Use of the Low-Flow Sampling Technique for Compliance Groundwater Monitoring at Resource Conservation and Recovery Act (RCRA) Facilities in the State of New Mexico

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Abstract: Currently, many sites use a traditional method of well purging and sampling: a specific, pre-calculated number of well volumes are removed (generally 3-5 well volumes) from the monitoring well prior to sample collection, indicator parameters are stabilized (if monitored), followed by collection of the sample. There are disadvantages of specific volume removal, including increased sample turbidity from agitation or mixing of the well water column, possible mobilization of colloids, and generation of large volumes of purge water. The predetermined number of well volumes is arbitrary, not well specific, and agitation can alter groundwater chemistry. Due to rising disposal costs, facilities are looking for new techniques to reduce the volume of water produced during purging. As a result, low-flow purging and sampling techniques for compliance groundwater monitoring at Resource Conservation and Recovery Act (RCRA) permitted facilities in New Mexico have become an important issue for both the facilities and the regulatory agency. The low-flow purging and sampling techniques attempt to reduce the amount of purge water generated, lower disposal costs and reduce sample turbidity eliminating the need for filtration. The New Mexico Environment Department guidance attempts to provide clarity and consistency, as well as examples of appropriate uses of low-flow techniques, for RCRA facilities in New Mexico.

Many factors contribute to the water chemistry results obtained from groundwater monitoring wells. Extensive planning and examination of the site-specific conditions must be conducted during the initial stages of monitoring well network design, installation, development, and operation and maintenance. If a well is not properly constructed and developed, zones other than the intended zone may be sampled (Puls and Barcelona, 1996). Proper development immediately following monitoring well installation is essential. Careful selection of the development technique must be based on the aquifer properties. In addition, documentation of indicator parameters during well development is essential to aid in the establishment of formation water characteristics and purging behavior for a specific well (Barcelona, Wehrmann, and Varljen, 1994). Finally, the correct monitoring well purging and sampling technique must be selected to collect the highest quality data possible.

Traditionally, a specific number of well volumes (3-5) was calculated and then removed from the well prior to sample collection. The water was typically removed utilizing bailers or a high purge and sample flow rate. This method has several disadvantages including increased sample turbidity, possible mobilization of colloids, and generation of large volumes of purge water for disposal. The predetermined number of well volumes is arbitrary and not site/well specific and agitation can alter groundwater chemistry. Low-flow purging and sampling techniques have been developed in an attempt to reduce the amount of purge water generated which will have a

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direct result on the disposal cost associated with purging a large diameter well or a high yield well. Low-flow purging will also reduce sample turbidity, eliminating the need for filtration.

There are significant differences between low-flow and no-flow, or micropurging. We also make a distinction between MicroPurge®, the tradename, and micropurging, the sample collection method. Micropurging refers to evacuation of tubing and sample device water prior to sample collection. Indicator parameters are not collected. Basically, the well is sampled at a low flow rate but is not purged prior to sample collection. Without purging the well before sample collection, there is no mechanism for determining if formation or stagnant well water is being sampled. This method does not provide evidence that the sample is representative of groundwater conditions in the vicinity of the well sampled. The New Mexico Environment Department (NMED) does not approve micropurging.

The low-flow method is related to the amount of drawdown in a well during purging. When using the low-flow method, indicator parameters are collected and allowed to stabilize prior to sample collection and purge rates may be higher than sample rates in order to maximize purge efficiency. Prior to the collection of the groundwater sample (following stabilization of the site-specific indicator parameters), the pump rate may be reduced in an attempt to reduce sample turbidity and entrained air in the sample and to mimic conditions that may exist in the natural aquifer. Although low-flow purging and sampling has been used at a variety of sites, it has mostly been tested in two-inch diameter wells; however, there is limited data on the use and performance (reliability and defensibility) of the results and use in larger diameter wells (Van Maltby and Unwin, 1992). Also, it is important to point out that low-flow purging and sampling results may not be indicative of the water chemistry in the entire screened interval, only the interval in the immediate vicinity of the pump.

In order to consider a well for low-flow purging and sampling the well should be properly constructed and meet specific well selection criteria. The criteria to be evaluated include well construction details, aquifer characteristics, wellhead completion, screen lengths and stabilization of groundwater chemistry parameters during purging. If the well meets the selection criteria, and a low-flow purging and sampling approach is used, groundwater chemistry indicator parameters should be selected based on site specific conditions. The use of well-dedicated equipment is suggested, but not required. If non-dedicated equipment is used, the well water should be allowed to equilibrate prior to purging and sample collection. The procedure for low-flow purging and sampling is outlined in detail in NMED guidance and includes the selection of the proper pump, tubing size and material, water level measurements and monitoring of indicator parameters. NMED approves the use of low-flow purge and sampling, as long as the well meets the selection criteria and the low-flow procedure is followed. Any variation from the procedure for low-flow purging and sampling must be submitted in writing to NMED for approval prior to implementation.

Finally, when conducting low-flow purging and sampling for metals, filtration of the sample prior to analysis is not required by RCRA. EPA Regions 1-10 require metals in water to be unfiltered in an attempt to emulate drinking water standards; however, some regulatory agencies in New Mexico have standards for metals in filtered groundwater. Since there may be instances where metal samples are being collected to satisfy multiple regulatory authorities, it is important

to coordinate with the regulatory agencies to determine if both unfiltered and filtered samples need to be collected or a variance may be granted to collect only unfiltered samples using the low-flow method.

Other methods of sampling may also be used to collect groundwater samples from a monitoring well without the generation of purge water. The passive sampling technique allows for the collection of a representative groundwater sample by allowing a sample device to equilibrate with the groundwater in a well over time. Basically, diffusion across a membrane occurs causing the sample device to fill with groundwater that is analyzed for specific constituents. This method assumes that groundwater in the well is representative of water in the formation surrounding the well. In addition, the diffusion multi-layer sampler (DMLS^{TM}) is a passive sample technology which is capable of collecting discrete samples from a monitoring well in a passive (no purging or exertion of external energy required to collect the groundwater sample) manner. Discrete sampling systems, such as the Waterloo Profiler^{TM} or Westbay® system, are designed to collect groundwater samples from the formation without extensive purging prior to sample collection. Discrete sampling systems may be designed to collect groundwater samples at targeted sample intervals or from multiple zones.

The monitoring well purging and sampling method selected for a specific well or group of wells is dependent on many site-specific variables. It is important to stress the importance of initial planning, proper selection of well location, proper selection of well construction material, proper installation technique, well completion, and well development. If these factors are not considered, the well may not be properly installed or may even be installed in the improper location and data obtained from the monitoring well may be of suspect quality. Once it has been determined that the well has been properly constructed, installed and developed, the correct monitoring well purging and sampling technique may be selected.

Regardless of the method of purging and sampling selected at a site, it is important to be familiar with the equipment being used. It is also important to follow the same purging and sampling procedure each time to obtain data that is reproducible. The goal of any purging and sampling program should be to collect the highest quality data possible. All aspects of the monitoring well design, installation, construction, and development need to come together to obtain high quality data that is reproducible and defensible.

References

Barcelona, M.J., H.A. Wehrmann, and M.D. Varljen, 1994. "Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling." Groundwater. Volume 32, No. 1, pp.12-22.

Puls, Robert W., and Michael J. Barcelona, 1996. "Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures." EPA Groundwater Issue, April 1996, 10 Pages. EPA/540/S-95/504

Van Maltby and Jay P. Unwin. "A Field Investigation of Groundwater Monitoring Well Purging Techniques." Current Practices in Groundwater and Vadose Zone Investigations, ASTM STP 1118. Ed. David M. Nielsen and Martin N. Sara. Philadelphia: ASTM, 1992, pp.281-299.