INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

INTERA Incorporated
6000 Uptown Boulevard NE, Suite 220
Albuquerque, New Mexico 87110 USA
505.246.1600

ENTERED

TECHNICAL MEMORANDUM

DATE: **5 May 2014**

FROM: **John Sigda, Ph.D., INTERA, Incorporated**

TO: **Dave Cobrain, Manager, Hazardous Waste Bureau, NMED**

CC: **Rick Shean, Water Quality Hydrologist, Albuquerque Bernalillo County Water Utility Authority (ABCWUA)**

SUBJECT: **ABCWUA comments on the Air Sparging for LNAPL Interim Measure April 2014**

1.0 INTRODUCTION

On behalf of the Albuquerque Bernalillo County Water Utility Authority (Water Authority), INTERA Incorporated (INTERA), reviewed the document entitled *Air Sparging for LNAPL Interim Measure* written by Chicago Bridge and Iron, Inc. (CB&I).

The white paper describes an interim measure (IM) for LNAPL in the source area of the fuel release consisting of two air sparging wells 50 feet upgradient from monitoring well KAFB 10617 and a new soil vapor extraction (SVE) well located between the air-sparging wells and KAFB 10617.

2.0 SUMMARY

In summary, INTERA's review of CB&I's proposed IM for air sparging of the LNAPL source area identified the following major issues:

1. Air sparging at the proposed location will do nothing to remove LNAPL from the deep vadose zone and saturated zone because no LNAPL has been observed at this well and it lies outside the known extent of the LNAPL lens. The two proposed air sparging wells will not serve to contain a significant fraction of the contaminant plumes. Thus, the proposed design fails as an IM because it will not remove LNAPL mass and it will not contain the migrating dissolved phase plume.
2. The proposed location not only lies outside the known extent of the LNAPL lens, it also appears to have relatively low concentrations of EDB and benzene. Installing the proposed IM remediation at this location will not be cost effective because the

KAFB4279

investment will remove a relatively small contaminant mass. Installing the proposed system at locations with LNAPL and higher contaminant concentrations will prove far more cost effective.

3. The proposed location and design will require several new monitoring wells to evaluate performance. Well KAFB-10617 cannot serve as a monitoring well because its groundwater levels are above the top of the screen, reaching 2.15 ft above the screen during the third quarter of 2013.
4. The proposed design does not discuss the most recent guidance on design of air sparging systems from the US Army Corps of Engineers (US ACE, 2013). The design should follow that guidance to the extent appropriate for the site.
5. CB&I contend that anaerobic bioremediation is reducing BTEX and EDB concentrations in the LNAPL source area and therefore air sparging is not appropriate. CB&I present no data to demonstrate that anaerobic degradation rates are for EDB are anything other than negligible and ignore the reality that combined mass removal from volatilization and aerobic biodegradation will be many times greater than mass removal from anaerobic biodegradation.
6. The proposed location for the LNAPL IM fails to remove LNAPL and will remove a relatively small contaminant mass from the dissolved phase, therefore the location should be changed to one where LNAPL and higher contaminant concentrations have been observed, such as near KAFB-10610 and KAFB-106142. SVE must be put in place prior to starting air sparging so that the EDB does not migrate in the vadose zone as vapor.

3.0 DETAILED COMMENTS

1. An IM should achieve source removal or contain contaminant migration within a reasonably short time period. Air sparging at the proposed location near KAFB-10617 will do nothing to remove LNAPL from the deep vadose zone and saturated zone. LNAPL has not been observed at this well and it lies outside the known extent of the LNAPL lens. The two proposed air sparging wells will not serve to contain a significant fraction of the contaminant plumes because they will affect an area less than 100 feet (ft) in total width, whereas the shallow 1,2-dibromoethane (EDB) plume is approximately 1,500 ft in width at KAFB-10617. Thus, the proposed design fails as an IM because it will not remove LNAPL mass and it will not contain the migrating dissolved phase plume. Instead the proposed design appears to address source removal from the dissolved phase.
2. The proposed location not only lies outside the known extent of the LNAPL lens, it also appears to have relatively low concentrations of EDB and benzene. Data from CB&I's quarterly reports for monitoring well KAFB-10617 reveal that benzene concentrations have remained at or below 1 microgram per liter (μg/L), less than the MCL, since the second quarter of 2009. EDB concentrations have consistently exceeded the MCL, but remained below 2 μg/L since the start of 2010. Installing the proposed IM remediation at this location will not be cost effective because the investment will remove a relatively small contaminant mass. Installing the proposed system at locations with LNAPL and higher contaminant

concentrations will prove far more cost effective. For example, a location near KAFB-10610 and KAFB-106142 will be likely be orders of magnitude more cost effective than the proposed location because EDB concentrations are two orders of magnitude greater and benzene concentrations are three orders of magnitude greater.

3. CB&I provided inadequate information about how they will evaluate the zone of influence for air sparging. KAFB-10617 will be more than 50 ft from the two air sparging wells, which is very likely outside the radius of influence for the air sparging. Furthermore, KAFB-10617 cannot be used to evaluate air sparging performance because its groundwater levels are above the top of the screen. Groundwater was 2.15 ft above the screen during the third quarter of 2013. The proposed location and design will require several new monitoring wells to evaluate performance.
4. The US Army Corps of Engineers recently updated its engineering manual for air sparging (US ACE, 2013), but CB&I do not appear to have used the most recent engineering guidance in creating their proposed air sparging design. CB&I should revise their design to follow that guidance to the extent appropriate for the site.
5. CB&I contend that air sparging should not be located within the LNAPL source area because it will interfere with the ongoing anaerobic bioremediation and abiotic EDB degradation. The comments below identify the flaws in the four reasons provided by CB&I for not locating air sparging in the LNAPL source area.

    5.1. (It) "Will negatively impact the ongoing anaerobic biodegradation of BTEX and EDB".

Sparging air into the LNAPL source area will cause the relatively slow anaerobic degradation of BTEX to be replaced by the much more rapid volatilization and aerobic degradation BTEX. Air sparging will also remove some of the residual/mobile/migrating LNAPL mass in the source area, whereas anaerobic degradation will only remediate dissolved phase BTEX.

CB&I present no data to demonstrate that anaerobic degradation rates are for EDB are anything other than negligible. Even in anaerobic degradation of EDB is occurring, the degradation rate appears to be much smaller than the rate of EDB dissolution and migration with ambient groundwater given the extent of the known EDB dissolved phase plume. According to CB&I (page L-26 of the RFI), 15 wells see a "statistically significant EDB concentration trend". Of these 15 wells, only 3 fall within the LNAPL footprint: KAFB-1065, KAFB-1066, and KAFB-1068. Some of the other wells fall along the margin of the LNAPL footprint. However, SVE was operating on these three wells within the LNAPL footprint (KAFB-1065, KAFB-1066, and KAFB-1068); thus, the observed decrease in EDB cannot be attributed to anaerobic degradation alone or perhaps at all (see Table 4-3 of Appendix L). On page L-19 of the RFI, CB&I describe several data discrepancies related to the CSIA EDB data. The data discrepancies must be investigated to determine whether they contradict or support CB&I's contention that anaerobic biodegradation of EDB occurs in the LNAPL source area. CB&I should compare the effectiveness and EDB removal rates in the LNAPL source area for air sparging and for anaerobic degradation.

Air sparging will likely lead to far more contaminant mass removal than anaerobic degradation because it will remove LNAPL (unaffected by anaerobic degradation), volatilize dissolved and pure phase contaminants including EDB (not possible with anaerobic degradation), and induce aerobic degradation that is much more rapid than anaerobic degradation.

5.2. *(It) "May expand the plume size since the containment mechanism (anaerobic biodegradation) has been disrupted."*

CB&I have not demonstrated that any containment mechanism exists in the LNAPL source area. Anaerobic degradation of EDB may occur, but at a negligible rate. Introducing air sparging into the LNAPL source area will replace relatively slow rates of anaerobic BTEX degradation with much more rapid rates of aerobic BTEX degradation.

5.3. *"...another EDB degradation mechanism is abiotic degradation in the anaerobic zone...".*

Page L-1 of the RFI states that abiotic degradation of EDB in LNAPL is not widely documented but has been documented to occur in the dissolved phase. What evidence does CB&I have that demonstrates that abiotic degradation of EDB in LNAPL occurs at the site and that the rate of abiotic degradation of EDB in LNAPL is comparable to the mass removal rate expected for volatilization of EDB by air sparging?

5.4. *"Is not consistent with the "first, do no harm" approach to remediation".*

Air sparging has been demonstrated at other sites to be an effective remediation alternative for removing LNAPL and removing EDB. If designed and implemented correctly according to guidance, the combination of air sparging and SVE will serve as an effective IM for LNAPL.

6. The following data needs from the US ACE (2013) guidance for drilling must be addressed:
   6.1. Characterize the LNAPL and hydrocarbon distribution in the subsurface using visual observation for LNAPL, and continuous TPH and VOC soil samples.
   6.2. Perform a moisture retention analysis from an undisturbed core from a representative sample from within the proposed screen interval. This will determine potential air-entry pressure.
   6.3. Measure grain size distribution, dry bulk density, and NAPL and water contents in saturated zone samples of sediments within the proposed screened interval.
   6.4. Measure hydrocarbon distribution and LNAPL chemical composition, if present.
   6.5. The geological logging of the well is very important. Minor changes in the geology are important because they will affect air flow and air entry pressures. Continuous logging is required from above the water table to the bottom of the deepest sparge well (sonic drilling techniques are recommended because they are expected to provide better subsurface data). It is imperative that the screen be placed in homogenous high permeable layer. Setting the screen in a low permeable layer will increase the injection pressure (due to the high air-entry pressure requirements of finer grained soils) as well as minimize the zone of influence.
7. The following comments on the proposed well design must be addressed:
   7.1. Guidance documents suggest placing screen depths to match the 3D contaminant distribution. Typically the air will escape through the top 12 inches of the screen;

therefore a 2 to 5 ft screen length is sufficient. Ideally, the top of screen should be placed at the base of dissolved phase contamination or at the base of LNAPL in saturated zone, if it is present. At a minimum, the top of screen needs to be 5 ft below the low water table.

7.2. Monitoring well KAFB-10617 is screened from 482-507 ft bgs. The proposed design specifies a 490-495 ft bgs screen depth. However, based on US ACE guidance, the proposed screen interval should be placed so that top of screen is at 507 ft bgs, but this placement depth is dependent on the lithology (see comment 7.5 above).

7.3. Following the available guidance, screen length should be 5 ft, slot size should be 0.010'', and Schedule 80 PVC should be used. A stainless steel screen may be more appropriate as it is more durable than PVC, and if fouling occurs, it will be easier to treat (e.g., with H_2O_2).

8. We recommend strongly that the system be installed near monitoring wells KAFB-10610 and KAFB-106142. This location falls within the LNAPL footprint and has EDB and benzene concentrations that are hundreds to thousands of time larger than those at proposed location.

8.1. Install the nested air sparging/SVE well adjacent to KAFB-106142 as close to KAFB-10610 as possible.

8.2. Install a nested well consisting of 2 air sparging wells and 1 SVE well. Place the intermediate air sparging top-of-screen at ~ 511 ft bgs and the shallow screen top at ~492 ft bgs. However, if LNAPL is observed, then place the top of screen for the shallow well at the observed base of the LNAPL.

REFERENCES

CB & I, 2014. *Air Sparging for LNAPL Interim Measure*. Prepared for U.S. Army Corps of Engineers, Albuquerque District, Albuquerque, NM 87109 by Chicago Bridge and Iron, Inc. April, 2014.

US ACE. 2013. In Situ Air Sparging Engineer Manual. US. Army Corps of Engineers EM 200-1-19. 31 December 2013. http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_200-1-19.pdf