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INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Non-Purge Sampling Option at Petroleum Sites

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Notice

The Technology Evaluation Group (TEG) completed this evaluation of *The Non-Purge Sampling Option at Petroleum Sites* based on professional expertise and review of items listed in the "References" section of this document.

This evaluation applies to petroleum sites only and does not verify the effectiveness of the sampling technique in conditions not identified here. It cannot be used for metals, chlorinated VOCs, dense non-aqueous phase liquids (DNAPLs), or other pollutants. Mention of trade names or commercial products does not constitute endorsement or recommendation by the IDEM for use.

Background

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 approximately 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.

Problems Encountered

Traditional purging methods may present problems such as:

- Excessive agitation resulting in volatilization 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 (VOCs) (McAlary and Barker, 1987);

- 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, purged water at considerable handling expense, and some risk of additional spills.

Studies to determine actual well flow patterns, including direct observation of colloidal suspensions and dyes in wells, have changed previously held doctrine (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 in the screened section actually 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 below the screen) should be of "fresh" water, representative of the aquifer. Purging, with its attendant problems, could be avoided. Normally constructed wells do not have additional casing below the screen, restricting the depth of the sampling device. Stagnant water in the casing above the well screen is much more difficult to avoid. However, it should not be a factor in properly constructed wells measuring petroleum hydrocarbon contamination, because the screen is required to extend above the water table.

Research has reported on the feasibility of not purging at all in sampling wells used for petroleum hydrocarbon monitoring. A large study sponsored by the Western States Petroleum Association (1996) used 13 different contractors to take 556 paired (non-purged and purged) samples from 101 sites. Overall, the non-purged samples averaged 9.5% higher benzene, ethylbenzene, toluene, and xylene (BTEX) results than purged samples. Most of the variation was found in samples taken using bailers or vacuum trucks to purge the wells and from a few wells in coarse lithology. When these wells were removed from the data set, there was no difference in purged and non-purged samples at a 90% confidence level.

Another study by the California Regional Water Quality Control Board (Williams, et al, 1996) took 164 paired samples at 69 sites. Mean values for all BTEX components were slightly higher for non-purged samples than for purged ones. The cost for non-purging was 50% less than the purged sampling.

A similar study in New York by Shell (Byrnes, et al, 1996) utilized 168 paired samples from 13 sites, and found no significant difference at a 99% confidence level. No difference was found between samples from fine and coarse grained sediments.

Tests by Shell in Indiana analyzed 29 paired samples from 12 locations. No significant variations were found, except for two wells, both of which would be invalid for a non-purge sampling. One well had the screen below the water table, and the other contained free product.

Conclusion

These studies, and others like them, have demonstrated that purging may not be necessary under specific conditions when sampling petroleum hydrocarbon monitoring wells. Data are reliable, much time and money is saved, and waste handling and disposal problems of purged water are dramatically reduced.

The state of California allows non-purge sampling for petroleum hydrocarbon monitoring wells. The California EPA issued a guidance document (California EPA, 1997) detailing procedures, conditions, and exceptions. Such an approach has a benefit to Indiana. Besides the resources saved, much of this state is covered with low permeable soils, in which purging is difficult or impossible without running the wells dry, thus costing more time waiting for recharge and possibly biasing samples.

The Office of Land Quality, Science Services Branch, evaluated studies on well purging and sampling, and concluded that a non-purge (or "passive" – see below) sampling methodology may provide comparable results in most cases to purged petroleum hydrocarbon samples, with a significant saving in time, money and waste generated. If the two methods vary at all, petroleum hydrocarbon analytical results from non-purged samples tend to be slightly higher than purged samples, which will result in a more conservative remediation. Accordingly, this non-purge method can be used as an option for monitoring petroleum hydrocarbons, if the conditions outlined below are met. These requirements may be modified in the future, as additional information is acquired.

Please note that the term "passive sampling" pertains to devices that recover a grab sample such as Hydrosleeve™; devices that rely on diffusion of the analytes such as Polyethylene Diffusion Bag (PDB) samplers; and devices that rely on diffusion and adsorption to accumulate analytes such as Semi-Permeable Membrane samplers (ITRC 2007). This reference is included here to address confusion concerning the various passive sampling methods. This document does not apply to such uses or employment of these types of sampling systems.

Conditions for Utilizing the Non-Purge Option

1) The method can be utilized only for wells used to monitor petroleum hydrocarbons: BTEX and methyl-tert-butyl ether (MTBE). It cannot be used for metals, chlorinated VOCs, dense non-aqueous phase liquids (DNAPLs), or other pollutants.

2) Samples may be taken with bailers, in-well pumps, out-of-well pumps, or other equipment found to be appropriate.

3) Bladder pumps or centrifugal pumps are preferred over bailers. In site-specific cases peristaltic pumps may be used (IDEM 2017).

4) The Non-Purge Option is utilized only in unconfined aquifers.

5) The monitoring well must be properly constructed and developed (Indiana Water Well Drilling Rules 312 IAC 13).

6) The water table should be below the top of the well screen.

7) The monitoring well cannot contain free product.

8) If dedicated bailers are used, they cannot be stored within the well.

9) If a site closure is requested on a site that has been monitored by non-purge sampling, the final sampling event shall include both purged and non-purged samples from each well, to maintain consistency and satisfy closure requirements for each program.

10) The sampling methodology and procedures should be detailed in the sampling section of each corrective action plan.

11) Appropriate procedures should be used for non-purge sampling.

12) Provide in each monitoring report, listing the screen depth, and current water level of each monitoring well, showing fluctuations have not raised the water table above the well screens. If water is above the screened interval, other purging options should be used for that well.

13) Any observed unusual conditions (i.e. turbid samples, well dry after 1st bailer, no observed recharge, unusual location of pump intake, etc.) should be noted in the sampling report to IDEM.

Further Information

If you have any additional information regarding this technology or any questions about the evaluation, please contact the Office of Land Quality (OLQ) Science Services Branch (SSB) at (317) 232-3215. This technical guidance document will be updated periodically, or if new information is acquired.

References

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