HAZARDOUS WASTE BUREAU

New Mexico Environment Department

Position Paper ***Position Paper***

Use of Low-Flow and Other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring[1]

1. Scope

Currently, many sites use a traditional method of well purging and sampling, which involves removal of a specific pre-calculated number of well volumes from the monitoring well prior to sample collection. Due to rising disposal costs, some Resource Conservation and Recovery Act (**RCRA**) permitted facilities in New Mexico are looking for ways to reduce the volume of water produced during purging and are exploring alternative sampling techniques. As a result, purging and sampling techniques for compliance groundwater monitoring have become an important issue for both facilities and the regulatory agency. The Hazardous Waste Bureau (**HWB**) of the New Mexico Environment Department (**NMED**) developed the following guidance regarding low-flow and other non-traditional sampling methods to promote clarity and consistency. This HWB position paper is intended to provide guidance to the regulated community and assist with preparation of written requests to HWB for sampling deviations based on site-specific conditions. The selection of a sampling technique depends on well and site conditions. HWB outlines the selection criteria for low-flow well purging and sampling in this document. Information is provided for the appropriate use of the low-flow technique in order to obtain RCRA compliant groundwater monitoring results that are defensible and reproducible. Other non-traditional sampling techniques are also discussed.

2. Background

[1]This document is intended as guidance for employees of the Hazardous Waste Bureau (HWB) and RCRA-regulated facilities within the State of New Mexico. This guidance does not constitute rule making and may not be relied upon to create a right or benefit, substantive or procedural, enforceable at law or in equity, by any person. HWB may take action at variance to this guidance and reserves the right to modify this guidance at any time without public notice.

The objective of sampling is to obtain groundwater samples that are representative of aquifer conditions. However, many factors contribute to the water chemistry results obtained from groundwater monitoring wells. Laboratory analytical methods for most analytes and sample types are well established and carefully documented. Errors associated with the collection and handling of a sample generally exceed those associated with the analysis. The site-specific conditions must be fully evaluated during the initial stages of monitoring well network design, construction, installation, development, and during well operation and maintenance. If a well is not properly constructed and developed, zones other than the intended zone may be sampled (Puls and Barcelona, April 1996). Proper development following monitoring well installation is required prior to sampling. Selection of the development technique must be based on the aquifer properties encountered during well drilling and other site-specific factors. No sampling technique can overcome an improperly designed or developed well. Guidelines for proper well development (with the exception of open-borehole bedrock wells) can be found in ASTM D5521-94. Documentation of indicator parameters during well development is useful to aid in the establishment of purging behavior for a specific well.

With the traditional sampling technique, three to five well volumes are removed from the well prior to sample collection. Indicator parameters are collected during the purging process. Once the indicator parameters have stabilized, a groundwater sample is collected. This method has its advantages, some of which include: easy calculation and removal of a set volume of water, a variety of equipment can be employed (some of which is relatively inexpensive, e.g., disposable bailer) and it is a commonly accepted method. Disadvantages of this technique include: increased sample turbidity resulting from agitation or mixing of the well water, mobilization of colloids which may not be mobile under natural conditions[2], failure to ensure that stagnant[3] water is removed from the well prior to sampling, generation of large volumes of purge water, especially in large diameter wells, and arbitrary removal of a specific number of well volumes because the purge volume calculation is not site-specific.

Low-flow purging and sampling techniques have been developed to eliminate some of the potential problems associated with traditional sampling methods including: reduction in the amount of purge water generated, directly resulting in a reduction in disposal costs associated with purging a well, reduction in sample turbidity eliminating the need for filtration, attainment of better quality samples, and sample collection in a manner that minimizes disruption to the monitoring well (Powell and Puls, 1997). Although low-flow purging and sampling has been used at a variety of sites, it has primarily been tested and used in two-inch diameter wells. Initially there were limited data available on its performance in wells greater than 2-inches in diameter (Van Maltby and Unwin, 1992), but more recent information indicates that sufficient results may be obtained from larger diameter wells (Shanklin, Sidle, and Ferguson, 1995). Also, it should be noted that low-flow purging and sampling

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[2]Natural conditions refer to conditions that are assumed to exist in the aquifer under flow conditions that are not under stress due to pumping.

[3]Stagnant water is water that has been standing in the casing for a period of time and may be chemically different from formation water due to off-gassing or other chemical processes that may have occurred while the water remained in the casing.

results might not be indicative of water chemistry in the entire screened interval. Generally, low-flow purging and sampling water chemistry results will be indicative of the screened interval surrounding the pump intake. This can also be true when using traditional sampling techniques because the screened interval might cross variable stratigraphy, some of which yield water more readily than others. Therefore, it is best to minimize the overall length of the screened interval, if possible, and place the pump in the targeted contaminant zone that is representative of plume conditions.

HWB makes a distinction between low-flow and micropurging methods. There are major differences between low-flow and micropurging sampling techniques and the terms cannot be used interchangeably. In addition, HWB distinguishes between micropurging, the sampling method, and MicroPurge®[4], the trade name. To avoid further confusion, HWB will avoid using the terms MicroPurge® and micropurging interchangeably.

For the purpose of this document, micropurging refers to evacuation of water from the sample collection tubing and the sample device prior to sample collection. 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 whether formation or standing well water is being sampled. This method leads HWB to question the sample results and whether the sample is representative of groundwater conditions in the vicinity of the well. In some cases, this may also be a problem for the traditional method of sampling low-yield wells that are pumped dry, then allowed to recover and sampled once water has recharged the well.

3. Definitions

HWB provides the following definitions for use throughout this document. Most of these terms are not currently defined by standards organizations and may be used differently in other publications.

Discrete Sampling Device: A device or system that is installed in a monitoring well and collects a groundwater sample from targeted single interval or multiple zones.

High Flow Rate Sampling: Evacuation of water from the screened interval of a monitoring well at a rate that significantly exceeds natural flow through the screen (Barcelona, Wehrman, and Varljen, 1994) or the groundwater flow velocity for which the well was designed. High pumping rates of groundwater from the monitoring well may cause undue stress on the well screen or sand pack, shorten the usability and life span of the well, cause excessive turbidity, or may cause other damage to well construction. High flow rates coupled with long screen lengths (greater than 20 feet) can also yield false contaminant plume locations and, in some cases, incorrect contaminant concentrations (Powell and Puls, 1997). Long screens can result in the interconnection of different permeable zones that may cause misleading sample results.

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[4] The use of trade names does not imply endorsement by HWB.

Low-Flow Purge and Sampling: Minimal drawdown[5]. This approach allows for indicator parameters (e.g. dissolved oxygen, pH, temperature, and specific conductance) to be monitored and allowed to stabilize during well purging. Low-flow purging and sampling rates generally range from 0.1 to 1.0 liter per minute (**L/min**) using a pump. Bailers are not acceptable for use in low-flow well purging. The actual purge rate is site-specific and may vary slightly from the range provided (Powell and Puls, 1997). Steady-state drawdown in the casing should occur if the pumping rate is sufficiently slow. Drawdown should be kept to a minimum. For wells that recharge at a rate insufficient for the use of low-flow purging and sampling, another method must be used. Employing a lower pumping rate is an attempt to approach natural flow conditions in the formation surrounding the well and produce a less turbid[6] and more representative groundwater sample.

MicroPurge®: A low-flow sampling system developed, designed, and marketed by QED Environmental Systems, Inc. (QED). It may include the following components: flow control device, pneumatic power supply, power and flow control device, parameter stabilization system (to collect indicator parameters and determine when stabilization has occurred within the well), a drawdown meter, and a pump system. The system is designed to collect a representative and reproducible groundwater sample at a low-flow rate with minimal drawdown, using a dedicated or portable pump, with collection of indicator parameter values for the determination of stabilization prior to sample collection. Although QED equipment can be used for low-flow purging and sampling, equipment from other manufacturers is available.

Micropurging: (synonymous with **no-flow**) Evacuation of water from the sample device and tubing prior to sample collection. The sample is collected from standing water in the well; meaning an inadequate amount of water is evacuated from the well casing prior to sample collection. Indicator parameters are generally not measured; however, if measured they are representative of water present in the tubing device, not formation water. There is not a mechanism for determining whether stagnant casing or formation water is being sampled when collected from a standard completion monitoring well using this method since drawdown is not measured. In addition, water level fluctuations are not accounted for. Micropurging and no-flow assume that groundwater is constantly moving through the well screen and that the residence time of water in a well is minimal. In addition, vertical gradient and groundwater flow direction, which may vary from time to time, are not accounted for causing a high degree of variability in sample results. This method should not be confused with MicroPurge®, which is actually a low-flow sampling system.

No-Purge: Sampling groundwater from a well without any removal of water from the well prior to sampling (Newell, Lee, and Spexet, 2000).

Passive Sampling: Collection of a groundwater sample without the ongoing expenditure of external energy. Typically, a sample device is lowered into the well and allowed to equilibrate.

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[5]Drawdown of 0.1 meter (0.3 feet), based on site-specific hydrogeology is recommended; however, greater drawdown may be acceptable based on site-specific conditions (USEPA, 1995).

[6]Generally less than 5 Nephelometric Turbidity Units (**NTU**), although this is a site-specific value and may change based on site-specific hydrogeologic conditions.

Theoretically, diffusion across a concentration or electrochemical gradient occurs causing the collection of a water sample in the screened interval.

Traditional Sampling Method: Evacuation of three to five well volumes of water from a monitoring well prior to collection of a groundwater sample. Pumps or hand bailing equipment are typically used and many times the pumps are operated at high flow rates. Indicator parameters may be collected during purging and used to determine if the well has stabilized. Often the well is purged based solely on volumetric calculations.

Vertical Profiling (of monitoring wells): The collection of formation water samples along the screened interval using a low-flow or passive method to characterize the contaminant profile of the monitoring well. Samples should be collected at approximately two-foot intervals along the screened section of the well if information regarding permeable zones is unknown (based on drilling logs or geophysical information obtained from the well). If information regarding permeable zones is known, samples should be collected from the targeted permeable zones. If the screened interval is located in only one permeable zone (and supporting documentation is available), the pump location should be set at the mid-point or slightly above the mid-point of the screened interval (USEPA, 1996). Once the contaminant profile is established, proper pump placement may be determined. Re-evaluation of pump placement should be conducted periodically to ensure proper placement over time.

4. Description of Low-Flow Technique

Low-flow is related to the amount of drawdown in a well during purging and the rate at which the well is purged. During the purging process indicator parameters are collected and allowed to stabilize prior to sample collection. 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 pumping rate may be reduced. A reduced pumping rate more closely mimics natural aquifer conditions.

Once the well has met the selection criteria (*Low-Flow Well Selection Criteria*, Section 5), approval from HWB must be granted prior to changing sampling methodology for the well or at the site. This approval may require the applicant to submit new or revised standard operating procedures (**SOPs**) or other quality assurance documentation. The applicant should submit a revised sampling plan containing detailed information regarding the site hydrologic properties, the frequency and methodology of indicator parameter collection (as well as the indicator parameters to be measured), detailed lithologic logs, pump placement, tubing size, and contingencies to be implemented in the event indicator parameter stabilization cannot be achieved or equipment failure occurs. The applicant must submit the results of the initial vertical profile, if required, conducted to determine pump placement. HWB recommends a vertical profile be conducted if conditions change at the site (water table fluctuation, gradient changes due to pumping, or other factors). The actual frequency will be site-specific. Vertical profiling, where appropriate, will be required on a well-by-well basis as opposed to a site-wide basis. Vertical profiling will not be required if adequate geologic information is collected during drilling. Each well will be treated independently; therefore it is important to have construction and lithologic information for each well, as well as information regarding well development.

5. Low-Flow Well Selection Criteria

Once the well has been properly installed and developed, the sampling methodology for the well can be fully evaluated. Pre-approval from HWB is required to determine if the well or group of wells is appropriate for low-flow purging and sampling. In order for a well to be a potential candidate for the low-flow technique the following criteria must be met and documented to HWB for review and approval:

- Well construction details (detailed installation logs containing lithologic and well construction information or geophysical logs) are required;

- The wellhead must be constructed according to current State and EPA guidance and not allow for surface water infiltration into screened intervals. In addition to proper wellhead completion, screened intervals of the well must be properly sealed to prevent communication between saturated zones (if applicable) and/or surface infiltration;

- The screened interval of the monitoring well should be short[7]. Optimal screen length should be less than 10 feet (USEPA, March 1998). Low-flow purging and sampling may be approved for use in wells with screen lengths greater than 10 feet, provided pump intake placement is demonstrated to be appropriate. Wells with screened intervals connecting intervals of different head and/or hydraulic conductivity may act as conduits for vertical flow within the screened interval (Stone, 1997);

- Wells constructed across multiple perched or groundwater zones must be excluded unless they are constructed using devices that seal off discrete zones to eliminate communication between zones or unless they are constructed using a system designed to collect multi-level groundwater samples (discrete sampling systems);

- Drawdown must be measured and recorded during purging. The formation water must be recharging the well at a rate that is equal to the rate at which water is being removed from the well. If a well is pumped dry during purging, an alternate method[8] must used for sample collection; and

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[7] In guidance titled "NM Environment Department - Groundwater Section Monitor Well Construction and Abandonment Guidelines" a minimum 20-foot screened section for monitor wells (5 feet of screen above the water table to allow for seasonal water table fluctuations) is required. Note that a variance from the GWQB requirement may be requested by submitting a written request to the GWQB, if the site falls under more than one regulatory authority. HWB recommends that screened intervals be less than 10 feet unless the screened interval crosses the water table, in which case longer screen lengths are acceptable.

[8]For wells with insufficient recharge during sustained pumping where stabilization of indicator parameters cannot be achieved, samples shall be collected in the following manner (using a properly selected pump): collect indicator parameters, when the well purges dry the sampler shall note so in the log book and include the total volume of water removed, once the well is allowed to recover the sample shall be collected. Indicator parameters should be collected from the well prior to sample collection. If the well purges dry for four consecutive quarters or one year, the use of the well as a compliance monitoring point will need to be re-evaluated.

- Dedicated sampling equipment is preferred. If dedicated sampling equipment is not available, equipment must be installed prior to sample collection to allow well conditions to equilibrate prior to initiation of purging and sampling. Generally, equipment should be installed a minimum of 12 hours prior to sample collection. A shorter time period may be requested, if appropriate. If the use of bailers is planned, low-flow purge and sampling techniques cannot be employed.

6. Low-Flow Sampling Procedure

- Select the proper pump in order to avoid aeration, agitation, volatilization, or chemical interference during sampling. Selection of the proper pump is essential to obtaining valid and defensible sample results. Some pumps are not able to pump at a very low pumping rate without generating a large amount of heat, which may have a direct impact on temperature measurements (Giles and Story, November 1997). In addition, heat generation may cause the sample to off-gas possibly decreasing the concentrations of some chemicals, particularly volatile organic compounds (**VOC**) or semi-volatile organic compounds (**SVOC**).

- Select the proper tubing size and tubing material. In order to prevent air bubbles and other potential problems, a maximum tubing size of ¼ to ⅜ inch inside diameter (**ID**) is recommended (USEPA, March 1998). The type of tubing material (e.g., Teflon®, polyurethane, silicone) may influence the sample quality due to water interaction (i.e., leaching and sorption) with the tubing material. Excess surface tubing should be minimized in an attempt to avoid heating or cooling of the water by the atmosphere before temperature measurements are collected.

- Select the water quality indicator parameter measuring device. HWB recommends the use of in-line or flow-through cell monitoring equipment, but recognizes some facilities may have more limited instrumentation. In-line or flow-through cell equipment is recommended in order to minimize sample contact with the atmosphere, which may alter sample temperatures and results through the introduction of air. HWB recommends the use of dedicated equipment, however, portable equipment may be used. By using equipment dedicated to a specific well, decontamination time and cost will be eliminated, further reducing the volume of water generated during purging. In addition, preparation time will be decreased and the amount of variability introduced by the use of different sampling equipment will be reduced.

- If well-dedicated equipment is not used, equipment should be installed in the well a minimum of 12 hours prior to the purging and sampling event to allow the equipment to equilibrate with well conditions. HWB recognizes site-specific conditions may not allow for the equipment to be installed prior to the sampling event, however, every attempt should be made to allow the equipment to equilibrate prior to purging and sampling.

- Water levels must be measured prior to purging. Water levels should be monitored at 5-minute intervals during purging to ensure that minimal drawdown is occurring in the well during the purge event. If excessive drawdown is noted during the purge event, the flow rate must be adjusted until minimal drawdown is achieved.

- Begin purging the well at a pre-determined low-flow rate based on site and well-specific characteristics. If the water-yielding ability of the well is unknown, low-flow purging can be initiated at approximately 100 ml/min (0.1 L/min) and the drawdown measured. Based on results, the purging rate may be increased incrementally up to approximately 500 ml/min (0.5 L/min), but should not exceed 1 L/min.

- Monitor indicator parameters at least every 5 minutes until stabilization is achieved. The well is considered to be stable when the indicator parameters have stabilized over three consecutive readings spaced a minimum of 5 minutes apart and when indicator parameters fall within the ranges shown in Table 1.

Table 1. Indicator Parameter Stabilization

±0.5 pH	±10% Specific conductance	±10% Temperature	±10% Dissolved oxygen (DO)	±10% turbidity (if appropriate)

- Collect groundwater samples if minimal drawdown is achieved during purging. If the well consistently purges dry, an alternate purge method will be needed. Since each site is different and the contaminants of concern vary, analytical requirements will vary from site-to-site or well-to-well. In general, samples for VOC and SVOC analysis should be collected first.

- If well-dedicated equipment is not used, equipment must be properly decontaminated prior to use in a different well. In this case, wells should be sampled from lowest to highest contamination concentration in an attempt to minimize cross-contamination.

7. Low- Flow Sampling for Metals

RCRA and the New Mexico Water Quality Control Commission (**WQCC**) have different requirements for collection of groundwater samples for metals analyses. RCRA requires unfiltered inorganic groundwater samples in an attempt to emulate drinking water maximum contaminant levels (**MCLs**). However, the NMED Groundwater Quality Bureau (**GWQB**), which derives its regulatory authority from the WQCC regulations, requires filtered samples. It is important to identify the purpose of the metals sampling (characterization, risk assessment, or monitoring) to determine if filtered or non-filtered samples should be collected. Since NMED may use WQCC standards and/or standards based on drinking water MCLs, there are instances when HWB may require the collection and analyses of both filtered and unfiltered samples. Generally, unfiltered groundwater samples are collected to determine total metal content, while filtered samples are collected for dissolved or suspended metal content in groundwater. Dissolved and total metals data cannot be used interchangeably.

Filtration is used in an attempt to eliminate sampling-induced turbidity. Generally, when samples are filtered in the field prior to analyses a 0.45-micron (µ**m**) filter is used. Field filtration should not be used in an attempt to compensate for poor well construction or inadequate well development. Groundwater samples that are filtered in the field prior to chemical analyses will not provide accurate information regarding metals mobility because some metal species are mobile as colloidal-sized particulates and are likely to be removed by filtration (Puls and Barcelona, 1989). In addition, the Regional Superfund Groundwater Forum (a group of groundwater scientists) concluded that the use of a 0.45 µm filter was not useful, appropriate or reproducible, and that using a filter prior to metals analyses is not appropriate to determine "truly dissolved" constituents in groundwater samples (Puls and Barcelona, 1989). If properly conducted, low-flow purging and sampling for metals without sample filtration can provide an estimate of metals that may be mobile in groundwater, including both dissolved and naturally mobile particulates.

Since the low-flow purging and sampling technique is designed to reduce turbidity in groundwater samples (typically less than 5 NTU unless naturally mobile particulates exist in greater quantities), field filtration is not necessary. If groundwater generated during low-flow purging and sampling is in excess of 5 NTU, re-evaluation of the sample method and procedure should be conducted prior to sample collection and analysis. It may be necessary to conduct additional purging until the groundwater is below 5 NTU or further development of the well may be needed before metals sampling can be conducted.

8. Low-Flow Sampling Using Discrete Samplers

Discrete sampling systems are used to collect groundwater samples from the formation, not standing well water, without extensive purging prior to sample collection. Discrete samplers can be designed to collect groundwater samples from pre-determined targeted sample intervals or from multiple zones. Discrete samplers have many advantages, but can be expensive. Although the initial expense to purchase and install the equipment may be high, in the long term the amount of purge water generated is minimal and over the life of the well or sampling project, disposal costs can be significantly reduced. Examples of discrete sampling devices or systems include, but are not limited to: Multiport Sock Samplers (Jones, Lerner, and Baines, 1999), the WaterLoo Profiler™, and Westbay® sampling systems.

A type of discrete sampling device used for multi-layer groundwater sampling is the Multiport Sock Sampler produced and tested by the Ground Water Protection and Restoration Research Unit **(GWPRRU)**. Sock samplers are constructed of inexpensive materials and can be used in open boreholes to collect discrete groundwater samples (Jones, Lerner, and Baines, 1999).

The Waterloo Profiler™ is a tool that can be used to collect depth-specific groundwater samples using a direct-push groundwater-sampling tool. This method of sample collection can be used during the investigation phase (when direct-push technology is used) to collect a vertical groundwater profile for a specific location. The Waterloo Profiler™ collects the groundwater sample through screened ports or openings in the tip of the sample tube. The ports are connected to an internal fitting inside the tool and the water sample is brought to the surface inside the pipe using stainless steel or Teflon tubing (Precision, 1997).

Westbay® is a specific type of discrete sampling system that is designed to collect a representative groundwater sample from formation water with minimal purging. It contains a specialized sample casing that is designed and inserted into a borehole to collect discrete multi-level groundwater samples. Following installation, the system is purged to induce groundwater flow in an attempt to restore the formation to natural flow conditions, as existed prior to well installation. After proper well development and initial purging of the system, samples are collected from the Westbay® system without extensive purging because the sample is collected using valved port couplings along that casing that access the aquifer directly. Hydrostratigraphy must be determined to properly place the sampling ports. The monitoring and sampling system consists of casing components that allow a borehole to be completed at one monitor zone or many discrete monitoring zones. The inner casing contains sealed valves along its entire length to prevent groundwater from flowing in or out of the casing until the valves are opened. Casing packers seal the borehole between monitoring zones to prevent vertical flow of groundwater between zones. Electronic and mechanical probes and various sampling tools may be lowered inside the casing to measure various parameters (fluid pressure, temperature, and hydraulic parameters) and to collect groundwater samples. Monitoring zones are sampled using any number of valved port couplings that can be operated by the probe. A set volume of water is removed by sending pressure evacuated sample bottles down the well to the appropriately valved port. The bottles are filled when the sample ports are opened. Generally, sample bottles ranging from 250 to 1000 milliliters (**ml**) are used. HWB recommends discarding the first sample bottle collected. The number of bottles sent down the well is determined on a site-specific basis and depends on site analytical requirements.

Pre-approval from HWB is required prior to design, construction, installation, initial purging, and compliance sampling of a discrete sampling system.

9. Description of Micropurging, No-Flow and No-Purge Techniques

Micropurging, which is synonymous with no-flow, is often confused with low-flow (minimal drawdown) purge and sampling techniques, but the two methods are not the same and **cannot** be used interchangeably. Micropurging involves removal of water from the sample tubing and sample device prior to sample collection. Basically, micropurging and no-flow are considered to be sampling without purging. Micropurging does not have a mechanism to verify that the sample results are indicative of water quality in the formation surrounding the well. The water obtained has the potential to be stagnant, increasing the potential that off-gassing or volatilization to occur. If the sample has off-gassed or volatilization has occurred, results obtained may be biased.

Although the fact that groundwater is always moving through the system or within the aquifer is accepted within the environmental community, micropurging assumes that water is constantly flowing or being flushed through the well screen at a steady rate. The rate at which groundwater moves is not always the same. Several factors, including seasonal fluctuation, pumping, extreme drought or wet periods, and recharge rates can have an impact on the movement of groundwater causing the flow rate to vary over time. Vertical flow in the screened interval is not taken into consideration when the micropurging technique is employed. The micropurging method assumes groundwater flow is horizontal in the screened interval and does not account for vertical flow that may be an important factor, especially in wells with long screened intervals (Stone, 1997). If a well is not purged prior to sample collection, sample results will vary over time because the residence time of well water varies, as does flow direction. If the water is recharging slowly, residence time may be increased within the well. The standing water present in the well casing may volatilize or off-gas causing the water quality results to be biased or the pH of the water to be potentially altered due to microbial action caused by exposure to the air in the well casing, which may affect metals mobilization. Based on these reasons, HWB does not approve micropurging methods.

No-purge is another alternative sampling technique. Purging is not actually performed when this method is employed; the well is simply sampled. This raises the question as to whether the sample results are valid (other than observing the presence or absence of particular constituents in groundwater). This method also assumes water is constantly moving through the screened interval, and does not account for the presence of stagnant or standing water in the well. Although this method of sample collection is extremely cost effective, not labor intensive, and requires little time (when compared to low-flow and traditional purging and sampling), samples obtained from the well are not representative of groundwater in the vicinity of the well. The American Petroleum Institute (**API**) (Newell, Lee, and Spexet, 2000) and the Western States Petroleum Association (**WSPA**) (SECOR, 1996), indicate that samples collected from monitoring wells at petroleum contaminated sites using the no-purge method "are not statistically different or provide conservative results" compared to samples collected from monitoring wells that are purged and indicator parameters stabilized. Also, these documents indicate that no-purge samples should be collected "where high-precision sampling is not needed" and "should be supplemented with conventional or low-flow techniques for key datasets." No-purge sampling may be appropriate to determine presence or absence of groundwater contamination, but is unacceptable for RCRA compliant groundwater monitoring. No-purge is not approved for use by HWB because it does not provide adequate data for RCRA compliant groundwater monitoring.

10. Other purging methods

Passive sampling can also be utilized to collect a groundwater sample. Passive sampling generates no purge water because the sample is obtained by diffusion or natural flow of groundwater. A sampling device is lowered into a well and allowed to equilibrate within the well water for a specific period of time. The device is then removed from the well and a sample is sent to the laboratory for analysis of target analytes. For a sampling program at a site use of a passive method has obvious advantages, including the fact that no purge water is generated when this method is employed. By eliminating purge water, waste disposal costs for a well or group of wells are reduced. It should be noted that air sensitive field parameters (Eh and DO) cannot be considered accurate when using these systems because no flow-through cell is used and these parameters must be measured in open air.

Two examples of passive sample devices are a passive diffusion membrane sampler and a diffusion multi-layer sampler (**DMLS**™). DMLS™ is an example of a multi-layer sample device for the collection of groundwater samples from targeted intervals within a 2-inch or 4-inch inside diameter monitoring well. Rods and sampling cells, which are filled with distilled water and covered with a membrane, are lowered into the well. When equilibrium is reached the sampler is removed for laboratory analysis. Based on product literature, groundwater samples obtained using the DMLS™ can be analyzed for major ions, trace metals, organic contaminants, gases and various contaminants. Theoretically, the DMLS can be used to collect vertical chemical distribution data, sample in low permeability zones, and in highly turbid environments (USF/Johnson, 5120). Other passive diffusion membrane samplers are designed to collect groundwater samples utilizing a deionized water-filled, low-density polyethylene diffusion membrane sampling device that is inserted into the well, allowed to equilibrate over time, then removed for analysis (Rennie and Chapman, 1999).

The use of passive sample devices requires prior approval from HWB. These technologies are new and currently evolving and may not be applicable to many site conditions.

11. Summary

The terms micropurging and low-flow have been used synonymously, when in fact they mean very different things. MicroPurge® is a trade name, while micropurging refers to a sampling method of water removal from the sample device and tubing prior to sample collection. When using the micropurging method, water may not be flowing into the well, recharging the water around the sample point. A determination as to whether stagnant well water or formation water is actually being sampled cannot be made. Micropurging is not approved by HWB.

The low-flow method is related to the pumping rate and amount of drawdown measured in the well during purging. Indicator parameters are collected and allowed to stabilize before sample collection. Also prior to sample collection, the pumping rate may be reduced in an attempt to reduce sample turbidity and entrained air in the sample and to mimic natural conditions in the aquifer.

In order to consider low-flow purging and sampling, the well must meet the *Well Selection Criteria* in Section 5. If the well meets the selection criteria and a low-flow purging and sampling approach is selected, indicator parameters are chosen based on site-specific conditions and low-flow sampling equipment may be installed in the well. The use of well-dedicated equipment is suggested, but not required. If non-dedicated equipment is used, it must be allowed to equilibrate. The procedure for low-flow purging and sampling is outlined in detail in Section 6, *Low-Flow Sampling Procedure*. Written requests that specify the proposed use of low-flow purging and sampling, summarize the well selection criteria and follow the correct sampling procedures must be submitted to HWB for prior approval. Variations from the described low-flow purge and sampling technique described herein must also be submitted in writing to HWB for approval prior to implementation.

Finally, when conducting low-flow purging and sampling for metals, filtration of the sample prior to analysis is typically not required by HWB. However, WQCC regulations dictate groundwater standards for filtered metals samples. Since there may be instances where metals samples are being collected to satisfy both RCRA and WQCC, it is important to check with the regulatory agency to determine if both unfiltered and filtered samples need to be collected or if a variance should be requested to collect only unfiltered samples using the low-flow method.

The monitoring well purging and sampling method selected for a specific well or group of wells depends on many site-specific variables. Initial planning, the proper selection of well locations and well construction materials, proper installation techniques and well completion and development are very important. 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 suspect. 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 properly train sampling personnel to use the equipment. It is also important to follow the same purging and sampling procedure each time to obtain data that are reproducible and comparable. The goal of any purging and sampling program should be to collect the most representative, highest quality data possible.

Regulatory agency approval is important for appropriate monitoring well design, construction, and development. When considering a low-flow purge and sampling program for a well, the regulatory agency should be notified and, if possible, involved in the initial planning. The same is true for any non-traditional sampling system being considered for a site.

REFERENCES

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