ATTACHMENT 1C.6.6

Permeable Reactive Barriers
Parker Brothers Arroyo Assessment Area

ARCADIS

Permeable Reactive Barriers
Parker Brothers Arroyo Assessment Area

Introduction

As described on page 6 of Worksheet 1.0 in the Response Action Plan (RAP) (Arcadis 2016e), a Response Action objective was to treat groundwater with Permeable Reactive Barriers (PRBs) installed within the lower portion of the Parker Brothers Arroyo (PBA) Assessment Area (AA) to reduce the mass of constituents of concern (COCs) in groundwater and achieve the surface water to groundwater (^{SW}GW) protective concentration level (PCL) at down-gradient locations from PRBs. The PRBs would provide passive treatment using zero valent iron (ZVI) to oxidize and adsorb dissolved metals in groundwater passing through the PRB.

TCT has submitted information on the PRBs in the following documents:

- *Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo (Rev. 1), July 2012* (Malcolm Pirnie 2012) – included responses to EPA technical review comments in an e-mail dated February 29, 2012; TCEQ verbal comments provided on April 24, 2012; and TCEQ comments in e-mail dated June 13, 2012
- *Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Status Report", January 2014* (Malcolm Pirnie 2014)
- *Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Performance Monitoring Report, November 2014* (included as Attachment 2A.19 in the RAP)
- *Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Summary Report, October 2015* (Malcolm Pirnie 2015)
- Letter dated January 21, 2016 *Request to Modify the PRB Sampling Schedule* (Arcadis 2016)
- Email dated December 13, 2016 Request for Reduced Groundwater Monitoring Well List for the Second Sampling Event in 2016

Information on the PRBs was presented in the following sections of the RAP (Arcadis 2016e):

- RAP Worksheet 1.0, pages 6, 14, 23 and 42 - Treatment of groundwater with PRBs installed within the PBA
- RAP Worksheet 1.0, page 16 - Source area remediation work began in the Lower PBA AA with the excavation of the Cell 4 WCU, removal of slag from the PBA channel, and installation of the PRBs.
- RAP Worksheet 2.0, pages 15 and 19 – Design and installation details of the two PRBs in the subsurface of the Lower PBA
- RAP Worksheet 3.0, page 2 and Worksheet 3.1, page 14 – PRB performance and monitoring
- RAP Worksheet 3.2, page 32 - PRB operation and maintenance (O&M) activities
- RAP Attachment 2A-11 - Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo, dated April 2012
- RAP Attachment 2A-19 – Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Performance Monitoring Report, dated November 2014
- RAP Appendix 3-8, Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo, Summary Report, dated October 2015

Regulatory Approval

Approval from TCEQ for the ZVI treatment technology and subsequent PRB monitoring is presented in the following letters:

- Letter from TCEQ dated October 17, 2014 regarding Authorization of Class V Wells
- Letter from TCEQ dated May 2, 2014 regarding TCEQ/EPA Comments related to the review of the January 2014 Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Status Report
- Letter from TCEQ dated December 16, 2014 regarding TCEQ/EPA Approval of the following documents: Response to TCEQ/EPA Comments received July 1, 2014; Revised Responses to TCEQ/EPA received October 31, 2014
- Letter from TCEQ dated March 2, 2015 regarding TCEQ/EPA Approval of the November 24, 2014 Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Status Report (Interim Performance Monitoring [December 2013-June 2014])
- Letter from TCEQ dated February 29, 2016 regarding TCEQ's Approval of Request to Modify the PRB Sampling Schedule, dated January 21, 2016
- Email from TCEQ dated December 15, 2016 regarding TCEQ's Approval of Request for Reduced Groundwater Monitoring Well List for the Second Sampling Event in 2016, dated December 13, 2016

Response Actions

Two PRBs were designed and installed in the subsurface of the Lower PBA channel as a groundwater response action to provide in-situ treatment of arsenic and other metals in groundwater using ZVI as an iron source. ZVI will oxidize and adsorb metals of concern from groundwater passing through the PRBs. PRB-1 was designed based on contaminant concentrations, gradient, and groundwater seepage velocity to calculate a ZVI demand of 740,000 lbs. PRB-1 has a length of 140 feet, average depth of 15 feet, and thickness of 8 feet, and contains ZVI at a concentration of approximately 30 weight percent by mass to accommodate the calculated ZVI demand. PRB-2 was designed based on a ZVI demand of 1,073,000 lbs. The design of PBA-2 was for a length of 120 feet, average depth of 26 feet, and thickness of 8 feet. The dimensions for PRB-2 are consistent with a ZVI concentration of approximately 30 weight percent. Attachment 2A.11 of the RAP provides the basis for design and field constructed data for the PRBs in the PBA.

Monitoring of the PRBs is included in the monitoring program presented on page 14 in Worksheet 3.1 in the RAP. Because the PRBs are primarily a Response Action for groundwater, they will be described in more detail in the Groundwater RACR.

Supporting Documents Included in This Attachment

- Letter from TCEQ dated October 17, 2014 regarding Authorization of Class V Wells
- Letter from TCEQ dated December 16, 2014 regarding TCEQ/EPA Approval of the following documents: Response to TCEQ/EPA Comments received May 2, 2014; Revised Responses to TCEQ/EPA received May 2, 2014
- Letter from TCEQ dated March 2, 2015 regarding TCEQ/EPA Approval of the November 24, 2014 Field Demonstration of Zerovalent Iron Treatment Technology in Parker Brothers Arroyo – Status Report (Interim Performance Monitoring [December 2013-June 2014])
- Letter from TCEQ dated February 29, 2016 regarding TCEQ's Approval of Request to Modify the PRB Sampling Schedule, dated January 21, 2016
- Email from TCEQ dated December 15, 2016 regarding TCEQ's Approval of Request for Reduced Groundwater Monitoring Well List for the Second Sampling Event in 2016, dated December 13, 2016
- RAP Figure 12 – PRB and GHB Facility Map