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RESPONSES TO COMMENTS ON WASTE MINIMIZATION AND GROUNDWATER SAMPLING EFFICIENCY: A NEW TECHNIQUE FOR PURGING GROUNDWATER MONITORING WELLS AT FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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Department of Energy
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Mr. James A. Saric, Remedial Project Director
U. S. Environmental Protection Agency
Region V-5HRE-8J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Thomas Schneider, Project Manager
Ohio Environmental Protection Agency
40 South Main Street
Dayton, Ohio 45402-2086

Dear Mr. Saric and Mr. Schneider:

RESPONSES TO COMMENTS ON WASTE MINIMIZATION AND GROUNDWATER SAMPLING EFFICIENCY: A NEW TECHNIQUE FOR PURGING GROUNDWATER MONITORING WELLS AT FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

The subject report was issued December 17, 1993, to document the field experiments of our proposed technique, micro-purging, in order to minimize waste water and improve groundwater sampling efficiency at the Fernald Environmental Management Project (FEMP). Enclosed are our responses to comments issued by the United States Environmental Agency (USEPA) on February 25, 1994.

On the basis of the successful experiment, as documented in the report and attached comments, the Department of Energy (DOE) requests that the USEPA grant approval to change the FEMP Groundwater Monitoring Program to include the micro-purging technique. Once approval has been obtained, the appropriate site documents will be revised to reflect the new sampling procedure.

We received approval from the Ohio environmental Protection Agency (OEPA) on February 17, 1994. We look forward to your approval so that we can implement micro-purging for the Spring sampling quarter.

If you have questions or require additional information, please contact William Sidle at (513) 648-3149.

Sincerely,

Johnny Reising

for Jack R. Craig
Fernald Remedial Action
Project Director

FN:Sidle

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RESPONSE TO UNITED STATES ENVIRONMENTAL PROTECTION AGENCY GENERAL COMMENTS

DOE GENERAL RESPONSE TO USEPA COMMENTS

Micro-purge sampling is based upon the rate and the contention that stabilization exists continuously within the screened interval as groundwater is allowed to naturally flow through. Micro-purge is not to be confused with well volume counting and/or the monitoring of indicator parameters. The focus of the USEPA comments is on the stabilization of indicator parameters as verification that purging is completed. In fact, the emphasis of DOE's experiment was to demonstrate the equivalency of samples taken without purging to those taken after conventional purging of three well volumes. In this sense, it is secondary to look at indicator parameter data in this study, when the focus is on the comparison of analytical results from the two sampling methods. Based on the work of Robin and Gillham (1987), Kearl et al. (1992), and Shanklin et al. (1994) discrete sampling from the screened interval of wells installed in transmissive aquifers (such as at the FEMP) should yield valid, representative samples.

DOE Specific Response to USEPA Comments

1. USEPA Comment

During sampling, geochemical stabilization of groundwater indicates that groundwater being withdrawn from the monitoring well is representative of the producing formation. Research conducted by the U.S. Environmental Protection Agency (U.S. EPA) R.S. Kerr Environmental Research Laboratory (RSKERL) and others indicates that indicator parameters, such as turbidity, dissolved oxygen (DO), and specific conductivity, are better indicators of stabilization than purge volume (Barcelona, Wehrmann, Varljen, 1994). The U.S. Department of Energy (U.S. DOE) studies used set purge volumes, with the maximum volume equal to three well volumes, to define a well as being stable. The fact that DO stabilized in only 6 of the 16 tests is evidence that stabilization had not occurred in the majority of the volume-based FEMP tests. Therefore, U.S. DOE should purge groundwater until indicator parameters are stable.

DOE Response

The emphasis of DOE's experiment was to demonstrate the equivalency of samples taken without purging to those taken after conventional purging of three well volumes. The study does not define stabilization by counting well volumes. The counting of well volumes is past protocol which this report states is unnecessary. The design of the field experiment was based, in part, on the conclusions from Kearl et al. (1992) in that stabilization exists continuously within the screened interval. Representative samples can be collected without well volume purging or the use of indicator parameters simply by discretely tapping into the naturally flowing groundwater. DOE has shown that, at the FEMP, using indicator parameters to determine geochemical stabilization of groundwater is not required (Shanklin, et al.,1994) to indicate that

groundwater being withdrawn from the monitoring well is representative of the producing formation. Most recently Kearl.....(1994 similarly demonstrates that indicator parameters are a misnomer for micro-purging and are aptly useful for the past practice of exchanging several borehole volumes prior to sampling.

2. <u>USEPA Comment</u>

Research pertaining to inorganic data performed by RSKERL shows that turbidity is the most sensitive indicator of stabilization and that dissolved oxygen (DO) is an acceptable indicator. RSKERL research also indicates that pH, temperature, and specific conductivity are the least sensitive indicators of inorganic stabilization. Additional research conducted by Barcelona, Wehrmann, and Varljen shows that specific conductivity is a good indicator of volatile organic compound (VOC) stabilization (Barcelona, Wehrmann, and Varljen, 1994). Although inorganics, and specifically uranium, are the primary contaminants of concern, VOC contamination is known to exist at FEMP. Therefore, U.S. DOE should measure specific conductivity, DO, and turbidity during purging, not just for quality control purposes, but as indicators of groundwater stabilization.

<u>DOE Response</u>

While the research mentioned does discuss stabilization as the means of determining when purging is completed, there has been no conclusive evidence to demonstrate that turbidity is a reliable indicator of completed purging (or any correlation at all, for that matter). In conversations with Dr. Robert Puls of RSKERL and Dr. Michael Barcelona of the University of Michigan, both researchers have stated that turbidity is not a direct indicator of purging completeness, and should not be used as an indicator parameter even for the past practice of multiple borehole exchange. Early work at RSKERL (eg. USEPA, 1990a; 1990b) has been superseded by Powell and Puls (1993) to discount turbidity unless the purpose of sampling is to collect colloidal fractions. Dr. Michael Barcelona was the primary technical contributor during the development of the procedure that was followed by the DOE for the micro-purge field work (Barcelona, 1993). The most reliable indicators mentioned by both researchers are DO and SC. Years of groundwater sampling experience at the FEMP has shown that turbidity is a function of rate (i.e. increased rate will increase turbidity readings). Therefore, on a site-specific level, it can be concluded that turbidity is not useful as an indicator.

Close examination of the data contained within Attachment A (Field Parameter Data and Charts) concludes that indicator parameters are <u>flow dependant</u> and inconsistent <u>within the same well</u> between very closely spaced sampling events (3 days). The conclusion can be made that by following the USEPA suggestion to measure specific conductivity, DO, and turbidity during purging, not just for quality control purposes, but as indicators of groundwater stabilization may produce inconsistent sample results due to differences in purge volumes, temporal effects, and lack of restrictions on maintaining consistent purge rate.

3. **USEPA Comment**

Site specific conditions, and on a smaller scale, well specific conditions play a large role in determining the validity of the FEMP study. The FEMP study was based on 2000- and 3000-series monitoring wells. While the geologic conditions of the 2000- and 3000-series monitoring wells may be similar to the geologic conditions of the 4000-series monitoring wells because all are installed in the Great Miami aquifer, the geologic condition of the 1000-series wells installed in the glacial overburden are probably not similar. In the 1000-series monitoring wells, turbidity may be higher than other monitoring wells due to a higher percentage of fine-grained material in the screened interval. Therefore, U.S. DOE should conduct additional studies using a larger data set (more monitoring wells) and monitoring wells representative of the entire monitoring well network at FEMP.

DOE Response

Micro-purge sampling is not being proposed for use on type 1 (1000 series) wells at the FEMP. Due to micro-purge requirements as stated on page 14 (Discussion and Conclusions) of the report, the isolation of the stagnant water column can not be assured on many of the type 1 wells. This is due to lower groundwater flow rates encountered in these wells. Micro-purge sampling is proposed for use for the RCRA Compliance Sampling Program and the Design, Monitoring, and Evaluation Program Plan (DMEPP) which contain only type 2, 3, and 4 wells.

4. **USEPA Comment**

The FEMP document references a study that shows it took several days for the screened interval of a monitoring well to equilibrate after a minor disturbance. Because the FEMP study included only 3 days between tests, the screened interval may not have reach equilibrium. Future studies should include greater periods of time between tests to allow monitoring well conditions to equilibrate.

DOE Response

The referenced study (Kearl, et al., 1992) defined the term "minor disturbance" as disturbances to the screened interval of the well as insertion of sampling equipment (bailers or pumps), and high-rate pumping (pumping that induces draw-down of the well and/or greatly exceeds natural formation velocities). Since the use of dedicated, low flow pumps was the basis for the DOE research, there was no disturbance of the screened interval as described in the referenced paper. Equilibrium was maintained throughout the testing period (two weeks) within the screened interval.

Dr. Michael Barcelona was the primary technical contributor during the development of the procedure that was followed by the DOE for the micro-purge field work (Barcelona, 1993). It was he that suggested only three days between tests to avoid any temporal effects influencing the data.

SPECIFIC USEPA COMMENTS

Abstract, Page 1, Line 3. The text states that studies have shown that groundwater samples can and should be collected without "prior well-volume exchange purging." Technically, this statement is correct, however, it is misleading and could be interpreted as meaning no purging should be performed. The statement should clearly convey that purging should not cause an exchange of groundwater between the screened interval and the stagnant water in the casing above the screened interval. The sentence should either be revised to clearly state the intended meaning or be deleted.

DOE Response

USEPA interpreted this statement correctly. No purging should be performed prior to sample collection. However, the existence of standing water in the bladder pump and tubing must be addressed. Therefore, to assure the complete removal of this water, two-times it's calculated volume should be removed before samples are collected. On a broader sense, this statement is only intended to make clear the fact that a representative sample can be collected without following a waste-generating and time-consuming process of counting well-volumes. This statement is further clarified in the text on page 6, "Micro-Purging Design Principles".

Purpose and Scope of Investigation, Page 2, Paragraph 2. The text states that prior to sampling, only the pump and tubing volume will be purged. Based on the research cited in the FEMP document, purging should be conducted until indicator parameters, such as specific conductivity, DO, and turbidity, are stable. Although micro-purge may require less purging, purging should be based on groundwater geochemistry stabilization, not the volume of groundwater purged. U.S. DOE should modify the purging and sampling technique to include purging until groundwater geochemistry is stable.

DOE Response

The focus of the report is not on fixed-volume purging or indicator parameter stabilization, but on discrete sampling of the screened interval without purging. Through a thorough examination of the field parameter date collected during the experiment, it is clearly shown that:

- Parameter stabilization may happen within minutes or never.
- Parameter stabilization is directly related to the purge rate. Parameter stabilization time increases with increasing purge rates.
- Parameter stabilization and actual parameter readings are inconsistent within the same well between very closely spaced sampling events (3 days). This close spacing would eliminate possible temporal effects that could explain parameter inconsistency.

<u>Discussion and Conclusion, Page 15, Paragraph O.</u> RSKERL research shows that the conventional 0.45 micron filter is a poor choice for any desired data use and recommends either a 0.1 or 5.0 micron filter depending on the data use. RSKERL research also shows that filtering metals should not be necessary if the low flow technique is performed properly. The FEMP document should provide the pore size of the in-line filter that U.S. DOE proposes to use for filtered metals analysis.

DOE Response

The intent of the DOE report was to collect samples using both micro-purge and conventional sampling techniques and then to statistically compare the results. It is well accepted that a 0.45 micro filter is a poor choice for field filtering, however, USEPA TEGD (USEPA, 1986) page 114, paragraph 2 states, "Ground-water samples on which metals analysis will be conducted should be split into two portions. One portion should be filtered through a 0.45-micron membrane filter...". In addition, the FEMP Sitewide CERCLA Assurance (SCQ) Document that has been approved by the USEPA requires the use of a 0.45-micron filter to prepare dissolved metals samples (WEMCO, 1992). Since current USEPA guidance does not establish any filter pore size for dissolved metals sampling other than 0.45-micron, there should be an established policy on the pore size to be used for filtration if other than this size, DOE runs the risk of ending up with non-comparable data if filter pore sizes are changed away from the established 0.45-micron size, only to have USEPA later change its position on filtration again.

The USEPA comment of filter selection is valid, however, the filtration issue does not factor into the conclusions of this report since sampling method consistency, not sample quality, was the intended goal.

The DOE is currently considering future field study in regards to colloidal transport in which filter sizes that clearly separate colloidal fractions from solution will be investigated.

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