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Short Review of the Micro-Purging Option for Monitoring Wells

Most of today's well purging methods were developed during studies of water supply wells in the 1960's and early 1970's (Powell and Puls, 1997). The studied wells were usually steel cased with screens set below the top of the water table, and they were analyzed for inorganic water quality parameters.

The procedures used for sampling the water supply wells called for removing about three well volumes of water before sampling, because all the water in a well was thought to be "stagnant", and not representative of water in the aquifer. This purging or removal of the "stagnant" water was deemed necessary before taking "fresh" samples. These procedures have since been carried over into the sampling of groundwater monitoring wells.

Traditional purging methods do present problems such as:

- excessive agitation resulting in volitalization and degassing which gives erroneous results;
- if the well is purged dry (common in Indiana's low permeable areas) the recharge water cascading through the sand filter pack can lose up to 70% of volatile organic compounds (McAlary and Barker, 1987), and bias metals analyses (Puls and Powell, 1992)
- preferential recharge from more porous layers, biasing the sample;
- increased turbidity from the disruption of the sand pack and surrounding soils;
- the large amount of time and effort, resulting in increased labor expense; and
- disposal of large volumes of contaminated purge water at considerable handling expense, and some risk of additional spills.

Recent studies to determine actual well flow patterns, including direct observation of colloidal suspensions and dyes in wells, have changed previously held dogma (Kearl, Korte and Cronk, 1992; Powell and Puls, 1993). Multiple studies have shown that while the water above and below a well screen may be stagnant, the water actually in the screened section flows across the well with no significant mixing of water in the screened interval with the stagnant water above or below. This holds true even for wells completed in low permeable materials (Robin and

Gillham, 1987).

Therefore, a sample taken from the screened area only (excluding stagnant layers above and sediments below the screen) should be of "fresh" water, representative of the aquifer. Purging, with its attendant problems, may not be necessary. Sediments below the screen can be avoided by restricting the depth of the sampling device. Stagnant water in the casing above the well screen is much more difficult to avoid, but dedicated pumps or careful, slow pump insertion will minimize mixing.

Recent research and testing of sampling procedures has focused on improving quality and the ease of sampling. Micro-purge sampling has been the most successful new approach. It involves using an in-well pump, not to remove a set volume of water, but to purge water at very low pumping rates (0.1 - 1.0 L/min) just until measured water characteristics exhibit steady state conditions, showing that the water is being drawn from the aquifer. The most useful parameters are turbidity, dissolved oxygen, and oxidation-reduction potential. Parameters of less value, but often measured, are temperature, pH, and specific conductance (EPA/540/S-95/504).

Micro-Purging has numerous advantages over conventional bailing or high speed pumping:

- Samples are much more consistent,
- Sample artifacts are minimized,
- Less operator variability,
- Less time sampling overall,
- Less expensive,
- Much less purge water to dispose of (95% less - Serlin & Kaplan, 1996),
- Much less stress on the formation, and
- Need for filtration reduced or eliminated due to marked decrease in turbidity.

The disadvantages are:

- Higher capital cost,
- More set-up time,
- Additional equipment, and
- Additional training needed.

The improvement in sample quality, particularly for metals analyses, are well documented (Powell & Puls 1997, EPA/540/S-95/504) and micro-purge sampling is allowed in at least 34 states. The EPA has approved its use (EPA/540/S-95/504) and Regions I, VIII, and IX have drafted standard operating procedures for micro-purge sampling. The OSHWM of IDEM has approved micro-purge sampling on a site specific basis for a RCRA landfill in Indiana. The sample results for this site, plagued by extreme turbidity, have significantly improved over previous sampling, with turbidity dropping from over 40,000 NTUs to 6 or less. (Weaver, 1997) The use of micro-purge sampling would have immense benefits to Indiana. Much of this state is covered with low permeable soils, in which purging is difficult or impossible without running the wells dry. This costs more time waiting for recharge and yields biased samples. Besides the money and time saved, the improvement in data consistency, accuracy and repeatability is also a bonus, particularly when the public's health is involved.

Bibliography

- Kearl, P.M., Korte, N. E. and Cronk, T. A. 1992. Suggested modification to ground water sampling procedures based on observations from colloidal borescope. *Ground Water Monitoring Review* 12, no. 2, pp 155-161.

- McAlary, T. A. and Barker, J. F. 1987. Volitalization losses of organics during ground water sampling from low-permeability materials. *Ground Water Monitoring Review* 7, no. 4, pp. 63-68.

- Powell, R. M. and Puls, R. W. 1997. Hitting the bulls-eye in groundwater sampling. *Pollution Engineering*, June, pp. 50-54.

- Powell, R. M., and Puls, R. W. 1993. Passive sampling of groundwater monitoring wells without purging: Multilevel well chemistry and tracer disappearance. *Journal of Contaminant Hydrology*, vol. 12, pp. 51-77.

- Puls, R. W., and Powell, R. M. 1992. Aquisition of representative ground water quality samples for metals. *Ground Water Monitoring Review* 12, no. 3, pp. 167-174.

- Robin, M. J. L. and Gilham, R. W. 1987. Field Evaluation of well purging procedures. *Ground Water Monitoring Review*. Vol. 7, no. 4, pp. 85-93.

- Serlin, C. L. and Kaplan, L. M. 1996. Field comparison of micropurge and traditional ground water sampling for volatile organic compounds. Proceedings of the Petroleum Hydrocarbons and Organic Chemical in Ground Water Conference, National Ground Water Association, Westville, OH, pp 177-190.

- U. S. EPA 1996. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures. EPA/504/S-95/504, 12 p.

- U. S. EPA Region I 1996. Low Stress (low flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells. Revision 2, 13 p.

- U. S. EPA Region IX 1995. Use of Low-Flow Methods for Ground Water Purging and Sampling: An Overview. 4 p.

- U. S. EPA Region VIII 1994. Standard Operating Procedure for Well Purging. SOP #4.1, Revision 0, 22 p.

This document is based on current information. It will be revised as additional data is acquired and evaluated.

- Weaver, T. 1997. Case History: Low-Flow Rate Sampling at a RCRA Facility. IDEM Internal Memo, 4 p.