MEMORANDUM – HYDROGEOLOGIC ZONES OF INTEREST
HOFF VC SITE
NEW HANOVER TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA
REQUISITION NUMBER GTAC5-1-263

May 22, 2012

SAIC Energy, Environment & Infrastructure (SAIC) is pleased to present this memorandum to the Pennsylvania Department of Environmental Protection (DEP) to summarize the findings of the hydrogeologic assessment of the potential water bearing zones at the monitoring wells recently installed at the Hoff VC Site (Site). In March and April, 2012, SAIC oversaw the installation six bedrock monitoring wells at the Site. Following well installation, borehole geophysical surveys were conducted on each of the wells. The geophysical survey logs were used in conjunction with SAIC's field observation logs to assess the primary water bearing zones and to determine potential zones of interest for future groundwater sampling and/or target well screen depths. Information pertaining to the drilling, geophysics, well construction and related information will be presented in more detail in a summary report to be completed and submitted under separate cover. The objective of this memorandum is to present a concise overview of the potential zones of interest for future groundwater sampling and/or target well screen depths. The following sections present a summary of SAIC's assessment and recommendations.

METHODOLOGY

SAIC relied on a site conceptual model to assess and identify zones of potential interest within each well. The site conceptual model is based on Site geology and assumed transport of the contaminants of concern (i.e. chlorinated volatile organic compounds [cVOC]). The Site is underlain by a thin layer of clayey silt soil which rests atop weathered siltstone/sandstone bedrock. Competent bedrock is encountered at approximately 8 to 15 feet (ft). The siltstone/sandstone transitions to hornfels and is underlain by granite and or diabase.

Based on field observations and monitor well data, SAIC assumes that a shallow aquifer exists in the weathered bedrock and upper portions of the unaltered siltstone/sandstone that extends into the hornfels. SAIC assumes that the granite and diabase have very little storage capacity and groundwater flow is limited to fracture flow.

In regard to cVOC transport, SAIC assumes that the source(s) were surface or shallow subsurface releases. It is assumed that the cVOC were transported primarily through the shallow aquifer. However, due to the density of cVOC, some mass was conveyed to the deeper aquifer via a network of interconnected fractures. Given the limited permeability of the granite and diabase as well as the low amount of organic carbon, it is assumed that cVOC exist primarily in the dissolved phase within the fractures of the rocks.

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Based on the assumptions described above, SAIC believes that it is imperative to identify the shallowest water bearing zones within the lower hornfels/granite/diabase aquifers. These fracture zones are more likely to contain and convey cVOC. However, it is also important to identify deeper fracture zones to determine whether cVOC have migrated to these zones and also to assess the degree of fracture interconnection. The following sections present the zones identified to be likely pathways for groundwater flow and contaminant transport.

MW-1D

MW-1D was drilled to a total depth of 300 feet (ft) with a final blown yield less than 0.5 gallons per minute (gpm). No water bearing features (i.e. fractures) were observed during drilling. However, after the well was completed to 300 ft and allowed to equilibrate overnight, water was observed in the borehole. Subsequent water level measurements indicate a very slow rate of water entry.

Review of the geophysical logs do not indicate any conspicuous water bearing features. The caliper log indicated several potential fracture zones, however the other logs do not provide supporting evidence of water entry zones. Similarly, the Acoustic Televiewer (ATV) indicated several potential fracture zones, however the other logs do not provide supporting evidence of water entry zones.

Due to the lack of discrete, detectable water bearing zones, SAIC does not recommend constructing nested wells within the MW-1D borehole. The extremely low well yield in conjunction with the lack of defined water bearing zones is not conducive for the isolation of targeted zones within the borehole.

While discrete water bearing zones were not identified, SAIC did determine two potential zones of interest within the borehole. The interval between approximately 135 to 145 ft displays a decrease in resistivity, a change in temperature, a fracture at 143 ft and softer rocks between 135 to 145 ft. The combination of these factors indicates the potential for water entry. Similarly, the zone between 255 to 265 ft indicated a change in temperature, a decrease in resistivity, a fracture around 258 ft and softer rocks between 257-260 ft.

MW-2D

MW-2D was drilled to a total depth of 300 ft with a final blown yield of 3 gpm. Water bearing features were observed during drilling at approximately 53 ft (0.5 gpm) and 279 ft (2.5 gpm). In addition, soft rock (easier drilling) was encountered at 110 to 115 ft. The geophysical logs present evidence of several water bearing zones and/or zones of interest, including: 50 to 60 ft, 105 to 115 ft, 205 to 215 ft, and 273 to 283 ft.

The zone from 50 to 60 ft contained a water bearing feature identified during drilling. In addition, geophysical logs indicate a rapid increase in conductivity in this zone suggesting the entry of water with higher dissolved solids. This zone also displayed an inflection in the temperature log indicating potential entry of water. The ATV log indicated several minor fractures as well as potential bedding plane partings.

The zone from 105 to 115 ft was observed to be softer rock during drilling. The caliper log indicates several large fractures in this zone and the resistivity logs indicate a decrease in resistivity. In addition, the ATV log indicates a fracture at 114 ft and several minor fractures at 109 to 112 ft.

The zone from 205 to 215 ft displayed a large deflection on the caliper log indicating a fracture at 206 ft. An abrupt change in conductivity was observed between 205 to 212 ft suggesting potential water entry. The zone from 205 to 230 ft displayed a decrease in resistivity, also indicative of potential water entry. The ATV log indicated a cluster of minor fractures beginning at 213 ft and extending to approximately 250 ft.

The zone from 273 to 283 ft contained a water bearing feature identified during drilling. The caliper log displays a deflection at 278 ft and the resistivity logs show a decline between 274 and 283 ft. In addition, the ATV log indicates a cluster of fractures, minor fractures and lithological banding between 273 and 286 ft.

MW-3D

MW-3D was drilled to a total depth of 250 ft with a final blown yield less than 0.5 gpm. A minor water bearing feature was observed at approximately 100 ft during drilling. This feature was preceded by soft rock from 93 to 94 ft. Geophysical logs do not indicate conspicuous water bearing features, however several zones of interest have been determined.

The primary zone of interest is 90 to 100 ft, where water was encountered during drilling. The ATV log indicates several lithologic/bedding plane features and several discontinuous hairline fractures between 90 to 100 ft. Additional evidence of water entry may be corroborated by the deflections in the caliper log and general decreases in the resistivity logs encountered between approximately 85 to 110 ft.

Additional zones of interest include 55 to 70 ft. A major deflection is indicated on the caliper log at 59 ft. In addition, the resistivity logs show a decrease. The ATV log indicates several discontinuous and hairline fractures between 55 and 70 ft. Similarly, the zones between 155 and 170 ft, and the zone between 220 and 230 ft show deflections on the caliper log, decreased resistivity and minor fracturing on the ATV log.

MW-4D

MW-4D was drilled to a total depth of 250 ft with a final blown yield of 4 gpm. Water bearing features were observed at approximately 109 and 113 ft during drilling. ATV logs indicated fractures at 99, 105 and 113 ft. The caliper log indicates a large deflection at 98 ft and several smaller deflections below. The conductivity log displays an abrupt increase at 108 ft and the resistivity logs show a general decrease between 92 and 116 ft. The combination of these observations indicates that the zone from approximately 97 to 113 ft is a primary water bearing zone.

No other prominent water bearing zones were encountered during drilling or indicated on the geophysical logs. Additional zones of interest include 205 to 215 ft and 235 to 245 ft where zones of low resistivity are accompanied by clusters of minor fractures as indicated by the ATV and caliper logs.

MW-5D

MW-5D was drilled to a total depth of 250 ft with a final blown yield of 8 gpm. Water bearing features were observed at approximately 67 ft, 85 ft, 145 ft, and 155 ft during drilling. In addition, soft rock was identified at 57 ft, 170 ft, and 240 ft. ATV logs indicated fractures at 72 ft, 87 ft, 181 ft. Numerous minor fractures and bedding features were encountered throughout.

Based on review of the drilling logs and geophysical logs the primary zones of interest are: 65 to 90 ft, 145 to 160 ft, and 170 to 185 ft. The zone from 65 ft to 90 ft contains two primary water bearing features observed during drilling (68-68 ft and 85 ft). This zone also displays multiple deflections on the caliper log, low resistivity, increased conductivity, and multiple fractures identified by the ATV.

The zone from 145 to 160 ft contains two primary water bearing features observed during drilling (145 ft and 155 ft). This zone also displays minor deflections on the caliper log, low resistivity, and multiple minor fractures and bedding plane features identified by the ATV.

The zone from 170 to 185 ft includes a soft rock unit observed during drilling, low resistivity, multiple deflections on the caliper log, low resistivity, and multiple minor fractures and bedding plane features identified by the ATV.

MW-7D

MW-7D was drilled to a total depth of 250 ft with a final blown yield of 4 gpm. Water bearing features were observed at approximately 142 to 145 ft, 192 ft, 206 ft, and 215 ft during drilling. In addition, soft rock was identified at 93 ft, and 108 ft. The ATV log indicates numerous discontinuous and minor fractures and bedding features throughout.

Based on review of the drilling logs and geophysical logs the primary zones of interest are: 130 to 150 ft, 192 to 207 ft, and 215 to 225 ft. The zone from 130 ft to 150 ft contains a primary water bearing feature observed during drilling (142-145 ft). This zone also displays a large deflection on the caliper log, low resistivity, increased conductivity, and multiple minor fractures and bedding features identified by the ATV.

The zone from 192 to 207 ft contains the primary water bearing feature observed during drilling at 192 ft. This zone also displays minor deflections on the caliper log, low resistivity, and multiple minor fractures and bedding plane features identified by the ATV.

The zone from 215 to 225 ft contains the primary water bearing feature observed during drilling at 215 ft. This zone also displays minor deflections on the caliper log, decreased resistivity, and multiple minor fractures and bedding plane features identified by the ATV.

Recommendations

Ideally, it would be most desirable to isolate the discrete water bearing zones in each well through the installation of nested well screens to determine the cVOC concentration, hydraulic properties and degree of fracture interconnections. For instance, if conditions permitted, it would be beneficial to seal off narrow (5-10 ft) sections of the well for sampling and hydraulic testing. Unfortunately, several factors such as low well yield, disperse fractures, lack of obvious water entry features, multiple water bearing zones and/or narrow borehole diameter prevent the determination and isolation of all the zones of interest in each well. Also, the diameter of the bedrock wells (6-inch) will only facilitate the installation of two separate, 2-inch PVC well screens in each well. There is concern that the installation of permanent PVC well screens in some of the wells, such as MW-1D and MW-3D, could result in dry well screens. Additionally, the installation of only two nested well screens in wells that have multiple zones of interest, such as MW-5D and MW-7D, might miss a primary contaminant transport feature.

Based on the lack of consistent findings within the wells, SAIC would recommend utilizing inflatable straddle packers to isolate and sample the zones of interest within each well prior to installing nested wells screens. Future well screening and/or sampling protocol may then be determined based on the results of the packer sampling. Straddle packers allow samples to be collected from discrete intervals and also to assess the water bearing properties of specific zones. Additionally, straddle packers can be installed and removed without damaging the boreholes. Therefore, if needed, the data from the packer tests can be used to identify specific zones to construct permanently sealed well screens.