MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

June 15, 2009

To: Sybil Kolon, RRD, Jackson District

From: Rick Mandle, RRD, Lansing

Re: Review of May 22, 2009 Potentiometric Surface – Evergreen Area

I have completed my review of the potentiometric surface map drawn using the latest static water level measurements (dated May 22, 2009). This map was prepared and submitted by Pall Life Sciences (PLS) in response to DEQ review comments (dated April 21, 2009) that questioned the contoured potentiometric surfaces from the January – February 2009 investigation (previous investigation) and the value of hydraulic head (static water level elevation) at MW-120s. As a confirmation of the previous investigation results, we had requested: 1) The installation of two additional monitoring well nests; 2) Verification of the top of casing survey for MW-120s; and, 3) A re-measurement of static water level elevations to be compared against the potentiometric surface drawn using the January 21, 2009 data (see Figure 1), the last measurement before the wells were turned off. The following is a brief summary of the May 22, 2009 work (current investigation), the comparison between the previous investigation and the May 22, 2009 potentiometric surface, and our assessment of the groundwater flow directions inferred from the data collected during both investigations.

January – February 2009 Investigation Review

The previous investigation was conducted for the purposes of demonstrating the impact of incrementally-reduced pumping rates in the Evergreen area extraction wells (LB and AE series wells) would have on surrounding groundwater levels. The concern was that reduction in pumping rates would result in a change in groundwater flow directions that would allow 1,4-Dioxane-contaminated groundwater to migrate to the northeast under a reduced or no pumping scenario. In our opinion, the findings of that investigation were not conclusive. This was primarily because of the relatively-high measured static water level elevation at monitoring well MW-120s and the manner in which the data were contoured. The measured static water level elevation in MW-120s was approximately three feet higher than the value in MW-120d. Using this value in preparing the potentiometric surface maps resulted in an inferred direction of groundwater flow from the vicinity of MW-120s to the southeast and toward monitoring well MW-92. We felt that this flow direction was incorrect as it fails to explain the migration of 1,4-Dioxane in groundwater in several wells in the Evergreen area, especially toward MW-92. Also, the equipotential contours along the north side of each map were drawn so that they point to the east-northeast, accentuating an inferred groundwater flow direction to the southeast (see Figure 1). There are not sufficient data to demonstrate this contour orientation. It was for this reason that additional verification work was requested.

May 22, 2009 Investigation

Prior to beginning the second water level measurement investigation, a monitoring well nest was installed near the intersection of Center and Bernice Streets, approximately mid-way between the location of the MW-120 nest and MW-92. The new monitoring well nest is labeled MW-123s & d. The vertical placement of well screens was determined by an examination of

subsurface geology as the analysis of groundwater samples obtained during vertical sampling of the aquifer detected no 1,4-Dioxane. We had requested the installation of a second monitoring well cluster with a proposed location to the northeast to determine the orientation of equipotential contours in this area; however, PLS selected not to install the second monitoring well nest.

Following the installation of MW-123s & d, the tops of casing for MW-120s & d were re-surveyed and found to be similar to those obtained during the previous investigation. Also, static water levels were measured on May 22, 2009 in all of the wells measured during the previous investigation. The data were used to create the map shown in Figure 2.

Discussion

During the previous investigation, it was found that the zone in which MW-120s & d are screened responded in a manner which shows some hydraulic connection to the zone from which the Evergreen Area extraction wells extract groundwater. The groundwater level recovery in well MW-120d was almost twice that observed in MW-120s (0.76 feet vs. 0.45 feet), indicating a greater degree of hydraulic connection to the deeper aquifer in which MW-120d was screened than to the interval over which MW-120s was screened. Because there was some response in MW-120s during this test, it was not possible to completely dismiss the data from this well. Regardless, the measured static water level elevation in MW-120s appeared to be anomalously high.

A re-survey of the top of casing of monitoring well MW-120s in the present investigation showed there was no significant surveying error that could explain the difference in measured static water level elevation between this well and MW-120d (2.88 feet).

The static water levels were measured in the new monitoring wells, MW-123s & d, and their elevations found to be 868.80 and 869.09 feet, respectively. These values are much closer to the static water level elevation measured at MW-120d (870.77) than the measurement at MW-120s (873.65) as the measured static water level elevation in MW-120s is 4.85 and 4.56 feet higher than the measurements in MW-123s and MW-123d. In addition, of all the wells in which there was a groundwater level response during the previous investigation, the measured static water level elevation at MW-120s was higher than the measurements in all other wells with the exception of MW-118 during all measurements in the previous and current investigations. MW-118 is located near Wagner Road, closer to the source area and approximately 3400 feet southwest of extraction well LB-1. It's my opinion that the relatively-high measurement at MW-120s indicates that the measurement in MW-120s is be more reflective of local conditions around this well and is not representative of regional groundwater flow directions. Since MW-120d showed a greater response during the previous investigation recovery test, it is more likely that static water level elevations measured in this well reflect regional flow conditions in the Evergreen Area.

After the previous investigation had been completed, the pumping from the Evergreen Area extraction wells was resumed. For this reason, the potentiometric surface prepared using the May 22, 2009 data (Figure 2) had to be compared to the January 21, 2009 measured surface (Figure 1), the last measurement taken with the Evergreen Area extraction wells in operation. There are two points to make, 1) A comparison between Figures 1 and 2 shows that, after two months of pumping, groundwater levels had not declined to their January 21, 2009 levels, and 2) The measured static water level elevations at MW-123s & d have an impact on the contouring of the potentiometric surface. When compared to the January 21, 2009 measurements, the data from May 22, 2009 show that groundwater levels were approximately 0.7 feet to slightly more than one foot higher on May 22 than on January 21. This may indicate

that the cone of depression had not yet fully developed since the wells re-started pumping, pumping rates may not be as great as in January, there has been significant recharge to the aquifer since January, or a combination of these possible explanations.

The impact of the measurement at MW-123s on depicting the potentiometric surface is readily apparent. In Figure 1, the interpolated static water level elevation in the vicinity of MW-123s was approximately 869.6 and the equipotential contours are drawn in an east-northeast direction. Using the value for MW-123s, in Figure 2 there is a flattening of the potentiometric surface between MW-92 and MW-123s and the equipotential contours change, showing a more northerly trend. To the north, beyond the extent of any data, PLS has drawn the equipotential contours so that they bend to the northeast. However, there are no data to support this orientation.

Neither of the potentiometric surfaces (Figures 1 or 2) explain how 1,4-Dioxane would be detected at well MW-92. In Figure 1, the source of this contamination would have had to originate northeast of MW-120s. In Figure 2, the contaminant plume would have migrated from an area southwest of MW-120s. Neither of these locations is likely. It is more likely that the data are not contoured correctly. The May 22, 2009 data were re-contoured, in the first example (see Figure 3) using the exact dataset used by PLS to draw the potentiometric surface shown in Figure 2, and in the second example (see Figure 4) substituting the value from MW-120d for the value for MW-120s. Both of the surfaces shown in Figures 3 and 4 better reflect regional groundwater flow directions in that there is no bending of equipotential contours to the northeast (toward the Huron River) and could better explain the presence of the 1,4-Dioxane detected at MW-113 and MW-92.

Available chemical data shows that the extent of detectable 1,4-Dioxane lies between the monitoring well nest at MW-123 and a line connecting Dupont Circle, the MW-122 nest, MW-113, and MW-92. Either of the potentiometric surfaces shown in Figures 3 or 4, and the inferred groundwater flow directions based on these surfaces, explain the known distribution of 1,4-Dioxane in the monitoring wells north of Dexter Road better than the May 22, 2009 potentiometric surface presented by PLS. However, it's my opinion that the surface shown in Figure 4 provides the best representation of regional groundwater flow directions and hydraulic explanation for the 1,4-Dioxane contamination found in MW-122s, MW-113, and MW-92. This figure was prepared using the measured static water level elevation from MW-120d, and not the measurement from MW-120s.

Whether 1,4-Dioxane will migrate to the northeast in the event that the Evergreen Area extraction wells reduce or stop pumping is not entirely clear and depends on the data used in this analysis. As an example, re-contouring the measured data from February 16, 2009 (Evergreen wells not pumping) and using the data from MW-120d in place of MW-120s results in a slightly different picture of potential groundwater flow direction than the one presented by PLS in the March 2009 report. This surface is shown in Figure 5. Without pumping from the Evergreen Area extraction wells or full recovery of groundwater levels, the inferred groundwater flow directions on this figure appear to be to the east-northeast. Depending on the subsurface geology, it might then be possible for the contaminant plume to move in this direction.

You may contact me at mandler@michigan.gov or (517) 241-9001 to discuss these review comments.

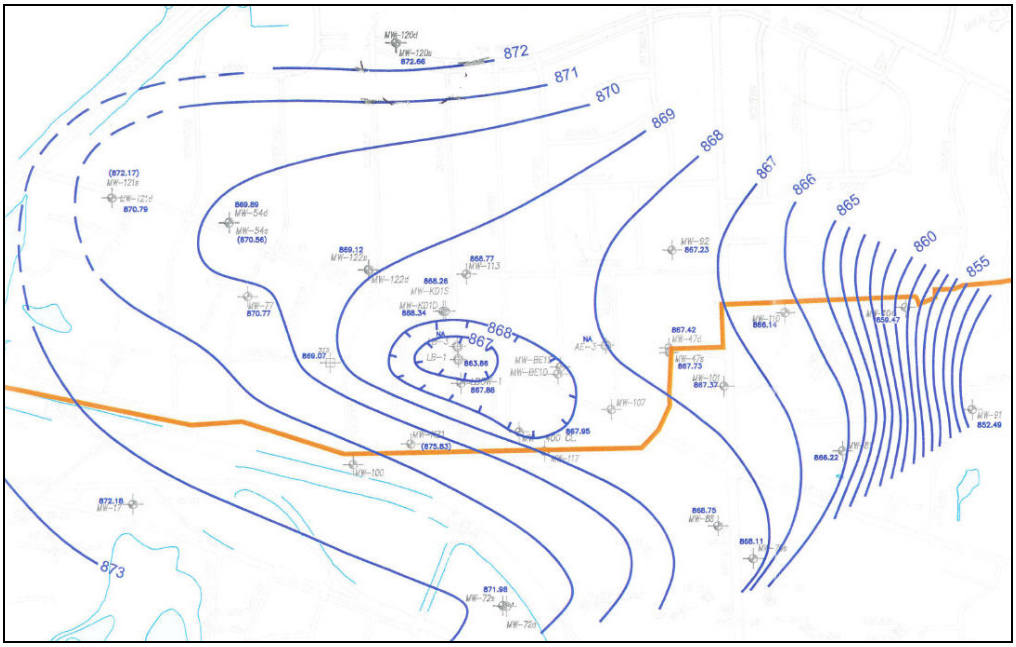

Figure 1 – Potentiometric surface measured January 21, 2009 (taken from the PLS March 2009 report). This map does not use MW-54s, MW-72d, MW-120d, MW-121s, MW-123d, or MW-122d in drawing the potentiometric surface.

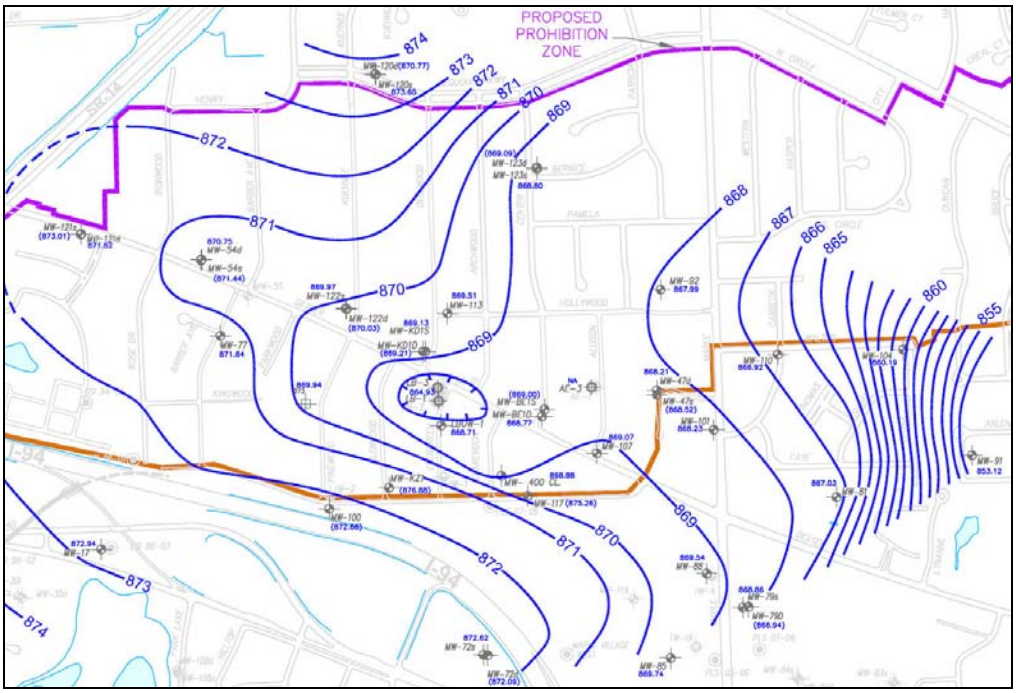

Figure 2 – Potentiometric surface measured May 22, 2009 (Taken from the PLS May22, 2009 map). This map does not use MW-54s, MW-72d, MW-120d, MW-121s, MW-123d, or MW-122d in drawing the potentiometric surface.

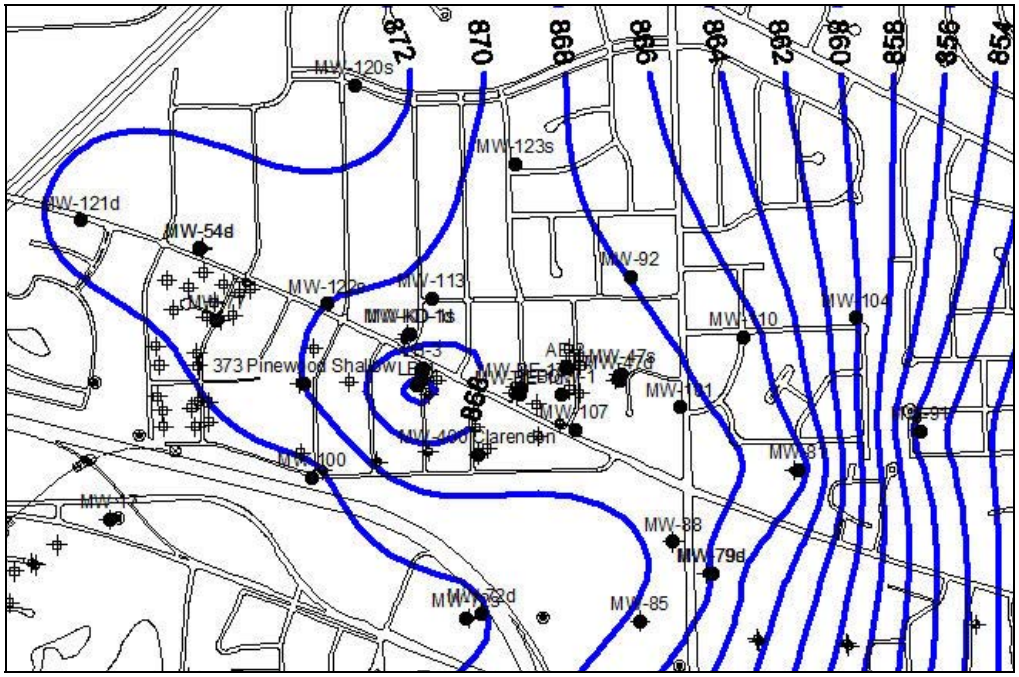

Figure 3 – DEQ contouring of May 22, 2009 data (does not use MW-120d, MW-121s, MW-123d, or MW-122d).

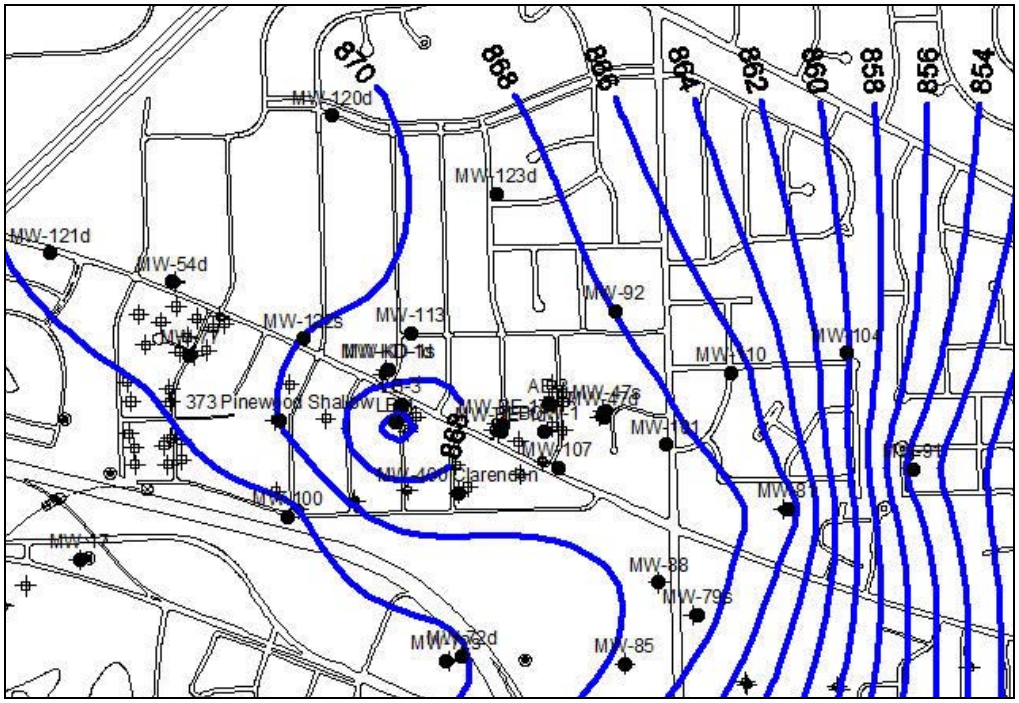

Figure 4 – DEQ contouring of May 22, 2009 data. (Does not use MW-120s, MW-121s, MW-123s, or MW-122d)

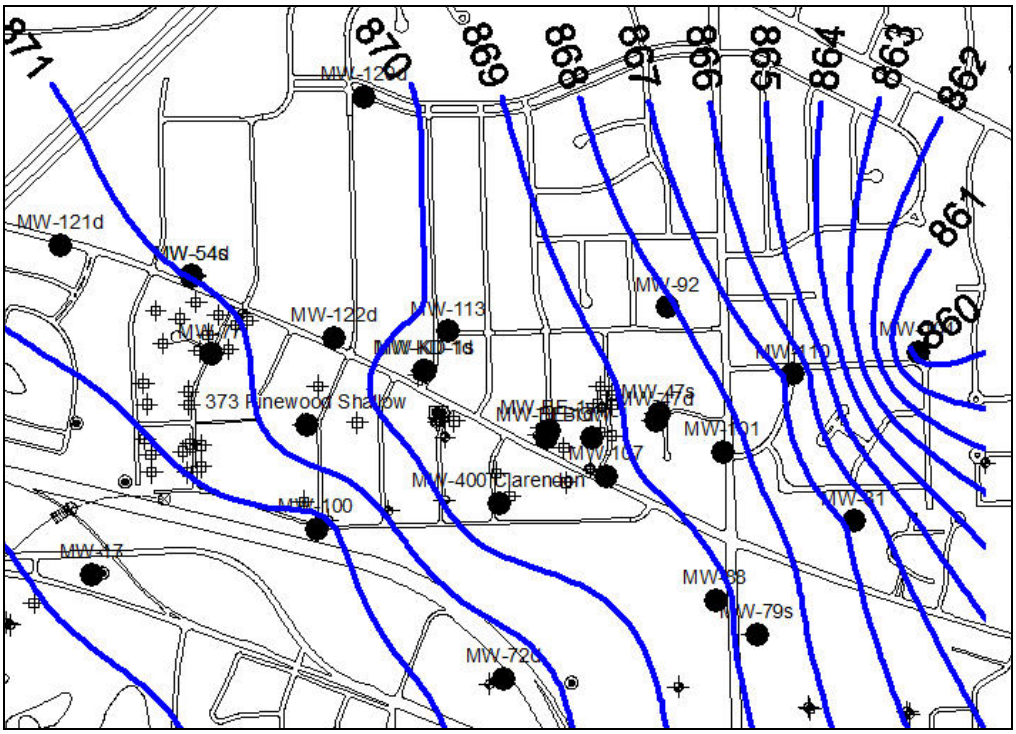

Figure 5 – DEQ contouring of January 21, 2009 data. (Does not use MW-120s, MW-121s, or MW-122s)