Pall Corporation

WORK PLAN FOR DOWNGRADIENT GROUNDWATER INVESTIGATIONS AND POTENTIAL UNDERFLOW OF THE HURON RIVER
UNIT E PLUME

October 7, 2004

BACKGROUND

Purpose

Pall Life Sciences (PLS) is proposing to investigate the projected migration pathway of the Unit E plume as it moves hydraulically downgradient from its current position. This investigation is in support of the PLS recommended approach set forth in the June 1, 2004 Feasibility Study. It is also intended to be used to satisfy Condition 5 for approval of the PLS Plan as identified in the DEQ's September 1, 2004 Decision Document. Implementation of this work plan is only necessary in support of response activities that allow continued migration of a portion of the Unit E plume.
The purpose of this investigation is to determine the probable horizontal and vertical migration pathways of the Unit E plume as it moves hydraulically downgradient. Data from this investigation can be used as necessary to design effective monitoring systems or models for predicting the fate of the Unit E plume.

If the data from this investigation confirms that the plume is migrating toward the Huron River, PLS will conduct additional investigations in the river corridor to demonstrate that the plume will not underflow the river.

PART A is to investigate the migration pathways of the Unit E plume as it moves hydraulically downgradient of the Maple Village Shopping Center. Once this investigation is completed, PLS will implement **PART B**, which is to investigate the potential for underflow of the Huron River at a location indicated by Part A.

GENERAL HYDROGEOLOGICAL SETTING

PLS has conducted extensive investigations into the hydrogeology of the Unit E plume area. Limited hydrogeological data are available east of the current extent of the Unit E plume. Available data have been used to assess the geologic and hydrogeologic character of the downgradient areas.

The following general observations can be made about the area east of the Unit E plume:

- The bedrock underlying the Unit E plume and areas east to the Huron River is the Mississippian Coldwater shale.

- Typical drift thickness in the area of the Unit E plume is 200 to 300 feet. Drift thickness generally decreases with proximity to the Huron River. This is primarily because the topographic surface lowers from approximately 920 feet above mean sea level (amsl) in the Unit E plume area to approximately 790 feet amsl along the river.

- PLS maps previously submitted to the Michigan Department of Environmental Quality (MDEQ) have indicated that groundwater flow in the Unit E aquifer is generally toward the east. Consequently, it is anticipated that the Unit E plume will move downgradient in a generally eastward direction. This general groundwater flow direction is also suggested by the City of Ann Arbor's groundwater potentiometric surface map (Figure 4-E, in Fleis & Vandenbrink Engineering, Inc., 2002 report).

- Surface elevations generally decline eastward, away from the current position of the Unit E plume (918 ft.), toward the Allen Creek Drain (<820 ft.) and the Huron River (<787 ft.). East of the Allen Creek Drain the surface elevations generally increase forming a channel-like depression along the Allen Creek Drain.

- Kunkle (1960), Western Michigan University (1981), the State of Michigan, and others, including PLS, have generated maps interpreting the bedrock surface topography. Many of these maps reveal a complexly dissected terrain reflecting an erosional topography caused by paleo-surface water drainage and accentuated by the more recent glacial ice.

PART A: WORK PLAN TO INVESTIGATE THE MIGRATION PATHWAYS OF THE UNIT E PLUME AS IT MOVES HYDRAULICALLY DOWNGRADIENT OF THE MAPLE VILLAGE SHOPPING CENTER

Available data suggest that the Unit E plume will migrate toward the Huron River. Additional data are needed to develop a greater understanding of both the geospacial boundaries of the downgradient aquifer system.. Data are also needed to better understand the hydraulic heads between Unit E and the Huron River.

PLS intends to initially focus its investigations on the area between the Unit E plume and Allen Creek Drain, then along the Allen Creek Drain to the Huron River. PLS considers this a probable pathway for the Unit E plume. This is supported by a review of the available water level data, bedrock surface data, and surface topography.

Task 1 – Boring/Well Installation

Proposed Boring/Well Locations

PLS proposes to install at least five borings/wells in the potential pathway of the plume. Boring/well locations have been selected based on interpretations of existing data. The areas for proposed boring/well locations for Task 1 are shown on Figure 1. PLS recommends that access agreements be sought for Task 1 drilling locations within the areas shaded grey. Plans for the specific depth and other parameters associated with each specific location can be determined once the final locations for the borings/wells are determined.

Figure 2 shows a map of the bedrock surface (red contours) and surface topographic contours (brown contours) in the area east of the current Unit E plume (bedrock map modified from Kunkle, 1960; surface topography source: the State of Michigan). The bedrock surface generally slopes away from the Unit E plume area toward the Allen Creek Drain and the Huron River. The surface topography shows a similar character. Given the general similarity between these surfaces and the fact that groundwater flow direction often mimics the slope of the surface topography, it is reasonable to infer that groundwater in the Unit E would follow a pathway to the Allen Creek Drain area, then flow toward the Huron River.

Cross sections A-A' and B-B' (Figures 3 and 4) show the general character of the drift sequence and aquifers east of the Unit E plume, along the pathway described in the previous paragraph. Cross section A-A' illustrates that the aquifer geometry changes between the West Park 73 and MW-82 (a distance of approximately 4,000 feet). PLS recommends that initial geological data be collected in the area between the West Park 73 and MW-82 to investigate the nature of the aquifer systems between these two boring/well locations. Additional data are also needed regarding subsurface conditions between the West Park 73 boring and Well 20-2 (a boring included in the 1960 Kunkle report), near the Huron River.

While groundwater flow direction is generally agreed to be eastward from the Unit E plume area, limited water level data are available between the current Unit E plume and the Huron River. PLS proposes to install and measure water levels measured to establish the generalized groundwater flow direction east of the Unit E plume boundary.

Well Boring/Well Installation Methods

The proposed test borings for Task 1 will be drilled using hollow stem auger (HSA) drilling methods to depths sufficient to encounter bedrock.

The proposed sampling methods are split-spoon and Simulprobe for collection of soil and soil/groundwater, respectively. Soil samples will be collected as split-spoon samples at 10-foot intervals, beginning at ground surface. Starting at a depth approximately 10 feet below the uppermost water bearing zone, soil/groundwater samples will be collected using Simulprobe techniques and continue through the aquifer(s) to the total depth of the boring/well. All soil samples will be described/classified based on their physical characteristics during the drilling of each boring by an onsite geologist. In water-bearing units, Simulprobe sampling will be

performed at a maximum frequency of every 10 feet. Split-spoon sampling will not be collected at the Simulprobe intervals, as the Simulprobe will account for the soil sampling. If it is not possible to collect a representative groundwater sample (i.e., not able to drive the Simulprobe sampler into undisturbed soil), a temporary well constructed of galvanized riser and stainless steel screen will be installed. The temporary well screen will be set into the aquifer and a K-packer assembly will be used to allow for the collection of a representative groundwater sample. The groundwater samples will be analyzed for 1,4-dioxane by PLS.

Upon reaching the total depth of the individual borings, as determined by the on-site geologist, the borehole will be geophysically logged using a natural gamma tool. This data will supplement the formation samples and provide additional information regarding site geological conditions.

Monitoring wells will be installed at each soil boring location for the primary purpose of obtaining representative water level data. This may involve installing nested wells or one strategically positioned well. PLS will discuss all well installation plans with the MDEQ. Water quality data will also be considered in the selection of a representative screen zone.

Wells will be constructed of either 2-inch polyvinyl chloride (PVC) or galvanized steel casing, equipped with a 5-foot stainless-steel well screen. The well will be gravel packed and grouted. The wells will likely be completed as flush mounts, equipped with locking caps and locks.

Soil cuttings derived from the drilling and development water will be transported back to PLS for appropriate management.

Task 2 – Groundwater Sampling

PLS will collect groundwater samples from the newly installed wells. The samples will be analyzed for 1,4-dioxane by PLS. PLS may also analyze the samples for other natural water quality parameters.

Task 3 – Water Level Data Collection

Surveying

Well location and elevation surveys will be conducted for all new wells. All elevation data will be referenced to United States Geological Survey (U.S.G.S.) datum.

Water Level Data Collection

Water level data will be measured from the following wells:

- All new wells
- PLS monitoring wells east of Wagner Road inclusive of MW-47s&d, MW-BE1s&d, MW-70, MW-71, MW-30d, MW-72s&d, MW-86, MW-85, MW-76s,i&d, MW-87s&d,

MW-79, MW-81, MW-88, MW-91, MW-84s&d, MW-89, MW-90, MW-83s&d, MW-82s&d, and the Montgomery Well test well.

Additionally, PLS will measure a minimum of five surface water elevations along the Huron River. Measurements will begin immediately upstream from the Allen Creek Drain – Huron River confluence and ending no further downstream than the Dixboro Road Bridge near Geddes. Surface-water level data will be collected contemporaneously with the groundwater elevation measurements.

Task 4 – Data Analysis

PLS will summarize the data collected from the Tasks 1 through 3 activities, and present the findings to the MDEQ, along with recommendations for the installation of additional wells.

Task 5 – Well/Boring Installation

The purpose of the additional wells will be to fill data gaps identified from the initial five Task 1 borings/wells. The additional locations will be determined after completion of Tasks 1 through 4. Both HSA and Roto Sonic drilling (RSD) techniques will be utilized. A minimum of one soil boring will be drilled using RSD techniques. HSA methods for installation will be similar to Task 1.

At soil boring locations using the RDS techniques, a continuous, relatively undisturbed, unconsolidated sediment sample will be collected using either a thin-wall or split-spoon sampler. Soil sampling will begin at the ground surface and will terminate at the bedrock surface. All soil samples will be described/classified based on their physical characteristics during the drilling of each soil boring by an onsite geologist. Either Simulprobe or temporary wells will be utilized to collect groundwater samples (as above).

Task 6 – Groundwater Sampling

PLS will collect groundwater samples from the newly installed wells. The samples will be analyzed for 1,4-dioxane by PLS. PLS may also analyze the samples for other natural water quality parameters.

Task 7 – Water Level Data Collection

<u>Surveying</u>

Well location and elevation surveys will be conducted for all new wells. All elevation data will be referenced to U.S.G.S. datum.

<u>Water Level Data Collection</u>

Water level data will be collected from the following wells:

- All Tasks 1 and 5 wells.

- PLS monitoring wells east of Wagner Road inclusive of MW-47s&d, MW-BE1s&d, MW-70, MW-71, MW-30d, MW-72s&d, MW-86, MW-85, MW-76s,i&d, MW-87s&d, W-79, MW-81, MW-88, MW-91, MW-84s&d, MW-89, MW-90, MW-83s&d, MW-82s&d, and the Montgomery Well test well.

PLS will collect a minimum of five surface water elevations along the Huron River, beginning immediately upstream from the Allen Creek Drain – Huron River confluence. Water level data will be collected contemporaneously with the groundwater elevation measurements.

Task 8 – Data Analysis

PLS will prepare a report of Tasks 1 through 7 investigations. The report will include various maps, cross sections, water quality and water level data, and relevant conclusions. The report will be provided to the MDEQ.

PROJECT SCHEDULE

The proposed project schedule is provided in Appendix 1.

PART B: WORK PLAN FOR THE INVESTIGATION OF THE POTENTIAL FOR UNDERFLOW OF THE HURON RIVER

BACKGROUND

Purpose

PLS has proposed an investigation in areas downgradient of the Unit E plume. Once the Part A has been completed, PLS will conduct this investigation in the river corridor at the locations indicated by Part A results to demonstrate that the plume will not underflow the river.

The Huron River is a major hydraulic feature. It is unlikely that groundwater would flow under this feature. It is more likely that groundwater will vent to the Huron River, or flow along the river corridor until it eventually vents into the river.
The purpose of this investigation is to collect the data necessary to evaluate whether groundwater containing 1,4-dioxane associated with the PLS site will discharge to the Huron River rather than underflow the Huron River. This investigation is called for in Condition 5 identified by DEQ in its Decision Document in connection with the potential approval of PLS' selected response action.

WORK PLAN OVERVIEW

Task 1 – Assemble and Review Available Data

PLS will assemble and review Water Well Records for areas east of the Huron River. These records will be used to evaluate water level and geological conditions. PLS will also review any relevant hydrogeological studies for this area. This and other available information will be used to determine the potential for groundwater on the west side of the river, in the area near the predicted Unit E plume discharge, to underflow the Huron River. PLS will present the findings of this review/analysis to the MDEQ.

If the available data suggest that there is a potential for underflow of the Huron River, PLS will continue this investigation and undertake Task 2.

Task 2 – Boring/Well Installation

PLS will select locations and install a minimum of three borings/wells on the east side of the Huron River, opposite the location site where the Unit E plume would likely discharge if it were to flow to the river. PLS will install nested well sets or single wells at each of the three selected well locations. This will allow for the measurement of vertical hydraulic gradients in the vicinity of the river.

The proposed test borings will be drilled using either HSA or RSD methods, or a combination of both, to a depth sufficient to encounter bedrock.

For soil borings drilled using the HSA technique, the proposed sampling methods are split-spoon and Simulprobe for collection of soil and soil/groundwater, respectively. Soil samples will be collected as split-spoon samples at 10-foot intervals, beginning at ground surface. Starting at a depth approximately 10 feet below the uppermost water-bearing zone, soil/groundwater samples will be collected using Simulprobe techniques and continue through the aquifer(s) to the total depth of the boring/well. All soil samples will be described/classified, based on their physical characteristics during the drilling of each boring, by an onsite geologist. In water-bearing units, Simulprobe sampling will be performed at a maximum frequency of every 10 feet. Split-spoon sampling will not be collected at the Simulprobe intervals, as the Simulprobe will account for the soil sampling. If it is not possible to collect a representative groundwater sample (i.e., not able to drive the Simulprobe sampler into undisturbed soil), a temporary well constructed of galvanized riser and stainless-steel screen will be installed. The temporary well screen will be set into the aquifer and a K-packer assembly will be used to allow for the collection of a representative groundwater sample.

At soil boring locations using the RSD techniques, a continuous, relatively undisturbed, unconsolidated sediment sample will be collected using either a thin-wall or split-spoon sampler. Soil sampling will begin at the ground surface and will terminate at the bedrock surface. All soil samples will be described/classified, based on their physical characteristics during the drilling of each soil boring, by an onsite geologist. Either Simulprobe or temporary wells will be utilized to collect groundwater samples (as above).

The groundwater samples will be analyzed for 1,4-dioxane by PLS.

Upon reaching the total depth of the individual borings, as determined by the onsite geologist, the borehole will be geophysically logged using a natural gamma tool. This data will supplement the formation samples and provide additional information regarding site geological conditions.

Monitoring wells will be installed at each soil boring location for the primary purpose of obtaining representative water level data. This may involve installing nested wells or one strategically positioned well. PLS will discuss all well installation plans with the MDEQ. Water quality data will also be considered in the selection of a representative screen zone.

Wells will be constructed of either 2-inch PVC or galvanized steel casing and equipped with a 5-foot stainless-steel well screen. The well will be gravel packed and grouted. The wells will likely be completed as flush mounts, equipped with locking caps and locks.

Soil cuttings derived from the drilling and development water will be transported back to PLS for appropriate management.

Task 3 – Water Level Data Collection

Surveying

Well location and elevation surveys will be conducted for all new wells. All data will be referenced to U.S.G.S. datum.

Water Level Data Collection

Water level data will be collected from the following wells:

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PLS will collect a minimum of five surface water elevations along the Huron River, beginning immediately upstream from the Allen Creek Drain – Huron River confluence. Water level data will be collected contemporaneously with the groundwater elevation measurements.

REPORTING

PLS will prepare a report of Tasks 1 through 3 investigations. The report will include various maps, cross sections, water quality and water level data, and relevant conclusions. The report will be provided to the MDEQ.

PLS will present the findings to the MDEQ, along with recommendations for the installation of additional wells (if necessary). The purpose of the additional wells would be to fill in data gaps identified from the initial Task 1 wells.

SCHEDULE

The proposed project schedule is provided in Appendix 1.