Assessment of Contamination and Remediation at the Fly Ash Disposal Site, Gambrills, MD

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This report reflects an assessment of the groundwater contamination and remediation system at the fly ash disposal site in Gambrills, Maryland. The findings are based on several information sources that include monitoring well results, site maps, and the PRRP report. The PRRP report (http://esm.versar.com/pprp/bibliography/PPRP_142/PPRP-142.pdf) reviews the geology of the area, and summarizes the impacts of fly ash up through 2007. In essence, beginning in 1995 Constellation Power Source Generation, Inc. ("Constellation") deposited fly ash in the Waugh Chapel and Turner Pits in Gambrills, MD. Groundwater monitoring data collected from September 1999 through 2004 in monitoring wells down gradient of the Turner Pit revealed elevated concentrations of sulfates and heavy metals. In 2004, Constellation installed a "Pump and Treat" groundwater recovery system in the Turner Pit. The Pump and Treat system discharges to Towsers Branch. Another source of information is the report by Dr. Grant Garven that addressed the vertical movement of groundwater from the Magothy Aquifer to aquifers beneath it- the Upper Patapsco Aquifer and the Lower Patapsco Aquifer. The outcomes of this analysis are detailed below.

Turner Pit Site and Monitoring Well Data for the Magothy Aquifer

The locations of the monitoring wells and recovery wells in the Magothy Aquifer at the Turner Pit site before August 2010 are shown in Figure 1. The monitoring wells are represented by pink dots, and the recovery wells are represented by green dots. The monitoring wells down gradient of the Turner Pit are MW-7, MW-8, MW-9, MW-10, MW-13, MW-16, and MW-26. This figure also shows the five recovery wells currently in operation, which are located on the southeast corner of the Turner Pit. The groundwater contours shown in Figure 1 indicate that the groundwater flow is south to southeast at the site.

Three long-term sources exist for monitoring data at the site. One source is Constellation's Annual Trend Analysis prepared in 2009. The second source is Constellation's 2010 Annual Trend Analysis. The final source is Constellation's Quarterly Monitoring Reports.

The results from Constellation's 2009 Annual Trend Analysis are shown as a series of graphs in Figures 2 to 11. Similarly, the 2010 Annual Trend Analysis data appear in Figures 2A to 11A. Some of the graphs from the 2010 Annual Trend Analysis have different concentration scales compared to the graphs shown in the 2009 Annual Trend Analysis. The series of concentration versus time graphs show levels of certain contaminants over time in the Magothy Aquifer monitoring wells down gradient from the Turner Pit. The recovery well system began operating in May 2004. The analysis in this report focuses on the wells down-gradient from the Turner Pit- MW-7, MW-8, MW-9, MW-10, MW-13, MW-16, and MW-26.

In general, the monitoring well results shown in Figures 2 to 11 and 2A to 11A demonstrate elevated levels of the water quality indicators compared to background levels or levels typical for groundwater in the region. The PRRP report presents an analysis of the regional groundwater quality through the sampling of 28 residential wells in the area. The PRRP report on page 20 concludes that "ground water in the vicinity of the site naturally contains sulfate, iron and trace metals at low concentrations". The background concentrations indicated an average sulfate concentration of 15 mg/L with a maximum detected value of 50 mg/L. The monitoring data for sulfate concentrations in MW-7 and MW-13 prior to the pump and treat system are several

thousand mg/L (Figure 2). It is well known that fly ash contains elevated levels of sulfate, so sulfate is a good marker for the presence of leachate from the buried fly ash. Beginning around 2004, the results for MW-07 show a decline in sulfate concentrations. MW-07 is directly adjacent to the recovery well system. The sulfate concentrations have remained significantly above the background levels in MW-13, a monitoring well that is in the southwest direction from the recovery wells. Chloride is another marker of leachate contamination, and the chloride concentration data shown in Figures 3 and 3A show a similar pattern to that of sulfate. The chloride concentrations in MW-7 appear to decline after initiation of the pump and treat system, but the chloride levels in MW-13 increase and remain elevated relative to background chloride levels.

The data for arsenic (Figures 7 and 7A), cadmium (Figures 9 and 9A), thallium (Figures 10 and 10A), and nitrate (Figures 11 and 11A) show elevated levels in the monitoring wells with many data points above the current primary drinking water standards. As evidenced by the Figures and the second quarter 2010 monitoring data, these results indicate that metal contamination is persisting in the groundwater that has been monitored.

New Monitoring Well Results for the Turner Pit Site

In August 2010, seven new monitoring wells were installed to monitor groundwater contamination in the vicinity of the Turner Pit. One new recovery well was also installed. Four of these new monitoring wells are located in the median strip of Maryland Route 3, to the south/southeast of the Turner Pit. The map in Figure 12 depicts the current operation of monitoring and recovery wells surrounding the Turner and Waugh Chapel Pits. Wells MW-27, MW-28, MW-33, and MW-34 are located in the median strip. Other wells newly installed include MW-29, on the southern tip of the Turner Pit, MW-30, on the western tip of the Turner Pit, and MW-32, on the northwestern side of Turner Pit.

The sulfate concentrations in the samples collected from MW-27 and MW-28 in September 2010 showed sulfate concentrations of 81 and 99 mgL, respectively. These two monitoring wells are in the Route 3 median strip and downgradient from the Turner Pit recovery well network. These sulfate concentrations are above the background groundwater concentrations and provide evidence that contaminated leachate has migrated further downgradient than the pump and treat system.

Vertical Migration of the Fly-Ash Contamination

Prof. Grant Garven of Tufts University has performed an analysis of the potential for vertical migration of groundwater and contaminants at the Turner Pit site. Many of the contaminants in fly-ash readily dissolve when they come in contact with water. Prof. Garven concludes that there is a significant risk for the contaminated leachate from the fly-ash pits to move vertically in the subsurface and enter the lower confined aquifers, namely the underlying Upper and Lower Patapsco Aquifers. The vertical migration travel time is estimated to be 15 years to reach the Upper Patapsco Aquifer and 50 years to reach the Lower Patapsco Aquifer.

I draw the following conclusions from the monitoring data in the Magothy Aquifer and the analysis of vertical migration conducted by Prof. Garven on groundwater contamination and performance of the pump and treat system for the Turner Pit site:

1. In the immediate vicinity of the recovery wells as evidenced by the monitoring data for MW-7, the concentrations of sulfate, chloride, and arsenic exhibit a decreasing trend. However, the concentrations in MW-7 for thallium and nitrate show persistence.

2. At MW-13, concentrations of sulfate, chloride, lithium, cadmium, and thallium remain elevated and do not show a declining trend with the pump and treat system.

3. Given that there are elevated concentrations in MW-13, some of the contaminated leachate is extending beyond the initial monitoring well network. The presence of sulfate is a good marker for the fly-ash leachate. The newly installed monitoring wells in the Route 3 median strip (MW-27 and MW-28) show elevated sulfate concentrations in the groundwater sampled in September 2010. These results show that groundwater contamination in the Magothy Aquifer has moved downgradient from the recovery wells. The existing monitoring well network is insufficient to define the southeastern border of the plume. Consequently, the present monitoring plan and compliance points are not adequate to characterize the full extent of contaminant migration downgradient from the site.

4. The hydrogeological analysis conducted by Prof. Garven indicates that water can move vertically to reach the lower confined aquifers. A monitoring network needs to be installed to examine the potential for vertical migration of the fly-ash leachate and for contaminants associated with the fly-ash to reach the lower confined aquifers.

5. Contaminants continue to move downgradient and offsite as evidenced by the monitoring data, especially for MW-13, MW-27, and MW-28. There is also significant risk that the fly-ash contaminants can migrate vertically in the subsurface and eventually reach the lower confined aquifers. From an environmental engineering perspective, the construction of the proposed development above the Turner Pit is not recommended until the remediation system is modified to better capture the contaminant plume and a more effective monitoring plan is implemented. Appropriate cleanup for the groundwater may involve excavation of “hot spots” of contamination in the Turner Pit. Development of the site now and the planned construction will make it more difficult to access the site in the likelihood that future remediation efforts are required.