TriState) in 2003. It also included results of sampling events carried out by BrightFields in late 2003.

The environmental investigation included extensive soil samples, shallow groundwater samples, sediment samples, and ground water samples. The investigation methods and results are discussed below.

Soil
TriState drilled approximately 79 borings throughout the property and collected 143 soil samples. Samples contained elevated concentrations of arsenic, lead, chlordane, 4-4’ DDE, heptachlor epoxide and dieldrin. Samples collected from golf course greens were significantly higher in concentration than those collected from fairways.

On October 17, 2003, BrightFields personnel collected a total of four soil samples from two greens. Technical chlordane (and two of its components alpha and gamma chlordane), dieldrin, heptachlor epoxide, aldrin, arsenic, cadmium, lead and mercury were detected in several of the soil samples collected from both greens.

In November of 2003, BrightFields conducted a more extensive investigation on the property which included the collection of soil, groundwater, sediment and surface water data on the property. Twenty soil samples (10 surface and 10 subsurface) were collected from 10 locations not associated with greens, tees or fairways and were analyzed at Lancaster Laboratories for a wide range of contaminants (TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals and cyanide). The soil samples were collected from depths ranging from 0 to 12 feet below ground surface (bgs) across the golf course property. Elevated arsenic was not detected above the Delaware default background standard of 11 mg/kg (DNREC 2004) in these samples. Cyanide, SVOCs, VOCs, pesticides, and PCBs were either not detected or were detected below screening criteria.

During the RI Investigation, BrightFields also collected 102 soil samples from the two greens that had elevated concentrations of arsenic. Based on the results of the BrightFields Greens Characterization, arsenic, mercury, cadmium, and lead were detected at elevated concentrations in soil samples from the green, fringe, and rough areas of greens 2 and 4 from the surface to a maximum depth of 3.5 feet bgs.

To date more than 350 soil samples have been collected and analyzed from 179 locations across
the site (samples were taken at various depths in some locations). Additional soil samples will be collected and analyzed throughout the proposed remedial action in conjunction with the collection of real time field screening data (i.e., XRF soil analysis).

**Groundwater**

BrightFields used a direct-push device to place ten shallow wells. Eight groundwater samples were collected and analyzed. Iron, manganese and chloroform were present in several samples.

**Surface Water and Sediment**

Nine surface water and 9 sediment samples were collected from locations shown on Figure 2. Metals and pesticide-related compounds were detected in several samples.

**Supplemental Investigation**

In February 2006, per DNREC direction, BrightFields conducted additional soil investigations on the southern wooded lot (#10) to assess whether golf course operations on the adjacent lot have impacted this area where future residential lots are planned. Twenty-one hand auger locations, each having samples obtained at three depth intervals below ground surface (0-0.5 ft, 0.5-1 ft, and 1-1.5 ft), were advanced on the wooded lot.

Additional soil investigations on the golf course were also performed to confirm that additional pesticide/herbicide compounds (2,4-D, Glyphosate, Oxadiazon, and Chlorpyrifos), not analyzed previously, have the same vertical distribution with arsenic as the currently known pesticides documented in BrightFields’ Remedial Investigation/Feasibility Study, October 2004. Six hand auger locations, with samples obtained at three different depth intervals below ground surface (0-0.5 ft, 0.5-1 ft, and 1-1.5 ft), were advanced on the golf course.

A composite sample was also collected from the golf course to be analyzed for waste characterization parameters. The waste characterization analysis performs a set of tests that classifies the soil as either non-hazardous or hazardous, and determines whether a disposal facility will accept the material for off-site disposal.

**Supplemental Investigation Results**

According to the laboratory analytical data from the soil samples collected in the wooded lot, none of the compounds analyzed were detected at levels above the State’s Uniform Risk Based Standard (URS) for unrestricted (residential) use. The soil that was tested does not appear to be impacted by the application of pesticides and herbicides on the adjacent golf course and therefore the area of concern will not need to expand.
The lab results for the golf course samples establish that the additional pesticides/ herbicide compounds analyzed (2,4-D, Glyphosate, Oxadiazon, and Chlorpyrifos) were not at levels above the URS for residential use. This confirms that no modifications need to be made to the conclusions or remedial action objectives of the BrightFields’ Remedial Investigation/Feasibility Study.

Based on the results of this soil Waste Characterization analysis, the material expected to be removed off-site for remediation purposes should be classified as non-hazardous.

CONCLUSIONS

The conclusion of the remedial investigation is that compounds of concern on the site are mainly associated with soil on the greens, tees, and fairways, with concentration on greens and tees substantially higher than fairways.

Soil--These compounds include pesticides (including: chlordane, 4-4’ DDE, heptachlor epoxide and dieldrin) and metals (including: arsenic, lead, cadmium and mercury). Specifically arsenic appears to be present to depths of 3.5 feet bgs in some greens and tees, to depths of 1.5 feet bgs in the fringe and rough areas of the greens and to 6 inches bgs in the fairways. Based on the results of the TriState and BrightFields investigations, arsenic had a high degree of correlation to elevated levels of pesticides associated with golf course greens and tees.

Four of 9 tees, 5 of 8 fairways and two additional areas have arsenic concentrations between 11 and 37 mg/kg. Seven of 9 greens, 2 practice greens, 2 of 9 tees and one fairway have arsenic concentrations exceeding 37 mg/kg. The areas of contamination are shown on Figure 2.

Sediment--An area of sediment in a small stream tributary to Red Clay Creek (shown on Figure 2) has pesticide contamination.

Surface water--Surface water samples taken at locations SW01, SW04, SW05 and SW07 have alpha and gamma chlordane consistent with concentrations found at the background location (SW03). Higher concentrations of alpha chlordane are present in samples from SW08 and SW09. These elevated concentrations are likely due to historical runoff from identified impacted areas of this site.

Ground water--Iron and manganese are naturally occurring substances in ground water. They affect the taste and odor of drinking water but are not toxic at the concentrations present. Chloroform detected in two shallow wells (MW04 and MW03) may be related to the application of agricultural chemicals, however it is a common laboratory contaminate and may not represent true field conditions.

Additional sampling, during and after the remedial action, will be conducted, similar to a
standard HSCA cleanup site.

HUMAN HEALTH RISKS

The cumulative risk calculations indicate that exposure to site soil that is not associated with greens, tees or fairways does not pose an unacceptable carcinogenic or non-carcinogenic risk under the unrestricted (residential) use scenario.

Elevated arsenic concentrations on some of the greens and tees would result in unacceptable risks in a residential land use scenario.

Traces of inorganic substances and pesticides in shallow ground water and surface water do not contribute significantly to human health risks. Shallow groundwater at the site will not be used for drinking water supply. There is no potential for vapor intrusion into structures on the site.

Pesticide related compounds in sediment represent potential human health risks and current environmental risks.

REMEDIAL ACTION OBJECTIVES

Qualitative objectives describe, in general terms, what the ultimate result of the cleanup action, if necessary, should be. The following qualitative objectives have been determined to be appropriate for the Delaware National site:

- Control potential human contact (dermal and ingestion) with, and ecological impact to contaminated sediment (on-site stream).
- Minimize migration of contaminated soil to the surface water (on-site drainage swale/stream).
- Reduce migration of pesticide-related compounds from soil to ground water.
- Control potential human contact (dermal, inhalation and ingestion) with contaminated soil.

These objectives are consistent with the planned development of the site for residential use, New Castle County zoning policies, state regulations governing water supply, State HSCA regulations and remediation standards guidance, and worker health and safety.

Quantitative objectives define specific levels of remedial action to achieve protection of human health and the environment. Based on the qualitative objectives, the quantitative objectives will be used so that future site users such as visitors and workers do not come in contact with soils that contain elevated levels of pesticides (including: chlordane, 4-4’ DDE, heptachlor epoxide and dieldrin) and metals (including: arsenic, lead, cadmium and mercury).

Based on the qualitative objectives, the quantitative objectives are:
• The cleanup goal for arsenic in soil is a concentration 11 mg/kg. This the default background concentration recognized in DNREC guidance.

• The cleanup goal for pesticide-related compounds in sediment is a concentration of 0.002 mg/kg.

The cleanup goal will not distinguish between organic forms of arsenic and the more toxic inorganic forms, or apply a “bioavailability factor” as is done in many states. In these ways, the cleanup goals are more conservative than applied in some states.

PROPOSED REMEDIAL ACTION

Based on an evaluation of the site information, which includes current and past environmental investigations, historical information, the above remedial action objectives, and the remedial alternatives evaluated in the remedial alternatives evaluation study the following remedial actions are proposed:

1. No soil will be left on site with arsenic concentrations exceeding 11 mg/kg.
   a. Soil containing arsenic concentrations greater than 37 mg/kg, (See Figure 2.) will be excavated and removed offsite for proper disposal.
   b. Soil with arsenic concentrations between 11 mg/kg and 37 mg/kg will be mechanically blended with the soil below it (containing the default background standard of 11 mg/kg or less) in a 1:1 blending ratio resulting in lower overall concentrations of residual contaminants. The soil blending process will result in soil suitable for construction without environmental restrictions because the resulting arsenic concentrations will be less than the default background standard of 11 mg/kg. (See Figure 2.)

2. Sediment materials with elevated pesticide concentrations in an existing drainage depression will be excavated and transported offsite for disposal. (See Figure 2.)

3. Post-remedial confirmatory samples will be collected for each individual building lot and for common areas to document that the remedial action objectives have been achieved by excavation and soil blending operations.

BrightFields will conduct environmental health and safety oversight during implementation of the PRA. This will include field monitoring and sample collection to confirm that the Remedial Action Objectives are achieved, that materials are handled and disposed in accordance with the PRA, and monitoring of site conditions (i.e., dust) for compliance with applicable health and safety regulations. Contingency plans will also be prepared which address procedures in the event unforeseen environmental conditions are encountered during implementation of the
remedy. BrightFields will coordinate oversight and monitoring activities with DNREC and will document activities throughout remedy implementation.

REFERENCES

1. BrightFields Remedial Investigation/Feasibility Study, October 2004
2. BrightFields Supplemental Soil Sampling Report, April 2006
3. Delaware Regulations Governing Hazardous Substance Cleanup
4. Remediation Standards Guidance
5. Standard Operating Procedures for Chemical Analytical Programs under HSCA.