UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
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September 23, 2010

OFFICE OF
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: North Penn Area 5 (OU-1) Superfund Site, Colmar, Pennsylvania (10-R03-002)
Response to Correspondence Regarding Evaluation of the Use of Monitored Natural Attenuation (MNA) for OU-1

FROM: Steven D. Acree, Hydrologist
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TO: Stacie Pratt, Remedial Project Manager
U. S. EPA, Region 3

As requested, a technical review was conducted on the *Response to EPA's April 13, 2010 Correspondence regarding Evaluation of the Use of Monitored Natural Attenuation for OU1*, July 22, 2010 (the Response), prepared by Environmental Alliance, Inc. (Alliance) and WISE, Ltd. (Wise) for submittal to U.S. EPA Region 3 on behalf of BAE Systems Information and Electronic Systems Integration, Inc. (BAE). The review was performed by [redacted], Shaw Environmental & Infrastructure, Inc., and me. Shaw is an on-site contractor providing technical support services to this laboratory.

The Response presents BAE, Alliance, and Wise's response to U.S. EPA April 13, 2010 review comments on the *Evaluation of the Use of Monitored Natural Attenuation For Operable Unit 1 (OU-1) of the North Penn Area 5 Superfund Site*, January 26, 2010 (the Evaluation), prepared for BAE by Alliance. The Evaluation had presented BAE's assessment of site characterization information to support their view that monitored natural attenuation (MNA) is an alternative to continued or optimized pump-and-treat (P&T) for remediation of chlorinated VOCs (primarily TCE) in ground water at the North Penn Area 5 Superfund Site in Colmar, PA.

This technical review addresses each of the specific responses in the Response, and also provides some general comments on broad issues.

GENERAL COMMENTS

(1) It appears that there can be agreement that (a) temporal trends in data from site wells show decreasing contaminant concentrations, and (b) there are natural attenuation processes (i.e., primarily non-destructive mechanisms) occurring that contribute to decreasing TCE

concentrations. Disagreements arise due to the interpretations and the certainty of conclusions regarding application of the site information. These are addressed in the remainder of these comments.

(2) With respect to the data obtained from the North Penn Area 5 OU-1 site, the primary point of technical controversy appears to be the degree to which the trends of decreasing contaminant concentrations observed in wells can be used to project trends that would be observed if the extraction system was shut down and the confidence in such future projections. The discussions in the Evaluation and Response state that natural attenuation mechanisms are responsible for the greater contaminant concentration reduction outside the capture zone of the Recovery Well than within the capture zone. It is further stated or implied that concentration reduction in the capture zone area would be more rapid if ground-water extraction did not occur. Given the complexity of the site conditions, the accuracy of such projections is uncertain.

In addition, there are some specific points regarding interpretation of the significance of the TCE concentrations in the Recovery Well capture zone compared to the TCE concentrations downgradient of the capture zone:

(2a) Best-fit lines were determined for the TCE concentration data for various wells. The slopes of the best-fit lines were presented as the "rate of natural TCE remediation". Specifically, a rate was presented for well W-1 and a rate presented for well RW-1. Many of the interpretations and conclusions in the Evaluation and in the Response, especially, are based on these two numbers. However, the calculated rates should be used with caution. The rates may provide a very general indication of current trends, but to use only two specific rates to support all the conclusions and to state that remediation occurred 1.72 times more rapidly outside the capture zone than in the capture zone is over-reaching. There will be a range of rates based on the specific data points used (temporally and spatially), and the number of data points. Table 3-1 in the Evaluation shows a range of rates. One omission in the use of these rates is that no statistical measure of the uncertainty in these rates appears to have been provided (even though the Response states (p. 5) that "*The effectiveness of the natural attenuation processes... was specifically quantified (with statistical significance)...*", which may refer to the Mann-Kendall analyses, not the best fit lines). The correlation coefficients for these best fit lines do not appear to be presented or discussed. It should be noted that the R^2 value for the well W-1 data appears to be relatively low. Confidence intervals are not presented to support a discussion of the potential uncertainty in the estimated rates (see Newell, C.J., H.S. Rifai, J.T. Wilson, J.A. Connor, J.A. Aziz, and M.P. Suarez, 2002, *Calculations and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies*, EPA/540/S-02/500, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH, http://www.epa.gov/ada/download/issue/540S02500.pdf for a discussion of uncertainty). It is recommended that a discussion of the uncertainty in the rates be provided in any future analyses using such calculated rates.

(2b) While a significant amount of contaminant mass has been removed from the site, there is likely still a non-insignificant mass of contamination remaining which may cause persistence of low concentrations of TCE (e.g., via back-diffusion from bedrock matrix or from fractures). The presence of this contaminant mass in the source area would influence the calculation of apparent contaminant loss rates. As indicated in Newell et al. (2002), cited above, the rate of attenuation in the source area can be slower than attenuation rates in other areas due to presence of such mechanisms.

(3) The Evaluation and Response mention a potential pilot study. A monitored natural attenuation pilot study could be an option for providing information to better project the effectiveness of natural attenuation mechanisms at the field scale under non-pumping conditions. It is recommended that any pilot study incorporate extensive monitoring within, at the boundaries, and downgradient of the current capture zones. While a pilot study would need to be conducted for a sufficient period of time to observe meaningful trends (several years is likely), decision points and contingency plans could be prepared so that any unexpected increase in contaminant concentrations could be quickly addressed.

SPECIFIC COMMENTS

(1) Response to EPA Statement #1.

Much of this Response concerns what a "*reasonable timeframe*" for remediation may be, specifically, comparing a natural attenuation timeframe to timeframes for other remedial technologies. Determination of a reasonable timeframe depends on many factors, including regulatory concerns and other site-specific expectations, and is beyond the scope of this technical review.

The remainder of this Response discusses projections of well-specific attenuation rates. The uncertainties in the calculation and projection of such rates are discussed above.

(2) Response to EPA Statement #2.

The comment to which this Response refers was not meant to imply that the capture zone determinations were erroneous and should not be used in the evaluations. What the original comment says is that the Evaluation implies that the downgradient wells are unaffected by the extraction wells and capture zone. The downgradient wells are indeed affected by the extraction wells and capture zone in that there is no ground-water flow and contaminant mass flux from the area of the capture zone into the downgradient area. There are not only natural attenuation mechanisms occurring downgradient of the capture zone, but also a "non-natural" attenuation mechanism (i.e., anthropogenic ground-water extraction). The extraction well prevents contaminant mass from entering the downgradient area. Therefore, projections of attenuation rates under non-pumping conditions are uncertain.

(3) Response to EPA Statement #3.

The review comments did not reject the use of MNA for OU-1. What is being questioned is the conclusion that stopping ground-water extraction will increase the rate of reduction in contaminant concentrations, which is based on the lack of consideration of the potential impact and role of the ground-water extraction and capture zones on the calculated rates of contaminant concentration reduction.

(4) Response to EPA Statement #4.

The Response claims they could not respond to this "*vague comment*" because suggestions about "*other potential explanations*" were not provided. It should be noted that the paragraph immediately following Statement #4 in the EPA comments was a follow-up that did suggest and discuss other explanations.

(5) Response to EPA Statement #5.

There are several aspects to commenting on this response:

(5a) The Response states that there would not be an increased contaminant mass flux into downgradient areas if the Recovery Well is shut down, because the TCE concentrations around the Recovery Well are lower than in downgradient areas. This observation is then used to suggest that the Recovery Well has prevented ground water with lower concentrations of TCE from moving into downgradient areas that contain higher TCE concentrations. It is noted that the data presented in the Evaluation and Pre-Design Investigation Report indicate that relatively clean ground water appears to enter the capture zone of well RW-1 despite the on-going extraction at the Recovery Well. In addition, the data presented in the Evaluation and the Pre-Design Investigation Report indicate contaminant concentrations within the capture zone of the Recovery Well vary spatially (e.g., PW-1) and at some locations are similar in magnitude to concentrations observed within the capture zone of RW-1. If the Recovery Well extraction is stopped, the contaminant mass within the capture zone would be added to the downgradient areas.

(5b) The Response mentions the potential adverse effects of the Recovery Well on potential anaerobic reductive dechlorination. It is stated that ground-water quality data prior to implementation of ground-water extraction showed evidence of TCE degradation. It is then implied that cessation of pumping could help establish or re-establish anaerobic reductive dechlorination of the TCE. The Evaluation had appeared to downplay the occurrence or potential for anaerobic reductive dechlorination biodegradation, and in several places had indicated that there was little to no evidence of it (and that natural attenuation was occurring by non-destructive mechanisms). The degree to which contaminant biotransformation would improve the performance of an MNA remedy under non-pumping conditions is unknown.

(6) Response to EPA Statement #6.

The Response provides additional information and cites previous work to respond to this comment. This additional information is appreciated and indicates that a fuller discussion of the various issues in the Evaluation could have forestalled some of the areas of disagreement. However, despite the USGS not including heterogeneity in its modeling, the Evaluation did indicate that "*Aquifer testing conducted during the PDI demonstrated marked heterogeneity...*". It is still a concern that heterogeneity can affect if and how ground water in particular ground-water flow paths migrates to and enters specific monitoring wells.

(7) Response to EPA Statement #7.

The first part of this Response mentions "reasonable time frames" and also the interpretation that TCE concentration reduction is faster outside the capture zone than within the capture zone. These issues have been addressed elsewhere in these comments.

The remainder of this Response is an extensive discussion comparing activities at other portions of the North Penn Area 5 Site. These comparisons may be valid considerations but are outside the narrower scope of this technical review.

(8) Response to EPA Statement #8.

In response to an EPA comment regarding the uncertainty of what may happen once ground-water extraction is stopped, this Response reiterates several points that have been mentioned and addressed in previous comments, above.

(9) Response to EPA Statement #9.

This Response states that EPA has not provided any basis for concluding that "*The data that were provided in the Evaluation provide no support for a determination that natural attenuation processes would attain the remediation objectives currently in the ROD within a reasonable time frame.*" However, the original EPA comments and the comments provided here do indicate the uncertainties in and problems with the interpretations and firm conclusions of the Evaluation. The ROD indicates that the selected remedy requires source reduction to achieve MCLs in ground water. As discussed above, there are uncertainties with the interpretations of the data and with the estimation/projection of TCE attenuation rates that should raise concerns as to whether MCLs will be reached in a reasonable time frame. As noted above (and in the Response), it is acknowledged that a "*reasonable time frame*" is generally site specific and may be a difficult figure to establish and agree on. Judged on its merits alone (and not in comparison to other portions of the site, or other sites), there are concerns with some the definitive interpretations made in the Evaluation.

In summary, this review is not intended to imply that the performance of an MNA remedy would necessarily be unacceptable. The review indicates that the projected rates of attenuation used to support the argument against continued ground-water extraction are subject to uncertainty and are not necessarily good predictors of rates that would be observed in the absence of extraction. As previously noted, performance of a pilot study may provide much greater insight into the expected performance of an MNA remedy in the absence of extraction.

If you have any questions regarding these comments, please do not hesitate to call us at your convenience (Acree: 580-436-8609). We look forward to future interactions with you concerning this and other sites.

cc: Linda Fiedler (5203P)
Mike Cramer, Region 3
Kathy Davies, Region 3
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