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Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations[1]

This standard is issued under the fixed designation D 6771; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the method for purging and sampling wells and devices used for ground-water quality investigations and monitoring programs known as low-flow purging and sampling. This method is also known by the terms minimal drawdown purging or low-stress purging. This method could be used for other types of ground-water sampling programs but these uses are not specifically addressed in this practice.

1.2 This practice applies only to wells sampled at the wellhead.

1.3 This practice does not address sampling of wells containing either light or dense non-aqueous-phase liquids (LNAPLs or DNAPLs).

1.4 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "standard" in the title means that the document has been approved through the ASTM consensus process.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)[2]

D 5088 Practice for Decontamination of Field Equipment Used at Non-Radioactive Waste Sites[2]

D 5092 Practice for Design and Installation of Ground-Water Monitoring Wells in Aquifers[2]

D 5521 Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers[2]

D 5903 Guide for Planning and Preparing for a Ground-Water Sampling Event[3]

D 6026 Practice for Using Significant Digits in Geotechnical Data[3]

D 6089 Guide for Documenting a Ground-Water Sampling Event[3]

D 6452 Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations[3]

D 6517 Guide for Field Preservation of Ground-Water Samples[3]

D 6564 Guide for Field Filtration of Ground-Water Samples[3]

D 6634 Guide for the Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells[3]

3. Terminology

3.1 *drawdown (low-flow purging and sampling), n*—lowering of the water level in a well caused by pumping the well.

3.2 *entrance velocity, n*—the velocity with which formation pore water passes through a well screen during pumping of the well. This velocity should be controlled (held to less than 0.10 ft/s or 3.0 cm/s) to avoid turbulent flow through the screen and to minimize or eliminate deleterious effects on water chemistry and on well construction materials.

3.3 *low flow, n*—refers to the velocity that is imparted during pumping to the formation pore water adjacent to the well screen. It does not necessarily refer to the flow rate of water discharged by a pump at the surface.

4. Summary of Practice

4.1 Low-flow purging and sampling is a method of collecting samples from a well that, unlike traditional purging methods, does not require the removal of large volumes of water from the well. Low-flow purging differs from traditional methods of purging (as described in Guide D 6452) in that its use is based on the observations of many researchers that water moving through the formation also moves through the well

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground-Water and Vadose Zone Investigations.

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[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 04.09.

screen. Thus, the water in the screen is representative of the formation water surrounding the screen. This assumes that the well has been properly designed, constructed, and developed as described in Practice D 5092 and Guide D 5521. In wells in which the flow through the screen or intake zone is limited by hydraulic conductivity contrasts (for example, borehole smearing, residual filter cake, filter pack grain size, or well screen open area), the head difference induced by low-flow pumping provides an exchange of water between the formation and the well. Low-flow purging involves removing water directly from the screened interval without disturbing any stagnant water above the screen. This is done by pumping the well at a low enough flow rate to maintain minimal drawdown of the water column within the well as determined through water-level measurement during pumping. The objective is to pump in a manner that minimizes stress to the ground-water system to the extent practical, taking into account site sampling objectives. Pumping at low rates, in effect, hydraulically isolates the column of stagnant water in the well and negates the need for its removal prior to sample collection. Typically, flow rates on the order of 0.1 to 0.5 L/min are used; however, this is dependent on site-specific and well-specific factors **(1)**. Some very coarse textured formations have been successfully purged and sampled in this manner at flow rates up to 1 L/min. Pumping water levels in the well and water-quality indicator parameters (such as pH, temperature, specific conductance, dissolved oxygen and redox potential) should be monitored during pumping, with stabilization indicating that purging is completed and sampling can begin. Because the flow rate used for purging is, in most cases, the same or only slightly higher than the flow rate used for sampling, and because purging and sampling are conducted as one continuous operation in the field, the process is referred to as low-flow purging and sampling.

5. Significance and Use

5.1 The objective of most ground-water sampling programs is to obtain samples that are representative of formation-quality water. Wells used in ground-water quality investigations or monitoring programs are generally purged of some amount of water in an attempt to obtain a representative sample. For traditional methods of purging (for example, well-volume purging), purging is done to minimize bias associated with stagnant water standing in the casing of the well (above the well screen), which generally does not accurately reflect ambient ground-water chemistry. To use low-flow purging and sampling, a pump intake is set within the well screen and the pump is operated at a low flow rate (generally less than or equal to the natural recovery rate of the well), minimizing drawdown in the well and thus hydraulically isolating the water in the screened zone from the water in the casing. Water pumped in this way comes directly from the screened interval of the well. This obviates the need to purge the stagnant water in the well prior to collecting samples. Access to formation-quality water is confirmed by monitoring water quality parameters to the point at which they stabilize as described in Guide D 6452.

5.2 Low-flow purging and sampling may be used in any well that can be pumped at a constant rate of 1.0 L/min or less without continuous drawdown of the water level in the well **(1)**. It is feasible to implement low-flow purging and sampling in wells in which the water level is always above the top of the well screen, and in wells that are constructed so that the water level is always within the well screen.

5.3 Low-flow purging and sampling can be used to collect samples for all categories of aqueous-phase contaminants and naturally occurring analytes, including volatile and semi-volatile organic compounds (VOCs and SVOCs), metals and other inorganics, pesticides, PCBs, other organic compounds, radionuclides and microbiological constituents. It is particularly well suited for use where it is desirable to sample aqueous-phase constituents that may sorb or partition to particulate matter. It is not applicable to sampling either light or dense non-aqueous-phase liquids (LNAPLs or DNAPLs).

6. Benefits and Limitations of Low-Flying Purging and Sampling

6.1 Purging and sampling at a low flow rate offers a number of benefits over traditional methods including:

6.1.1 Improved sample quality and reduced (or eliminated) need for sample filtration, through minimized disturbance of the well and the formation, which results in reduced artifactual sample turbidity and minimization of false positives for analytes associated with particulate matter;

6.1.2 Improved sample accuracy and precision and greatly reduced sample variability as a result of reduced stress on the formation, reduced mixing of the water column in the well and dilution of analytes, and reduced potential for sample agitation, aeration and degassing or volatilization;

6.1.3 Samples represent a smaller section or volume of the formation, representing a significant improvement in the ability to detect and resolve contaminant distributions, which may vary greatly over small distances in three-dimensional space;

6.1.4 Overall, improved sample reproducibility, especially when using dedicated pumps;

6.1.5 Improved ability to directly quantify the total mobile contaminant load (including mobile colloid-sized particulate matter) without the need for sample filtration;

6.1.6 Increased well life through reduced pumping stress on the well and formation, resulting in greatly reduced movement of fine sediment into the filter pack and well screen;

6.1.7 Greatly reduced purge-water volume, (often 90 to 95 %) resulting in significant savings of cost related to purge water handling and disposal or treatment, and reduced exposure of field personnel to potentially contaminated purge water; and

6.1.8 Reduced purging and sampling time (much reduced at sites using dedicated pumps), resulting in savings of labor cost, depending on the time required for water-quality indicator parameters to stabilize.

6.2 Though the application of low-flow purging and sampling will improve sampling results and produce significant technical and cost benefits at most sites, not all sites, and not all individual wells within a site, are well suited to this approach. Limitations of the method include the following:

6.2.1 On a practical basis, low-flow purging and sampling is generally not suitable for use in very low-yield wells (those that will not yield sufficient water without continued drawdown with pumping over time). This limitation is largely a function of the limitations of discharge rates of available pumps and the volume of the flow cell (if used) for indicator parameter measurement;

6.2.2 The need to use a variable flow-rate pump capable of pumping within the desired flow-rate range. Low-flow purging cannot be performed using grab sampling devices, such as bailers, or inertial lift devices, which severely agitate the water column in the well, resulting in significant mixing of the water column and release of considerable sediment, which shows up as increased turbidity in samples.

6.2.3 For some applications, the need to use a flow-through cell, which may increase capital costs, lead to slightly greater set-up time in the field, and add one piece of field equipment.

7. Equipment Requirements for Low-Flow Purging and Sampling

7.1 A variety of pumps capable of pumping at low flow rates may be used for low-flow purging and sampling. Continuous discharge and cyclic discharge pumps work equally well as long as the pump has adjustable flow rate controls and is capable of being run at a low enough flow rate to avoid causing continuous drawdown in the well. Because the purging and sampling processes are joined together into one continuous operation, the pump selected (see Guide D 6634) should be appropriate for use both in purging and sampling the analytes of interest. For example, if VOCs or other pressure-sensitive parameters (for example, dissolved oxygen, carbon dioxide, trace metals) are analytes of interest, peristaltic and other suction-lift pumps should be avoided because they may cause loss of VOCs, degassing and redox and pH changes **(2-5)**.

7.2 Dedicated pumps (those that are permanently installed in the well) are preferred over portable pumps because they eliminate disturbance to the water column in the well resulting in lower turbidity values, shorter purge times and lower purge volumes to achieve stabilized indicator parameter measurements. However, portable pumps can be used if care is taken to minimize disturbance to the water column during pump installation and some time is allowed prior to pump operation for any fines agitated in the water column to settle.

7.3 Grab sampling devices, such as bailers and kemmerer samplers, and inertial-lift devices, cannot be used for low-flow purging and sampling because of the disturbance they cause to the water column in the well and the attendant effects of mixing and increased sample turbidity.

7.4 A volume measuring device (for example, graduated cylinder) and a time piece capable of measuring in seconds will be necessary to calculate the flow rate from the discharge tube from the pump.

7.5 Low-flow purging and sampling requires continuous or periodic water-level measurements (see Test Method D 4750). Any water-level measurement equipment that does not disturb the water column in the well may be used, as long as it provides the accuracy required by the sampling program (generally ±0.01 ft [3 mm]).

7.6 Low-flow purging and sampling requires continuous or periodic measurement of selected water-quality indicator parameters (and, possibly, turbidity) to determine when purging is complete and sampling can commence. Continuous monitoring in a closed flow-through cell of known volume generally provides the most consistent and reliable results, especially for dissolved oxygen and redox potential, and is the preferred method of measuring indicator parameters. However, individual instruments designed to measure the most common water-quality indicator parameters (temperature, pH, and conductivity or specific conductance) may also be used. Dissolved oxygen and redox potential measurements made after the purged water is exposed to atmospheric conditions, however, will not accurately reflect in-situ conditions. All instruments used to measure indicator parameters should be properly calibrated and maintained in accordance with manufacturers' instructions at the well head at the start of each day of sampling and calibration should be checked periodically throughout the sampling event.

7.7 Other equipment and supplies that may be used in low-flow purging and sampling include those items specified by the site-specific sampling and analysis plan (for example, decontamination supplies, sample bottles, filtration media and equipment, preservation supplies, wellhead screening instruments [PID, FID, OVA, combustible gas indicators], sample shipping containers, and field documentation materials [for example, field notebook, field data sheets, chain-of-custody forms, sample bottle labels, shipping documents]).

8. Description of the Procedure

8.1 *General*:

8.1.1 "Low flow" refers to the velocity with which water enters the pump intake and that is imparted during pumping to the formation pore water adjacent to the well screen. This velocity must be minimized to preclude the entrainment of artifactual particulate matter in the water to be collected as a sample. Low-flow does not necessarily refer to the flow rate of water discharged by a pump at the surface, which can be affected by valves, restrictions in the discharge tubing or flow regulators. Some researchers refer to the method as "low-stress" purging, where "low-stress" refers to the impact of pumping the well on the formation. Water-level drawdown provides a measurable indicator of the stress on a given formation imparted by a pumping device operated at a given flow rate. The objective of low-flow purging is to pump in a manner that minimizes stress (drawdown) or disturbance to the ground-water flow system to the extent practical.

8.2 *Preparation for Low-Flow Purging and Sampling*:

8.2.1 Prior to conducting the initial sampling event, the sampling team should prepare themselves and any equipment and materials to be used in the event in accordance with Practice D 5903. Any equipment used in the sampling program that could contact the water in the well, the water collected during field parameter measurement, or the water collected as a sample should be properly cleaned before each use (see Practice D 5088). The clean equipment should not be allowed to contact the ground or other surfaces that could impart contaminants. An effort should be made to closely match the length of the tubing used for portable pumps with the depth at which the pump will be set in the well. Excess tubing can affect the temperature of the water sampled, which could affect sample chemistry (see Guide D 6634). All instrumentation used during low-flow purging and sampling must be properly calibrated. Instructions for calibration are specific to the individual instrument and manufacturers' instructions should be followed. The frequency and timing of calibration should be in accordance with the site-specific sampling and analysis plan.

8.3 *Pump Placement*:

8.3.1 In situations where a well is screened or open across a single zone of interest, and that zone is comprised of nearly homogeneous geologic materials, the pump intake should be positioned at or near the mid-point of the well screen. In this type of situation, the water that is withdrawn will likely represent the water quality of the entire screened zone, even at low-flow pumping rates. In situations in which the geology of the screened zone consists of heterogeneous materials with layers of contrasting hydraulic conductivity, the pump intake should be positioned adjacent to the zone of highest hydraulic conductivity (as defined by geologic samples). This provides the preferred flow pathway for ground water, and samples will be drawn primarily from this zone. In situations in which dissolved-phase contaminants of interest are known to concentrate near the top or bottom of the screened zone, it may be desirable to position the pump intake to target this zone.

8.3.2 Care should be taken not to position the pump intake too near the top of the screen in wells in which the water level is above the top of the screen (to avoid drawing in water from storage in the casing), or too near the bottom of the screen (to avoid mobilization and entrainment of settled solids from the bottom of the well). If screen length allows, the pump intake should be at least two feet from the top and two feet from the bottom of the screen.

8.3.3 Portable pumps can be used for low-flow purging and sampling, but the pump must be installed carefully and lowered slowly into the screened zone to minimize disturbance of the water column. Even if done with the utmost care, the installation of a portable pump will result in some mixing of the water column above the well screen with that within the screened interval, and the release of some suspended material. This usually requires pumping for a longer period of time to achieve stabilization of indicator parameters and turbidity. Ideally the pump should remain in place prior to operation until any turbidity resulting from pump installation has settled out and until horizontal flow through the well screen has been reestablished. Carefully lowering the pump intake to the appropriate position in the well screen, then completing preparation of other equipment and materials to be used in the sampling event often allows sufficient time for reduction of initial turbidity to acceptable levels. If, after the pump is started, initial turbidity readings are high (for example, >100 NTU) and reducing the pumping rate does not result in lower readings after a few minutes, it may be necessary to stop the pump and allow turbidity to settle for an hour or more. The time required for turbidity to settle is well-specific and should be determined on a well-by-well basis.

8.4 *Pumping Rate*:

8.4.1 In general, the pumping rate used during low-flow purging and sampling must be low enough to minimize mobilization and entrainment of particulate matter that is not naturally mobile (for example, artifactual particles) under ambient, non-pumping conditions and to minimize hydraulic stress on the well and the formation (for example, to minimize drawdown and to eliminate inclusion of stagnant water from the casing in the sample).

8.4.2 Because each well screen is installed in a hydraulically unique position, and because of differences in the effects that drilling and well development may have had on the borehole and adjacent formation, the hydraulic performance of each well will be different. This means that the pumping rate used for low-flow purging and sampling should be determined on a well-specific basis. It is not appropriate to assess one well in a network of wells and apply the low-flow purging and sampling techniques and rates from that one well to all of the wells in the network. If possible, the optimum pumping rate for each well should be established in advance of the initial sampling event. For newly installed wells, this can be done immediately following well development by running a short-term single well pilot test ideally using the same pump that will be used for low-flow purging and sampling. Once the optimum pumping rate is established for a given well, the same pumping rate can be used for that well for each sampling event, provided well performance does not vary over the life of the well.

8.4.3 To determine the appropriate pumping rate for any given well, the following procedure is recommended. After the pump intake is properly set in the well, the pump should be started at a low pumping rate, generally 100 mL/min or less. For pumps that cannot achieve a flow rate this low, start the pump at the lowest flow rate possible. From the time the pump is started, the water level in the well should be measured (see 8.5) to determine the amount of drawdown caused by pumping. If drawdown is rapid and continuous, the pumping rate should be lowered until drawdown decreases and stabilizes. If drawdown is very slow or imperceptible, the pumping rate may be raised slowly and adjusted to the point at which drawdown stabilizes. The maximum pumping rate used for sampling should not exceed the rate used for purging. Increases in pumping rates may induce increases in turbidity **(6-9)**.

8.5 *Drawdown and Water-Level Measurement*:

8.5.1 Prior to installing a portable pump in the well or prior to the commencement of pumping in wells in which dedicated pumps are installed, an initial water level measurement should be obtained.

8.5.2 Measurement of the water level in the well during purging, on either a continuous or periodic basis, is critical to establishing the optimum flow rate for purging and to determining the stress placed on the well by pumping. The goal is to achieve a stabilized pumping water level as quickly as possible with minimal drawdown. Continuous water-level measurements may be made using devices such as downhole pressure transducers, bubblers or acoustic tools; periodic measurements may be made with electric tapes, poppers or ploppers or other devices as described in Test Method D 4750. Measurement accuracy of the device used should be in accordance with that specified in the sampling and analysis plan (generally ±0.01 ft [3 mm]). Water-level measurements should be taken every one to two minutes to the point at which the water level in the well has stabilized, or at which drawdown ceases. Pumping rate (see 8.4) may need to be adjusted to allow the water level to stabilize.

8.5.3 After the water level in the well has stabilized, water-level measurements can be discontinued. Once the optimum pumping rate is established for the well, it may be necessary to periodically monitor the water level during subsequent purging and sampling events, more frequently if a significant difference in well performance (generally signified by an increase in drawdown over time) is noted in subsequent sampling events.

8.5.4 Several researchers have proposed limits on the amount of drawdown that should be allowed before water-level stabilization occurs, but none have provided any scientific rationale for the proposed limits. For example, Puls and Barcelona suggest a limit of less than 0.1 m (0.33 ft or about 4 in.) drawdown for all wells, conceding that this goal may be difficult to achieve under some conditions due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience **(1)**. In practical terms, allowable drawdown should never exceed the distance between the top of the well screen and the pump intake, which is normally positioned near the mid-point of the screen. To provide a safety factor, drawdown should generally not exceed 25 % of this distance to ensure that no water stored in the casing prior to purging is drawn down into the pump intake and collected as part of the sample.

8.6 *Measurement of Water Quality Indicator Parameters and Turbidity*:

8.6.1 Water-quality indicator parameters should be measured to determine when purging is complete and sampling can commence. In wells in which the pump intake is set in the screen and operated at a rate less than the natural recovery rate of the well, stabilized water chemistry indicates that formation-quality water is being pumped and, therefore, that conditions are suitable for sampling **(1)**. The water quality parameters that are most easily measured in the field and that provide evidence that formation-quality water is being provided include: pH, conductivity (or specific conductance), dissolved oxygen and oxidation-reduction potential (redox or ORP, also measured as Eh).

8.6.2 Water-quality indicator parameters can be monitored on either a continuous or periodic basis, though continuous monitoring in a closed flow-through cell provides the most consistent and reliable results, particularly for dissolved oxygen and redox potential. Indicator parameters are considered stable when three consecutive readings made several minutes apart fall within the ranges presented in Table 1.

8.6.3 While the criteria in Table 1 are reasonable criteria for many hydrogeochemical situations, it should be recognized that firm criteria may not be appropriate for other situations because of factors including variability in aquifer properties, monitoring well hydraulics, and natural spatial and temporal variation in ground-water chemistry and contaminant distribution. Therefore, the criteria in Table 1 should be compared to well-specific measurements to determine if the site-specific criteria need to be adjusted. Additionally, these criteria should be evaluated to select those that are most important and relevant to meeting the sampling objectives for the specific site. Not all criteria need to be met for all sites. Stabilization criteria that are too stringent may unnecessarily lead to the generation of large amounts of contaminated purge water without providing the benefit of ensuring that the samples are any more representative.

TABLE 1 Example Criteria for Defining Stabilization of Water-Quality Indicator Parameters

Parameter	Stabilization Criterion
pH	±0.2 pH units[A]
Conductivity	±3 % of reading
Dissolved Oxygen	±10 % of reading or ±0.2 mg/L, whichever is greater[A]
Eh or ORP	±20 mV[A]

[A] Related to the measurement accuracy of commonly available field instruments.

8.6.4 For in-line flow-through cells, the frequency of the measurements should be based on the time required to completely evacuate one volume of the cell, to ensure that independent measurements are made. For example, a 500 mL cell in a system pumped at a rate of 250 mL/min will be evacuated in 2 min so measurements should be made at least 2 min apart. It is important, therefore, that the sampling team establish the following volumes and rates in the field prior to the sampling event: (*1*) Volume of the pump and discharge tubing; (*2*) Optimum pump discharge rate; and (*3*) Volume of the flow-through cell corrected for displacement volume of the field parameter measurement instrumentation installed inside the flow-through cell. It is also important to know the manufacturer's recommendations for the amount of time to allow individual sensors being used to measure field parameters (for example, dissolved oxygen) to stabilize to ensure that representative data are being collected.

8.6.5 For wells in which dedicated pumps are used, chemical indicator parameters tend to stabilize more readily because there is minimal disturbance of the water column in the well. For wells in which portable pumps are used, the effects of pump installation on the water column usually result in the need to remove significantly more water before chemical indicator parameters (and, as noted below, turbidity) reach stabilization.

8.6.6 Though not a chemical parameter, and not indicative of when formation-quality water is being pumped, turbidity may also be a useful parameter to monitor. Turbidity is a physical parameter that provides a measure of the suspended particulate matter in the water being pumped. Turbidity may be most indicative of pumping stress on the formation. Sources of turbidity in monitoring wells can include: (*1*) Naturally occurring colloid-sized or larger solids that may be in transit through the formation; (*2*) Naturally occurring solids or artifactual solids from well drilling and installation (for example, drilling fluids, filter pack, grout) that have not been effectively removed by well development and are mobilized by agitation of the water column (that is, by bailing, by installation of a portable pump, or by overpumping the well); (*3*) Microbial growth that often occurs within monitoring wells in the presence of certain types of contaminants (that is, petroleum hydrocarbons); and (*4*) Precipitation caused by different redox conditions in the well than in the aquifer. Turbidity levels elevated above the natural formation condition can result in biased analytical results for many chemical parameters. Naturally occurring turbidity in some ground water can exceed 10 NTU **(1)** and may be unavoidable. Turbidity in a properly designed, constructed and developed well is most often a result of significant disturbance of the water column or excessive stress placed on the formation by overpumping.

8.6.7 To avoid artifacts in sample analysis, turbidity should be as low as possible when samples are collected.[4] Turbidity measurements should be taken at the same time that chemical parameter measurements are made, or, at a minimum, once when pumping is initiated and again just prior to sample collection, after indicator parameters have stabilized. The stabilization criterion for turbidity is ±10 % of the prior reading or ±1.0 NTU, whichever is greater. If turbidity values are persistently high, the pumping rate should be lowered until turbidity decreases. If high turbidity persists even after lowering the pumping rate, the pump may have to be stopped for a period of time until turbidity settles, and the purging process restarted. If this fails to solve the problem, well maintenance or redevelopment may be necessary. Difficulties with high turbidity should be identified during pilot tests prior to implementing low-flow purging or during the initial low-flow sampling event, and contingencies should be established to minimize the problem of elevated turbidity.

8.7 *Sample Collection Following Purging*:

8.7.1 After drawdown and chemical indicator parameters stabilize, sampling can begin per the site's approved sampling and analysis plan. If an in-line flow-through cell is used to continuously monitor chemical indicator parameters, it should be disconnected or bypassed during sample collection. The pumping rate may remain at the established purging rate or it may be adjusted downward to minimize aeration, bubble formation, or turbulent filling of sample bottles. For most parameters, sampling rates of less than 500 mL/min are appropriate **(1)**. Sampling rates for the most sensitive parameters (for example, VOCs) should be lower (generally less than 250 mL/min). Generally, the most sensitive parameters, or those that are of greatest interest at the site, should be sampled first; analyses that require filtration should be sampled last **(1)**. Sample filtration (see Guide D 6564), preservation (see Guide D 6517), handling, shipping and documentation (see Guide D 6089) should be consistent with procedures documented in the approved site-specific sampling and analysis plan.

9. Reporting

9.1 The procedures and equipment used during low-flow purging and sampling must be documented in the field. Specific guidance on documenting a ground-water sampling event is provided in Guide D 6089. Field data specific to low-flow purging and sampling that should be recorded includes:

9.1.1 Equipment calibration;

9.1.2 Equipment decontamination;

9.1.3 Equipment configuration for purging and sampling;

9.1.4 Pump placement (relative to well screen position and static water level);

9.1.5 Initial static water level;

9.1.6 Initial pumping rate;

9.1.7 Drawdown measurements;

9.1.8 Stabilized pumping water level;

9.1.9 Final pumping rate;

9.1.10 Water quality indicator and turbidity measurements;

9.1.11 Times for all measurements; and

9.1.12 Sampling flow rate.

10. Keywords

10.1 ground water; ground-water monitoring; ground-water quality; ground-water sampling; indicator parameters; low-flow purging; low-stress purging; micropurging; minimal drawdown purging; purging; water quality monitoring

[4] The primary reason for minimizing turbidity during purging and sampling is that turbidity can affect the aqueous phase concentration of the analytes of interest for both organic and inorganic analytes. The accurate analysis of aqueous-phase inorganic analytes can be affected by stripping of cations, particularly metal species, from the surface of suspended inorganic particulate matter (for example, clays) by the sample preservation process (acidification). The accurate analysis of hydrophobic organic compounds can be affected by the presence of both organic and inorganic particulate matter. In addition, analysis of aqueous-phase organic analytes can be hampered by the physical presence of suspended solids (that is, causing clogging of the nebulizer on the analytical equipment).

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