EVERGREEN SYSTEM

DUPONT AREA INVESTIGATION

PALL LIFE SCIENCES
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INTRODUCTION

This report summarizes recent investigations Pall Life Sciences (PLS) has completed in the Evergreen System – Dupont Circle area. PLS proposed an investigation in a work plan dated August 24, 2007, which has focused on evaluating the possibility that 1,4-dioxane in the Dupont area could migrate beyond the capture of the Evergreen extraction wells.

BACKGROUND

DUPONT AREA REVIEW

Elevated levels of 1,4-dioxane detected in groundwater samples have precipitated a series of investigations of the Dupont Circle area located in the western portion of the Evergreen Subdivision. 1,4-Dioxane concentrations in water samples from 465 Dupont Circle began to increase in fall 1998. By April 1999, these levels exceeded 85 micrograms per liter (µg/L), prompting investigations, including the installation of monitoring wells MW-54s, MW-54d, MW-55, and MW-77; water quality and water level monitoring; tritium analyses; slug testing; and other hydraulic testing. These historic investigations have been discussed in previous reports to the Michigan Department of Environmental Quality (MDEQ) and were reviewed in the recent Evergreen System Review dated May 2007.

In June 2007, the MDEQ sampled groundwater from numerous residential wells in the area northwest of Dupont Circle. 1,4-Dioxane was not detected in any of the samples. While these data support the hypothesis that migration of 1,4-dioxane from the Dupont Circle area to the northwest is unlikely, PLS agreed to further assess this possibility.

DATA COLLECTION

SURVEY, WATER LEVEL, AND WATER QUALITY DATA COLLECTION

On February 25, 2008, PLS collected water level data from an extensive list of wells, including the Evergreen Dupont area, residential wells northwest of Dupont, and selected wells in the PLS site area and Western System. These water level data are provided in Appendix 1. The residential wells selected for this investigation represent wells completed at various depths. The locations of the residential wells located northwest of the Dupont Circle area are shown on Figure 1. Available well logs for residential wells used in this investigation are provided in Appendix 2.

Atwell-Hicks, Inc. (AH) of Ann Arbor, Michigan, surveyed the location and top-of-casing elevations for newer wells and residential wells used in this investigation. The AH survey data is provided as Appendix 3.

DATA INTERPRETATION

HYDROSTRATIGRAPHY

Boring, well, and analytical data from this investigation have been incorporated into cross-sections that were previously provided to the MDEQ. Cross-sections that were augmented with new well data (e.g., MW-113, etc.) have been reinterpreted for presentation here. A map showing the location of each cross-section is embedded within each cross-section figure.

Hydrostratigraphic units are grouped based on hydraulic properties (i.e., aquifers/aquitards). Strata composed predominantly of fine-grained materials (e.g., silts and clays) are shaded in green and generally represent low hydraulic conductivity material that constitute confining units for the area. Strata composed predominantly of coarse-grained materials (e.g., sands and gravels) are shaded in yellow and generally represent material having higher hydraulic conductivity and form aquifer units for the area. Significant features of each cross-section are described below.

MW-113 is shown on Cross-Section 08-06 (Figure 2). Cross-Section 08-06 is constructed generally perpendicular to the Units E and D_2 to provide a profile view of these hydrogeologic units. Beginning at MW-72s&d, Cross-Section 08-06 traverses generally northward through IW-1, LB-1, and MW-KD1d to MW-113. Approximately 93 feet of Unit D_2 sand was encountered in MW-113.

Cross-Section 08-07 (Figure 3) extends through the Evergreen Subdivision area, beginning west of the Dupont Circle area, then generally follows the longitudinal axis of the Unit D_2 and plume through the Evergreen area. A review of Cross-Section 08-07 indicates at least three aquifers are present in the Evergreen Subdivision: Unit D_2, a shallower aquifer above Unit D_2, and a lower Unit E below Unit D_2.

As shown on Cross-Section 08-07, the aquifer thickness of Unit D_2 remains relatively uniform along its longitudinal axis from MW-77 and the 373 Pinewood well, then eastward through LB-1, LB-2, and MW-BE1s&d, toward MW-47 and MW 101. Westward from 373 Pinewood, Cross-Section 08-07 shows Unit D_2 becomes divided in the general vicinity of Dupont Circle, west of MW-77. As shown, an intervening confining layer splits Unit D_2 into upper and lower Unit D_2 sands at 465 Dupont Circle. Both MW-77 and 465 Dupont are screened in the lower Unit D_2. Again, the thicker sand at MW-77 and 373 Pinewood form the main body of Unit D_2 through the Evergreen area (Cross-Section 08-07).

Cross-Section 08-08 (Figure 4) was constructed using residential wells in the general area of the Wagner Road north and Dexter intersection, located west of the Dupont Circle area. Wells at 520 Wagner and 3480 Dexter are common to both cross-sections. Comparison of Cross-Sections 08-07 and 08-08 shows an upper Unit D_2 sand present in the Wagner/Dexter area. The deeper sand at an elevation of approximately 740 to 760 feet above mean sea level on Cross-Section 08-08 may correlate to the lower Unit D_2; however, this lower sand may represent the base sand unit above the bedrock, and could form a later equivalent unit to the lower Unit E sand (E_2).

Cross-Section 08-11 (Figure 5) is constructed using wells common to both the Evergreen area 373 Pinewood, LBOW-1, LB-1, etc., then southward from 373 Pinewood through GSI-96-01, MW-17, and MW-30 to the Ferry Street area, ending at MW-69. Wells MW-69 and MW-30d are completed in the lower Unit E sand (E_2). Cross-Section 08-11 shows a "gap" in the confining unit separating Units D_2/E_1 from Unit E_2. As discussed in the 2007 Evergreen Review previously submitted to the MDEQ, a loss of the confining unit separating Units D_2/E_1 and Unit E_2 (e.g., at GSI-96-01) suggests the lower Unit E sand at MW-30d could be hydraulically communicated to the 373 Pinewood (shallow). If true, this may suggest a localized merger of Units D_2/E_1 and E_2 sands. Consequently, the split Unit D_2 correlation shown on Cross-Section 08-07 potentially suggests a hydraulic communication of D_2/E_1 and E_2 sands that manifests as 1,4-dioxane impacted lower Unit D_2 sand at MW-77, 465 Dupont, MW-55, and MW-54d via a southern route.

Cross-Section 08-10 (Figure 6) is constructed from wells in the Dupont Circle area (MW-54, MW-55s&d, and MW-77) and the Evergreen area (373 Pinewood and MW-100). Review of Figure 6 shows an intervening confining layer splits Unit D_2 into upper and lower D_2 sands at MW-54 and MW-55s&d.

WATER LEVEL DATA/GROUNDWATER FLOW

Water level data collected from residential wells northwest of Dupont indicate the heads in the shallow wells are higher than the deeper wells. This is demonstrated on a plot of water levels versus depth provided in Appendix 4.

Water levels in the shallow wells are approximately 5 to 8 feet higher than wells completed in similar hydrofacies in the Evergreen area. Water levels in the deeper residential wells are very similar to deeper wells in the Evergreen area.

Potentiometric surface maps have been prepared for portions of the Unit D_2, Unit E, and Unit D_0 (Figure 7), and the lower Unit E (E_2) and deeper wells in the Dupont area (Figure 8) from water level data collected February 25, 2008. Water levels were collected from selected distant wells to get a regional perspective for the maps. The following key observations are noted for the Dupont area:

- Groundwater flow in the Unit D_2/E_1 equivalent aquifer flows generally from northwest to east/southeast through the Dupont area, with the hydraulic heads in wells completed in the Unit D_2/E_1 equivalent aquifer in the area northwest of Dupont, approximately 5 to 8 feet higher than the heads in the Dupont area.

- The potentiometric surface developed from water level data collected from the deeper wells used in this investigation, including the deeper residential wells northwest of Dupont, suggest groundwater in the Dupont area has a north/northeast component of flow.

- It has been demonstrated by interpretations of the hydrostratigraphy and hydraulic testing that there is a hydraulic connection between the Dupont area and the Evergreen extraction wells. As such, the two potentiometric surfaces (Figures 7 and 8) cannot be viewed independently, rather they need to be considered in two-dimensional representations of a three-dimensional flow field.

SUMMARY OF FINDINGS

Following are key findings from this investigation:

- The most plausible explanation for 1,4-dioxane in the Dupont area continues to be the migration of 1,4-dioxane at deeper elevations from the south, such as the area near MW-30d or GSI-98-01. This is consistent with hydrostratigraphic interpretations, water quality, and water level/flow data. New data from MW-118, recently installed near Wagner and Ferry, indicate a wide plume migrating from the south (north of Nancy Drive) is not the source of the 1,4-dioxane in the Dupont area.

- Monitoring wells MW-54d and MW-55 are strategically located to detect expansion of 1,4-dioxane from the Dupont area. 1,4-Dioxane concentrations at these well locations have been increasing slightly, but remain below 85 µg/L.

- Data collected as part of this investigation continue to support PLS previous interpretations that 1,4-dioxane in the Dupont area migrates toward the Evergreen extraction wells.

RECOMMENDATION

PLS recommends no further investigation of the Dupont area. At some point, should the Evergreen extraction rates be lowered, additional monitoring may be needed to monitor for expansion of 1,4-dioxane in the Dupont area to the north.