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OFFICE OF
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Final Field Variance Memorandum #5A – Extraction and Treatment Capture Evaluation, Former Liquid Fuels Storage Area, Site ST012, Former Williams Air Force Base, Mesa, Arizona (17-R09-001)

FROM: Eva L. Davis, Ph.D., Hydrologist
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TO: Carolyn d'Almeida, RPM
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I have reviewed the Final Field Variance Memorandum #5A (FVM#5A) – Extraction and Treatment Capture Evaluation for the Former Liquid Fuels Storage Area, Site ST012 at the Former Williams Air Force Base in Mesa, Arizona. A draft version of this report was not provided previously for Environmental Protection Agency (EPA) review. Clearly, the modeling results presented in FVM#5A for the modified extraction networks show that containment of the entire contaminant plume in the Cobble Zone (CZ) and Lower Saturated Zone (LSZ) will not be achieved by the proposed modified groundwater extraction networks. Based on Figures 7 and 9 provided in FVM#5A, additional pumping wells should immediately be added to the containment system in the CZ and LSZ to the east of the SEE treatment area to capture contamination migrating offsite. The lack of forward particle tracking in the area of contamination in the model makes it unclear whether the contamination in the Upper Water Bearing Zone (UWBZ) can be expected to be contained by the modified extraction system.

Ideally, the model used to evaluate containment should have been presented in detail in FVM#5A to allow a full review of its construction and parameterization. Also, a detailed sensitivity analysis should have been included in FVM#5A to evaluate the uncertainty in the model results. However, a review of the model would require significant time, which we do not have before we can expect downgradient migration of the contaminant plume. Temperature data from December 2016 contained in FVM#5A indicates that heat from the Steam Enhanced Extraction (SEE) operation is migrating to the east and northeast. Data in the December 9, 2016 weekly report shows that the temperature at all the perimeter monitoring wells is also increasing. The most recent groundwater data from within the SEE treatment zone shows that benzene

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concentrations at the eastern extent of the treatment area in many wells exceeds 1,000 micrograms per liter (μg/l). The fact that the groundwater is near steam temperatures means that it has a significantly lower viscosity than groundwater at ambient temperatures, allowing it to flow more rapidly in the subsurface. The elevated temperatures also increases the solubility of benzene, allowing more benzene to migrate with the groundwater. Thus, the migrating hot groundwater will carry significant benzene concentrations with it, and will allow the dissolved phase plume to spread downgradient more rapidly than groundwater at ambient temperatures. The imminent spreading of the dissolved phase plume puts us in the position of needing to activate the containment system as soon as possible, and proceed to field efforts to verify that containment is being achieved by the containment system without fully reviewing the modeling efforts.

The modified containment system as proposed in FVM#5A is supposedly ready for operation, with the exception of a couple of high temperature pumps, according to the January 31, 2017 Base Closure Team (BCT) conference call. I recommend that the containment system be activated as soon as possible, and that we focus more of our efforts now on field data to provide the lines of evidence needed to demonstrate that capture has been achieved.

Attached to this memo is the document, *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems,* (Ground Water and Ecosystems Restoration Division, U.S. EPA, National Risk Management Research Laboratory Ada, OK EPA/600/R-08/003, January 2008). Exhibit 1 on page 13 of this document outlines six steps for the systematic evaluation of capture zones. Figures 7 through 9 of the FVM#5A (or preferably, figures showing forward tracking of particles from the former SEE treatment area, as requested during the January 31, 2017 conference call) are only one of the lines of evidence that are needed to demonstrate adequate capture of a dissolved phase plume. In order to complete Step 2, which is defining the target capture zone, additional characterization, particularly to the north of LSZ53 and south of LSZ46, are needed to fully define the extent of dissolved phase contamination. Based on Figures 7 and 8 provided in FVM#5A, it appears that determining the northern and southern extent of the contamination within the CZ and UWBZ will be critical to ensure that all of the contaminant mass in these zones is being contained. Then with the groundwater containment system operating, a synoptic round of groundwater elevations must be collected from monitoring wells in each zone, from which potentiometric surface maps and water level difference maps can be produced. This groundwater elevation data can also be used to look at gradient control points, which then completes Step 3 of the evaluation. For Step 4, calculations of flow rates can be done, and the field data and potentiometric surfaces can be compared to the model assumptions and predictions. Ongoing monthly monitoring of the perimeter wells for temperature and contaminant concentrations will complete Step 5. Then we will have the multiple lines of evidence to say that the groundwater extraction system is or is not providing capture of the dissolved phase contamination. It is possible that we will find that additional monitoring wells or piezometers to measure groundwater elevation are needed in critical areas to determine if capture is being achieved.

Specific Comments

1. Temperature data in Table 3 shows that the temperature is increasing at wells LSZ14 and LSZ29, which clearly demonstrates that heated groundwater is migrating to the east in the LSZ. Dissolved phase contamination and possibly light nonaqueous phase liquid (LNAPL) will migrate with the hot groundwater. The containment system should be activated as soon as possible to contain this contamination.

2. Figure 1 shows that CZ23 has no significant benzene impact. However, the groundwater data provided on January 25, 2016 shows that this well has a benzene concentration of 5.5 µg/l on December 20, 2016. Thus, the groundwater at this location needs to be within the capture zone of the groundwater containment system. Figure 7 shows that this area will not be captured by the modified extraction network in the CZ. Additional pumping wells must immediately be added in this area.

3. Figure 1 shows the location of LSZ46 as having no significant benzene impact. However, the boring log for LSZ46 showed photoionization detector (PID) readings ranging from 12.7 parts per million (ppm) to 20 ppm in the 145 to 155 feet depth range. These PID readings, according to Attachment 1 of Field Variance Memorandum #4, could indicate the presence of dissolved phase benzene at concentrations greater than the cleanup criteria. Without having groundwater data that indicates that concentrations in this area are below the cleanup criteria, this area should in included within the containment system. Based on Figure 7, it is not clear that contamination in the cobble zone at LSZ46 will be captured by the proposed pumping scheme.

4. Figure 1 shows that LSZ53 is an area of know benzene impact in the CZ. However, it is not clear from Figure 7 whether this area is included in the capture zone. This will be a critical area for field monitoring to determine if dissolved phase contamination in this area is being captured.

5. Figures 4 to 9 show particle tracks starting from the western extent of the model domain. However, no particles were released within the SEE treatment zone, which is the critical area of interest for this containment system. Figures 8 and 9 tell us little about where groundwater and contamination within the former SEE treatment area in the UWBZ and LSZ will travel. Capture of the contaminated, hot groundwater at the downgradient side of the site is not demonstrated by these figures. Forward particle tracking should be used in the model with particles released within the areas of known contamination to aid in the determination of the capture zone. Based on Figure 9, pumping wells will be required on the east side of the SEE treatment zone in the LSZ to contain the remaining contamination.

6. Figure 7 clearly shows that contamination at CZ09 (which had a benzene concentration of 180 µg/l) and beyond to the east and northeast (including CZ23, which has a benzene concentration of 5.5 µg/l) will not be captured by the proposed pumping scheme. Additional pumping wells should be added to the containment system immediately to capture this area.

If you would like to discuss any of these comments, I would be happy to do so. I can be reached at (580) 436-8548 or davis.eva@epa.gov.

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