

Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Purging and Sampling Water Supply Wells

Version 1.0

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*Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.*

*Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.*

*Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.*

SOP Revision History

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## Environmental Assessment Program

Standard operating procedure for purging and sampling water supply wells.

### **1.0 Purpose and Scope**

- 1.1 The Environmental Assessment Program (EAP) is responsible for measuring, assessing, and reporting information about the environmental condition and health of Washington's land and water resources. This information is used by resource managers, policymakers, and others to help protect and manage Washington's environment. As such there is a need to document and ensure that consistent and scientifically defensible practices, procedures, and techniques are used by EAP staff, and that the data and information they provide are of consistent and high quality.
- 1.2 The goals of collecting groundwater samples from water supply wells, both public and private, can include characterizing ambient groundwater conditions, defining the nature and extent of groundwater problems, or defining and sampling water supply wells at-risk from groundwater contamination.
- 1.3 Groundwater measurements and samples should be as representative of in-situ conditions as possible. Several factors such as changes in temperature, pressure, and exposure to air can alter the groundwater chemistry during the sampling process. This SOP summarizes the general procedures and practices that EAP staff use to collect representative groundwater samples from water supply wells that have dedicated in-place pumps. Although this SOP does not explicitly describe the procedures used to assess the quality of the water well users may actually be exposed to via consumption or dermal contact (i.e. at the tap), the methods can be easily modified to meet this goal.

### **2.0 Applicability**

- 2.1 This SOP applies to EAP staff collecting and handling groundwater samples from water supply wells. It provides general information to help guide field staff in proper purging and sampling techniques. Field staff are encouraged to supplement the information in this SOP by reviewing the large body of existing literature on the science of groundwater sampling (see reference list). Alternative procedures are allowed as long as they are properly documented in the project Quality Assurance Project Plan (QAPP), and provide scientifically valid and legally defensible groundwater data.

- 2.2 Field staff should be familiar with other standard procedures related to activities described in this SOP. Depending on the analyte being sampled for, there can be special sample pre-treatment, filtering, post-treatment, and collection procedures that are described in separate SOPs. Digital versions of all EAP SOP's can be found on Ecology's quality assurance page at <http://www.ecy.wa.gov/programs/eap/quality.html>.

### **3.0 Definitions**

- 3.1 Aquifer – A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield usable quantities of water to wells and springs.
- 3.2 Dissolved oxygen – The relative amount of oxygen that is dissolved or carried in a given medium.
- 3.3 Data Quality Objectives (DQO's) – Data Quality Objectives are qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (USEPA, 2006).
- 3.4 Depth-to-Water - also referred to in this SOP as water level measurement.
- 3.5 EAP – Environmental Assessment Program
- 3.6 Ecology – Washington State Department of Ecology
- 3.7 EIM – Environmental Information Management System. A searchable database developed and maintained by the Washington State Department of Ecology.
- 3.8 Field Data Sheets – Weather resistant sheets (“Rite in the Rain” ® writing paper) used to document all field activities, sample data, methods, and observations for each collection site.
- 3.9 GPS - Global Positioning System
- 3.10 Measuring Point – Established point on a well casing from which depth-to-water/water level measurements are collected to ensure data comparability.
- 3.11 ORP - Oxidation-Reduction Potential. The electric potential required to transfer electrons from one compound or element (the oxidant) to another compound (the reductant). Used as a qualitative measure of the state of oxidation in water.
- 3.12 pH - A measure of the acidity or alkalinity of water. A pH value of 0 to 7 indicates that an acidic condition is present, while a pH value of 7 to 14 indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.
- 3.13 Specific Conductance (SC) – A measure of the water's ability to conduct an electrical current. Specific conductance is related to the concentration and charge of dissolved ions in water.

- 3.14 Quality assurance project plan (QAPP) – A written plan that describes how a study will be conducted and its results assessed.

#### **4.0 Personnel Qualifications/Responsibilities**

- 4.1 Staff new to groundwater sampling should review the most recent USGS National Field Manual for the Collection of Water-Quality Data (USGS, 1997); The Essential Handbook of Ground-Water Sampling (Nielsen, 2007), or an equivalent, for background information on the principles and techniques of groundwater monitoring. Staff should have a working understanding of the groundwater monitoring needs for the project prior to preparing the project Quality Assurance Project Plan (QAPP) and beginning field work.
- 4.2 Field staff should have a detailed working knowledge of the project QAPP to ensure that credible and useable data are collected and should be briefed by the field lead on the sampling goals and objectives prior to arriving at the site.
- 4.3 Before a water supply well can be sampled, field staff need to gain permission from the well owner or operator. Discuss with each well owner which sampling activities will be permitted at the well (well tagging, water level measurement, alterations to the water system, etc.). Field staff should be sensitive to the fact that they are sampling someones water supply and only perform activities which they've been granted permission.
- 4.4 This document supplements but does not replace the need for on-the-job training. All field staff should be familiar with the sampling equipment and instruments being used. The field lead is responsible for ensuring that all field staff adhere to prescribed sampling methods when conducting field work.
- 4.5 EAP staff who conduct groundwater sampling are responsible for complying with this SOP and the requirements of the EAP safety manual - particularly Chapter 1 'General Field Work' and the following sections of Chapter 2: 'Groundwater Sampling and Water-Level Measurements' (Ecology, 2009).

#### **5.0 General List of Equipment and Supplies**

##### **5.1 Sample Measuring and Collecting Equipment**

- 5.1.1 Field data sheets
- 5.1.2 Water level measuring equipment (calibrated electric water level meter, graduated steel tape)
- 5.1.3 Water quality meters and probes (pH, SC, DO, temperature, ORP)
- 5.1.4 Probe calibration standards/reagents
- 5.1.5 Flow cell
- 5.1.6 Faucet sampling attachment (see Figure 1 for example)
- 5.1.7 Tubing and connectors
- 5.1.8 Sample containers/bottles
- 5.1.9 Sample preservatives

- 5.1.10 Filters (analyte specific)
- 5.1.11 Coolers with ice or ice packs
  
- 5.2 Cleaning and Disinfecting Supplies
  - 5.2.1 Deionized water
  - 5.2.2 Laboratory grade soap (Liquinox®)
  - 5.2.3 Dilute chlorine bleach solution
  - 5.2.4 Cleaning solvents, if applicable
  - 5.2.5 Butane lighter or propane torch
  
- 5.3 Safety Equipment
  - 5.3.1 Nitrile gloves
  - 5.3.2 First aid kit
  - 5.3.3 Orange vest, Ecology issued
  - 5.3.4 Wasp spray (avoid using if sampling for organics/insecticides)
  - 5.3.5 Employee photo ID
  
- 5.4 Miscellaneous Equipment
  - 5.4.1 Well location map
  - 5.4.2 All applicable SOPs
  - 5.4.3 Field paper work: well owner contact information, field data sheets, sample bottle labels and tags, chain-of-custody sheets.
  - 5.4.4 Pencils, pens, etc.
  - 5.4.5 Permanent marking pen or paint stick (for marking measuring point)
  - 5.4.6 Calculator
  - 5.4.7 Keys for wells or gates, if applicable
  - 5.4.8 Compass
  - 5.4.9 GPS unit
  - 5.4.10 Digital camera
  - 5.4.11 Paper towels or clean rags
  - 5.4.12 Plastic garbage bags
  - 5.4.13 Plastic sheeting for ground cover
  - 5.4.14 Buckets, plastic 5-gallon (to calibrate purge volume/rate)
  - 5.4.15 1-liter container (to calibrate slower purge volume/rate)
  - 5.4.16 Stop watch
  - 5.4.17 Field bag (containing rain gear, rubber boots, work gloves, etc.)
  - 5.4.18 Hand cleaner
  
- 5.5 Tools
  - 5.5.1 Steel hand measuring tape (engineer scale)
  - 5.5.2 Socket wrench set
  - 5.5.3 Allen wrench set
  - 5.5.4 Pipe wrenches
  - 5.5.5 Crescent wrenches
  - 5.5.6 Set of screwdrivers

- 5.5.7 File
- 5.5.8 Knife
- 5.5.9 Hammer
- 5.5.10 Pliers
- 5.5.11 Crow bar/manhole hook
- 5.5.12 Shovel
- 5.5.13 Machete
- 5.5.14 Whiskbroom
- 5.5.15 Spare well cover bolts/nuts
- 5.5.16 Spare well caps/plugs
- 5.5.17 Wire brush
- 5.5.18 WD-40
- 5.5.19 Flashlight
- 5.5.20 Spare batteries (e.g. electric-tape, GPS, flashlight)
- 5.5.21 Tape (duct tape/electrical tape)
- 5.5.22 Well tagging equipment

## **6.0 Summary of Procedure**

### **6.1 Project Planning**

- 6.1.1 A Quality Assurance Project Plan (QAPP) must be completed and approved before collecting water quality samples for analysis. The QAPP details project goals, data quality objectives, quality assurance program procedures, sample handling requirements (container requirements, preservation, holding times), and field and laboratory procedures. [Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies](#) (Lombard, 2004) provides detailed guidance on developing EAP project plans. A QAPP can reference SOPs for standard field monitoring or measurement procedures; however, non-standard procedures or deviations should be described in detail in the QAPP.
- 6.1.2 Detailed information should be collected for each well location whenever practical, including well construction logs, water level data, pump setting information, sample faucet location relative to pressure tanks, water treatment systems, etc., site access agreements, and any other relevant information about the wells to be sampled.
- 6.1.3 When sampling water supply wells, field reconnaissance is usually necessary to determine a well's appropriateness for the project. If a well is selected, draw a diagram showing where the sample faucet is located with respect to the well and any pressure or storage tanks or treatment systems. An example of a well reconnaissance field form is included in Appendix A.
- 6.1.4 Well location and construction information for wells that are sampled should be entered into Ecology's Environmental Information Management (EIM) system database.

- 6.1.4.1 If the well hasn't been previously inventoried, use a GPS receiver when visiting the well to define a preliminary latitude and longitude coordinates as described in SOP EAP013, *Determining Coordinates via Hand-Held GPS Receivers* (Janisch, 2006). The field-collected coordinates can be refined using mapping tools when entering the well into the EIM system.
- 6.1.4.2 If the well hasn't been assigned a Department of Ecology unique well ID tag, then it should be tagged. Only tag water supply wells when permission has been granted by the well owner. Procedures on how to tag a well are described in EAP SOP *Tagging Wells* (in preparation). Well tags are available from Ecology's Water Resources Program. Securely attach the tag to the well casing, or any other permanent, easily-seen fixture of the well. Once a well is tagged, complete the well tag form and submit to Ecology's Water Resource Program along with a copy of the well log.
- 6.1.5 Collecting samples from water supply wells with permanently installed pumps requires specific considerations, preparations, and precautions. Characteristics of the well, operation of the pump, and selection of the sample point must be considered to obtain data that will meet the project objectives and data quality requirements.
- 6.1.5.1 Factors to consider when selecting a water supply well for sampling include: physical characteristics of the well and water delivery system (location of screened interval, location of the sample point relative to pressure tanks, aerators, water softeners, etc.), and compatibility of analytes being sampled with well, pump, and delivery system construction and operation. Documents such as the USGS National Field Manual for the Collection of Water-Quality Data have detailed explanations of what factors to consider when selecting water supply wells for sampling.
- 6.2 Field Work Preparation
- 6.2.1 Prior to sampling, inventory consumable field supplies such as disposable gloves, calibration standards, tubing, filters, etc. Order necessary supplies. Allow ample time for delivery.
- 6.2.2 Arrangements must be made with Ecology's Manchester Environmental Laboratory before sampling. The [Manchester Environmental Laboratory \(MEL\) Laboratory User's Manual](#) (Ecology, 2008) contains detailed guidance on the planning steps necessary to request, track, ship, and analyze water quality samples collected in the field.
- 6.2.2.1 To notify the lab submit a [Pre-sampling Notification Form](#) and a [Sample Container Request Form](#) a minimum of 2 weeks prior to sampling. For large projects the lab should be informed 4-6 weeks prior to sampling.
- 6.2.2.2 Coordinate with the lab regarding any special arrangements such as contract lab analysis, special courier or delivery of samples.

- 6.2.2.3 Inventory sample bottles when they arrive to ensure the lab provided the correct type and number.
- 6.2.3 Establish the order the wells will be sampled. Sample order is either based on logistics or the known or suspected water quality of a sample location.
  - 6.2.3.1 Obtain permission for site access. Contact the well owner, operator, or property resident to confirm the sampling date and time and to discuss any site access issues. Be sure to get specific instructions on what activities are allowed at the well. For example many well owners will allow water samples to be collected, but do not want their wells opened for water level measurements.
  - 6.2.3.2 Before going in the field prepare field data sheets for each well location. It can be helpful to bring previous sample data for each well such as pump rate, total purge time, stabilized field parameter values, etc. Other sample paperwork should also be filled out as much as possible. Sample paperwork typically includes: bottle labels and tags, as well as Manchester Labs Chain-of-Custody/[Lab Analysis Required Form](#) (LAR) for the project sample event. Examples of field data sheets are provided in Appendix A.
- 6.2.4 Inspect all equipment and verify that water quality field meters are in good working order, calibrate properly, and are fully charged. Calibration procedures are normally outlined in the meter user's manual.
- 6.2.5 Field equipment, especially equipment being placed in a well, must be properly cleaned, disinfected, or decontaminated prior to and after use in each well. This is especially important when placing equipment in water supply wells. All field equipment that enters a water supply well must be properly disinfected to prevent the introduction of bacterial contamination (e.g. coliform or iron bacteria) into the water supply. Equipment should be disinfected just prior to and after use in each well.
  - 6.2.5.1 It is recommended that gloves (Nitrile) be worn when cleaning sample equipment. This will help maintain sanitary conditions of the cleaned equipment and will protect the sampler from the cleaning products being used. When not in use, equipment should be placed on a clean surface, such as a clean plastic sheet. If the equipment is not re-used immediately it should be wrapped in plastic sheeting or aluminum foil. Equipment should never be placed on bare soil prior to using it in a well.
  - 6.2.5.2 Water level measuring equipment: disinfect probe and any potentially submerged tape with dilute chlorine bleach. Depending on how much of the tape is submerged the equipment can be sprayed with disinfectant, soaked in a bucket of disinfectant or wiped with a clean disinfectant soaked towel. Rinse equipment with deionized water. Dry equipment with a clean paper towel or air dry.
  - 6.2.5.3 Water quality field probes may be rinsed with deionized water between sample locations. If the probes are slow to respond and additional cleaning is needed,

then the probes should be cleaned and maintained according to the manufacturer's instructions.

6.2.5.4 Non-dedicated sample equipment such as the Y-split flow controller/Y-fitting that is attached to the sample faucet/tap should be washed in a laboratory grade soap (e.g. Liquinox) solution after use. Use a brush to scrub the sample equipment if needed. Rinse the equipment with tap water, followed by a deionized water rinse.

6.2.5.5 Equipment that sample water contacts that is difficult to clean, such as pump tubing or tube fittings, should be replaced between sample locations.

### 6.3 Purging and Sampling Procedures

6.3.1 Most water supply wells are equipped with permanent, large-capacity pumps. If the well is not equipped with a permanent pump then follow the purge and sampling guidance in SOP EAP078, *Purging and Sampling Monitoring Wells* (Marti, 2011).

6.3.2 Upon arriving at a well, set out safety equipment as needed.

6.3.3 Check the site for hazardous conditions, either physical or chemical.

6.3.4 If needed spread clean plastic sheeting on the ground to keep sample equipment clean.

6.3.5 Set up and field check sample equipment: water level meter, water quality meters and flow cell, etc.

6.3.5.1 Wear clean disposable powder-free gloves (e.g. Nitrile) when handling all equipment used for collecting and processing samples.

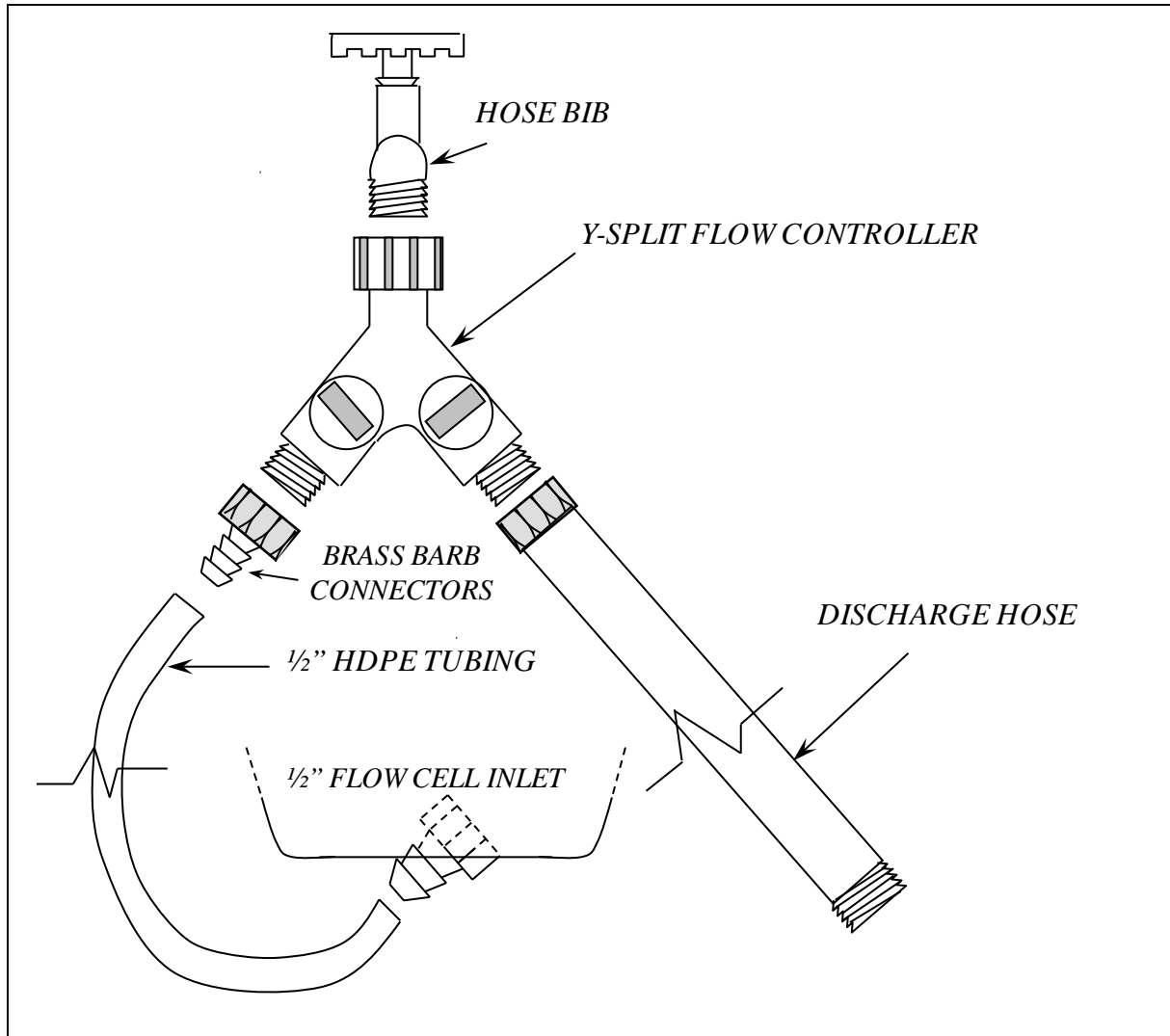
6.3.5.2 Calibrate field water quality meters according to the manufacturer's instruction. Field parameters should be measured in a closed-atmosphere flow cell. If for some reason it's not possible to use a flow cell at a particular location, it should be noted on the field data sheets.

6.3.6 If you've been granted permission by the well owner to collect a water level measurement, remove the well cover, cap, or well instrument access port plug located on the well cover.

6.3.6.1 If the well has not been sampled before, establish and document a water level measuring point using the procedures described in SOP EAP052, *Manual Well Depth and Depth-to-Water Measurements* (Marti 2009).

6.3.6.2 Measure the water level according to SOP EAP052 (Marti, 2009). Record the water level value, date, and time on the well specific field data sheet (Appendix A). The water level should be measured twice to confirm an accurate measurement. If the well has been pumped recently record that on the field data sheets next to the water level measurement.

- 6.3.7 Water supply well samples should be collected as close to the well's pump/wellhead as possible. It is preferable to collect samples from a cold water faucet/tap, before the water passes through any storage tanks, pressure tanks or physical or chemical treatment systems that may alter the quality of the groundwater sample. Document on the field data sheet the location of the sample point.
- 6.3.8 If there is no sample point close to the wellhead, choose a location least affected in the well's distribution system. Document on the field data sheet the location of the sample point, the type of system the water passes through and what effect it may have on the quality of the sample.
- 6.3.9 Faucets or taps used to collect water samples should be in good condition. Inspect the faucet for any signs of corrosion, dirt or leakage that might compromise field parameter measurements or sample quality.
- 6.3.10 If the faucet needs to be altered or cleaned in any way prior to sample collection, obtain permission from the property owner first.
- 6.3.10.1 Remove any hoses. If possible, remove aerators, filters, or other devices from the faucet.
- 6.3.10.2 If the faucet is dirty or corroded, use a stiff bristle or wire brush to clean the threads on the faucet. Rinse with deionized water.
- 6.3.10.3 If collecting bacteriological samples such as fecal coliform, sanitize the inside and outside of the faucet with a butane lighter or propane torch until dry. Do not touch the faucet with your bare hands after sanitizing.
- 6.3.11 Connect an apparatus, such as a Y-split flow controller/Y-fitting (Figure 1), to the selected faucet.
- 6.3.11.1 Connect tubing or a hose to one arm of the Y-fitting. This will be the main purge water discharge. The flow rate for the purge water discharge hose can be at the pumps capacity (e.g. 5 gallons/minute) so that the well can be purged in a reasonable time frame.
- 6.3.11.2 Connect tubing to the other arm of the Y-fitting and attach it to the flow cell for field parameter measurements. Flow rate for this side of the Y-fitting should be low (e.g. 1-2 L/minute) to accommodate flow specifications of the field meters and flow cell. Consult manufacturers guidelines to determine the maximum allowable flow rate for the field parameter probes and flow cell chamber.



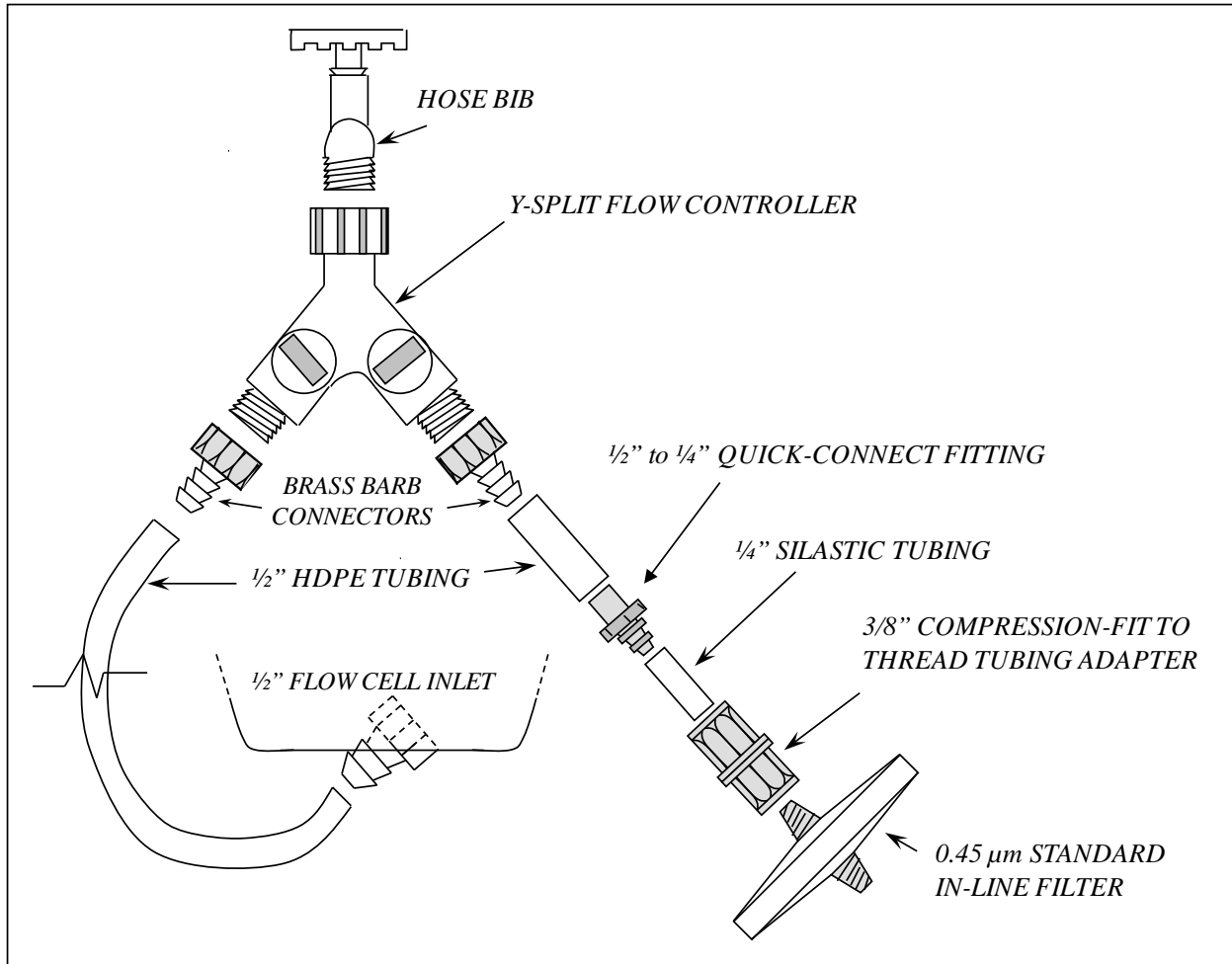
**Figure 1 – Schematic for Typical Water Supply Well Purging Apparatus**

- 6.3.12 If the well has been sampled before, review past field data sheets for purge rates, total purge time, and stabilized field parameter values prior to sample collection.
- 6.3.13 Start purging by opening the faucet and valves on the attached Y-split flow controller. Use the valves on the Y-fitting to regulate the flow rates to both the flow cell and the discharge hose. Use a 5-gallon bucket and a stopwatch to measure the pumping rate from the discharge hose. Record the rate on the field data sheet.
- 6.3.13.1 Purge water for most projects may be discharged directly to the ground. Direct the purge water away from the well head and work area.
- 6.3.13.2 If the purge water is contaminated it should be disposed of in accordance with Washington State regulations (Chapter 173-303-400 WAC).

- 6.3.14 The amount of water to be purged depends on two primary factors: 1) whether there's a storage/pressure tank located between the pump and sample point and 2) whether the well is used regularly or infrequently.
- 6.3.14.1 If the sample faucet is located before any storage or pressure tanks, the purge time should be relatively short. Purge until enough water has flushed any standing water from the plumbing and field parameters have stabilized.
- 6.3.14.2 If the sample faucet is located after a tank, than the storage capacity of the tank needs to be accounted for while purging. Purge until enough water has flushed any standing water from the plumbing, including the tank, and field parameters have stabilized.
- 6.3.14.3 Water supply wells that are in regular service, where the pump runs routinely, should purge rather quickly. Wells that are used infrequently should be given enough time to purge so that the plumbing is thoroughly flushed and field parameters have stabilized.
- 6.3.15 During purging and sample collection the flow should be a smooth, solid stream of water with no air or gas bubbles in the tubing or flow cell. Gradually adjust the pumping rate to eliminate bubbles if present.
- 6.3.16 Once the flow is constant begin monitoring field parameter values in a flow cell at regular intervals (e.g. 2 to 5 minutes). The frequency of these measurements depends on the pump rate and the estimated time for the field parameters to stabilize.
- 6.3.17 Record the field parameter values, time of measurement, and if tracking, the amount of purge water discharged. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to instrument problems. Record observations on the pumped water's appearance (e.g. clarity, odor, etc.) during purging and sampling.
- 6.3.18 Continue purging until field parameters stabilize. At a minimum, five sets of field measurements should be recorded. Monitored field parameters for EAP studies include but are not limited to pH, specific conductance, dissolved oxygen, and water temperature. Field parameters should be specified in the project QAPP.
- 6.3.19 Field parameters are considered stable when 3 consecutive readings fall within the following stabilization criteria:

pH	± 0.1 standard units
Specific Conductance	± 10.0 µmhos/cm for values < 1000 µmhos/cm ± 20.0 µmhos/cm for values > 1000 µmhos/cm
Dissolved Oxygen	± 0.05 mg/L for values < 1 mg/L ± 0.2 mg/L for values > 1 mg/L
Temperature	± 0.1° Celsius
ORP	± 10 millivolts

- 6.3.19.1 If sampling for metals, turbidity should be measured and have either stabilized or be below 10 NTUs. Turbidity readings should be below 5 NTUs if metals samples will not be filtered.
- 6.3.20 Once field parameters stabilize conduct any end of purge field parameter analysis, then collect samples as specified in the project QAPP. Purge and sample withdrawal should form a continuous process.
  - 6.3.20.1 Prepare the Y-fitting for end of purge field parameter analysis and sample collection. Slowly reduce (1-2 L/min), but do not stop, the faucet flow rate. Use the Y-fitting valve to turn off the flow to the discharge hose. Maintain the flow through the flow cell side of the Y-fitting. Remove the hose.
  - 6.3.20.2 Connect the tubing for sample collection to the Y-fitting (Figure 2). Use connectors and sample tubing that is compatible with target analytes.
  - 6.3.20.3 Slowly reopen the Y-fitting valve to the sample collection tubing. Allow some water to pass through the sample tubing before conducting end of purge field parameter analysis (e.g. low dissolved oxygen, alkalinity, iron).
  - 6.3.20.4 Collect samples once end of purge parameter analysis is complete.
  - 6.3.20.5 If samples are to be filtered, connect the filter to the sample tubing (Figure 2). Pre-soak the filter with sample water. Discard the first 100-200 mL of filtrate before filling the sample containers.



**Figure 2 – Schematic for Typical Water Supply Well Sampling Apparatus**

- 6.3.21 Samples should be collected in a specific order as determined in the project QAPP. The order of sample collection, processing and preservation for specific analytes should be adhered to consistently throughout the project. The recommended sequence for sample collection and processing is often based on logistics for maintaining sample integrity.
- 6.3.21.1 Sample collection order is usually based on the analytes' sensitivity to change. Those analytes most sensitive to change (e.g. organics) are usually collected first, while analytes less sensitive to change (e.g. nutrients) may be collected last.
- 6.3.21.2 The sequence can be modified, depending on the types of samples to be collected and on data objectives. The relative importance of each analyte should be evaluated by project. Samples for analytes of most interest may be collected first to ensure that a representative sample is obtained.

- 6.3.21.3 Modification in sample order may also be necessary to maintain sample integrity. For example, sulfate samples should be collected before samples preserved with sulfuric acid (e.g. nitrogen series, phenolics). This can prevent the accidental contamination of an unpreserved sulfate sample with sulfuric acid preservative used for another sample. Likewise, nitrogen series samples should be collected before samples preserved with nitric acid (e.g. total and dissolved metals).
- 6.3.21.4 When filtering samples for several analytical parameters they should be filtered in a specific order so that the analytical concentration will not be significantly affected as the pore size of the filter decreases as more water passes through it. For example the USGS (Wilde, 2004) recommends the following filter sequence: trace elements, mercury, major cations, major anions and nutrients (including alkalinity), radiochemicals, and stable isotopes.
- 6.3.21.5 As mentioned previously the quality of the groundwater sample may be altered as it passes through storage/pressure tanks or physical or chemical treatment system. The operation of permanent pumps installed in water supply wells can also affect certain analyte concentrations. Erroneous data produced as a result of using these pumps are most likely for dissolved gases, volatile organic compounds, and reduction-oxidation chemical species. Oil may also be present in the water column for pumps that are oil-lubricated. (Lane, 2003).
- 6.3.22 Change to clean disposable powder free gloves, if needed.
- 6.3.23 Prepare sample containers. To avoid possible container contamination, keep sample containers capped until it's time to fill them.
- 6.3.24 Sample containers are to be filled by transferring water directly from the sampling apparatus (discharge tubing, filters, etc.) into the appropriate sample container. During sample collection the discharge line/filter should be close to but not touching the sample container.
- 6.3.24.1 Follow industry standard procedures for sample collection and preservation, for example procedures discussed in the USGS National Field Manual for the Collection of Water-Quality Data (USGS, 1997). The EA Program is in the process of preparing analytes specific SOPs for sample collection and preservation for volatile organic compounds, metals, and general/physical chemistry parameters.
- 6.3.24.2 All samples requiring preservation must be preserved as soon as practical. Refer to analyte specific SOPs for proper preservations methods.
- 6.3.24.3 Collect quality control (QC) samples such as a field replicate from the well(s) specified in the project QAPP. Field replicate samples are collected by alternating the sample stream between two of the same type sample container.

- 6.3.25 Label sample containers and immediately place in an ice filled cooler. Samples must remain at or below 6°C throughout handling, storage, and shipping. Do not freeze samples.
- 6.3.26 Record sample date and time, and total purge volume on the field data sheet. If the pump is equipped with a flow meter, record the flow volume as well. Record any final observations or comments related to sample collection.
- 6.3.27 Follow the procedures in the project QAPP or Manchester Lab Manual for sample handling and management (e.g. chain of custody, sample courier service or any special shipping requirements or restrictions).
- 6.3.27.1 Be conscious of analytical holding times and minimize the time between sampling and delivery to the laboratory.
- 6.3.28 When all work at the well site is complete, replace any removed aerators, filters, or hoses. Properly close and secure the well.
- 6.3.29 Note any physical changes to the well or sample point on the field data sheets.
- 6.3.30 All equipment used to collect groundwater samples should be cleaned or disinfected as previously described. Store the equipment for transport to the next sample location or at the conclusion of the field study.
- 6.3.31 Before leaving the site make certain that all the appropriate quality control samples have been collected. These may include a field replicate, and field blanks (e.g. filter, equipment, transport). The types and number of quality control samples should be specified in the project QAPP.

## **7.0 Records Management**

- 7.1 Water supply wells that EAP samples must be documented to enable information about their location, construction, and subsequent monitoring data to be archived in Ecology's Environmental Information Management (EIM) system and well log imaging databases. Consult the EIM help documents for a list of the well specific metadata required by EIM.
- 7.2 Station information and monitoring notes should be documented, during each site visit on site specific field data sheets. Examples are presented in Appendix A. All field entries should be neat and concise. The field lead is responsible for reviewing the form(s) for completeness before leaving a field site.
- 7.3 EAP staff have developed a number of data analysis spreadsheets, field forms, and other tools to standardize data collection and processing for groundwater monitoring projects. See the EAP Groundwater Assessment Sharepoint site for the most up-to-date version of these tools. Examples of some of the field forms are provided in Appendix A.

7.4 All hardcopy documentation, such as well reports and field data sheets, are kept and maintained by the project lead. At the completion of a project, hardcopies are boxed and moved to EAP archives.

## **8.0 Quality Control and Quality Assurance**

8.1 To ensure that good quality data are obtained throughout a project, a Quality Assurance Project Plan (QAPP) must be completed and approved before performing any field work. The QAPP details project goals, data quality objectives, quality assurance program procedures, sample handling requirements, and field and laboratory procedures.

8.2 Both the equipment and procedures used in collecting and handling groundwater samples have limitations that introduce a certain level of error, variability and bias into the final analytical results. To minimize the level of error, all field staff should follow these general QA/QC procedures when collecting samples:

8.2.1 Follow the project QAPP and any applicable standard operating procedures (SOP) when collecting and handling samples.

8.2.2 Calibrate field water quality meters according to the manufacturers instructions.

8.2.3 Use equipment to purge and sample that is compatible with the characteristics of the well and analytes being sampled. Operate equipment in accordance with the manufacturer instructions, unless otherwise specified in the project QAPP.

8.2.4 Properly collect, handle and store samples.

8.2.5 Collect the appropriate quality control samples. These may include a field replicate, and field blanks (e.g. filter, equipment, transport). The types and numbers of quality control samples should be specified in the project QAPP.

8.2.6 Follow the procedures in the project QAPP or Manchester Lab Manual for sample handling and management (e.g. chain of custody).

8.2.7 Document all data, observations, notes, deviations from project QAPP, etc. on the field data sheets and other project paperwork.

8.2.8 Properly clean, maintain, and store all field equipment after use.

8.2.9 Use consistent procedures from well to well.

## **9.0 Safety**

- 9.1 Proper safety precaution must be observed when collecting groundwater samples. Field work should follow protocols described in the Environmental Assessment Program Safety Manual (Ecology 2006). A working knowledge of sections ‘Groundwater Sampling and Water-Level Measurements’ in Chapter 2 is expected. Protocols in the EAP Safety Manual should be used to complement the judgment of an experienced field professional.
- 9.2 A [Field Work Plan Form](#) must be completed to document field personnel, sampling locations, overnight lodging, planned itinerary, contact person(s), and emergency contacts.
- 9.3 Always consider the safety situations when accessing a water supply well. If entering a pump house watch for objects stored in the pumphouse, including hazardous chemicals. Be aware of any possible animal hazards such as dogs, mice, snakes, wasps, and spiders. Consult the EAP Safety Manual for further guidance when working at a well site.
- 9.4 All EA Program field staff who work in the field are required to complete and maintain certification in FIRST AID/CPR.

## **10.0 References**

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## **Appendix A: Example Field Forms**

EAP has developed several spreadsheet templates and field form to speed and where possible automate the tasks required to evaluate, install, and process groundwater sampling data. Examples of commonly used forms are included here. See EAP's Groundwater Assessment SharePoint site for up-to-date versions. These tools and forms can easily be modified to accommodate the needs of particular instruments or projects.

**Well Reconnaissance Field Sheet**

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Field Crew: \_\_\_\_\_

Well ID: \_\_\_\_\_

Well Tag ID: \_\_\_\_\_

Well Owner Name: \_\_\_\_\_

Facility Name: \_\_\_\_\_

Current Phone Number: \_\_\_\_\_

Current Mailing Address: \_\_\_\_\_

Renter?  Name: \_\_\_\_\_

Permission granted to locate well?

Permission granted to collect Water Level?

Permission granted to sample well for Water Quality?

Permission granted to tag well?  Tagged?

Call ahead required before site visit?

Recon GPS Well Coordinates:

Recording Datum: NAD83HARN  NAD83  NAD27

DDLAT: \_\_\_\_\_ DDLONG \_\_\_\_\_

Wellhead Photo #: \_\_\_\_\_

Comments: \_\_\_\_\_

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**Add sketch map of well location and sample faucet location on back**



Date	Time	Hold (ft)	Cut (ft)	Status	Mthd.	Accu.	Remark
/ /							
/ /							
/ /							
/ /							
/ /							
/ /							
/ /							
/ /							
/ /							
/ /							

Status Codes																
<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>	<b>J</b>	<b>N</b>	<b>O</b>	<b>P</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>V</b>	<b>W</b>	<b>X</b>	<b>Z</b>
Dry	Recently Flowing	Flowing	Nearby Flowing	Nearby Recently Flowing	Injector	Site Monitor	Discon- tinued measuring	Obstruction	Pump- ing	Recently Pumped	Nearby Pumping	Nearby Recently Pumping	Foreign Matter on Water	Well Des- troyed	Affected by Surface Water Site	Other

Method of Measurement Codes													
<b>A</b>	<b>B</b>	<b>C</b>	<b>E</b>	<b>G</b>	<b>H</b>	<b>L</b>	<b>M</b>	<b>N</b>	<b>R</b>	<b>S</b>	<b>T</b>	<b>V</b>	<b>Z</b>
Airline	Analog	Cal. Airline	Estimate	Pressure Gage	Cal. Pressure Gage	Geophys Log	Mano- meter	Non- Recording Gage	Reported	Steel Tape	Electric Tape	Calibrated E-tape	Other

Measurement Accuracy Codes		
<b>0</b>	<b>1</b>	<b>2</b>
±1 FT	±0.1 FT	±0.01 FT

Well Name: \_\_\_\_\_

Well Tag ID: \_\_\_\_\_



**Groundwater Quality Sampling Field Sheet (cont.)**

Well Tag ID: \_\_\_\_\_ Well Name: \_\_\_\_\_

**Purge Parameters (cont.):**

Time	pH	Temp (°C)	Cond (µS/cm)	DO (mg/L)

**Photometric O<sub>2</sub> :**                      **Kit:** \_\_\_\_\_ **Conc.** \_\_\_\_\_

**Photometric O<sub>2</sub> :**                      **Kit:** \_\_\_\_\_ **Conc.** \_\_\_\_\_

**Colormetric O<sub>2</sub> :** \_\_\_\_\_

**Field Alkalinity :**                      **Kit:** \_\_\_\_\_ **Conc.** \_\_\_\_\_

**ORP:** \_\_\_\_\_

**Other:** \_\_\_\_\_

**Comments :**

# Sample Container Request Form

Please FAX to Leon Weiks: (360) 871-8850

(Phone for Leon Weiks: (360) 871-8825)

Requestor: \_\_\_\_\_

Project Name: \_\_\_\_\_

Phone: \_\_\_\_\_

Today's Date: \_\_\_\_\_

Location for Delivery: \_\_\_\_\_

Date Needed by: \_\_\_\_\_

Index #	Description	Qty.
1	1 gallon jar *	
2	1/2 gallon jar *	
3	1 liter jar * (wide mouth) (special request only)	
4	1 liter jar ( narrow mouth) (oil & grease) **	
5	8 oz short jar *	
6	8 oz short jar **	
8	4 oz short jar *	
9	4 oz short jar **	
11	40 mL vial w/septum *	
13	2 oz short jar w/septum * (Volatiles: solids only)	
14	125 mL amber glass bottle * (carbamate)	
15	1 liter amber bottle * (narrow mouth)	
16	500 mL HDPE bottle (metals)	
17	1 gallon cubitainer	
19	125 mL clear Nalgene (nutrients or COD; bottle contains 1:1 sulfuric acid)	
20	125 mL amber Nalgene (filters and syringe also required for orthophosphate)	
21	125 mL polypropylene bottle (hardness - bottle contains acid) <b>For Hexachrome, request bottle without acid</b>	

Index #	Description	Qty.
22	500 mL poly bottle	
23	1000 mL poly bottle	
24	1000 mL amber poly	
25	250 mL amber poly bottle (Cyanide) (contains Sodium Hydroxide)	
26	60 mL poly bottle (TOC/DOC or TP; bottle contains 1:1 hydrochloric acid)	
27	250 mL glass or poly bottle (fecal coli)	
28	500 mL glass bottle or poly (multiple micro tests)	
29	250 mL glass or poly bottle <b>with thiosulfate</b> (fecal coliform - chlorinated)	
30	500 mL glass or poly bottle <b>with thiosulfate</b> (multiple micro tests - chlorinated)	
31	8 oz plastic jar (grain size only)	
32	1 liter jar ** with <b>sulfuric acid</b> (wide mouth, clear; for phenolics)	
33	sterile specimen cup (micro)	
34	2 oz short jar (TOC - NO septum)**	
35	Soil VOA/BTEX Airtight Sampling Capsules (3 per sample)	
36	Soil VOA/BTEX Sampling Handle (1 per sampling event)	
	<b>Other Supplies</b>	

\*organic free with Teflon lined lids, with Certificate of Analysis. \*\*same as "\*" but does not include Certificate of Analysis.

# PRE-Sampling Notification

Fax to Manchester Laboratory: (360) 871-8850

**Project Name:** \_\_\_\_\_ **SIC:** \_\_\_\_\_  Enforcement  
**Requested by:** \_\_\_\_\_ **Sampling Date(s):** \_\_\_\_\_  Monitoring  
**Program:** \_\_\_\_\_ **Date to Lab:** \_\_\_\_\_  Emergency  
**Phone No.:** \_\_\_\_\_ **Sample Pickup Location:** \_\_\_\_\_  Class II  
**QAPP:**  Yes  No **Date results needed by:** \_\_\_\_\_  Preliminary Invest.  
 Special turnaround

General Chemistry	W	S	O	Microbiology	W	S	O	Organic Chemistry	W	S	O
Alkalinity				Fecal Coliforms <input type="checkbox"/> MF <input type="checkbox"/> MPN				Base/Neutral/Acids (BNA)			
Conductivity				E. Coli MF <input type="checkbox"/> "MUG" <input type="checkbox"/> mTEC2				Polynuclear Aromatics (PAH)			
Hardness				E. Coli MPN							
pH				% Klebsiella				Volatile Organic Analysis (VOA)			
Turbidity								BTEX			
<input type="checkbox"/> Fluoride <input type="checkbox"/> Chloride <input type="checkbox"/> Sulfate								Pest/PCB's (Organochlorine)			
Cyanide <input type="checkbox"/> Total <input type="checkbox"/> Dissociable				<b>Metals</b>	<b>W<sub>T</sub></b>	<b>W<sub>D</sub></b>	<b>S</b>	<b>O</b>	Pesticides only (Organochlorine)		
Total Solids				Priority Pollutant Metals (13 elements)				PCB's only			
Total Nonvolatile Solids				TCLP metals				OP - Pests (Organophosphorous)			
Total Suspended Solids				Hardness				Herbicides (Chlorophenoxy)			
Total Nonvolatile Suspended								Nitrogen Pesticides			
Total Dissolved Solids				Mercury (Hg) <input type="checkbox"/> Low Level <input type="checkbox"/> Regular				PCL Pesticides (8085)			
Chlorophyll <input type="checkbox"/> Filtered in field <input type="checkbox"/> Filtered at lab				Other: List individual elements:				PBDEs			
% Solids								Hydrocarbon ID (match to source)			
% Volatile Solids (TVS)								TPH-ID (gas/diesel/oil)			
Total Organic Carbon								TPH-G <sub>x</sub>			
Dissolved Organic Carbon								TPH-D <sub>x</sub>			
Biochemical Oxygen Demand (BOD) 5 day											
BOD - Inhibited								TCLP-VOA			
BOD - Ultimate								TCLP-BNA			
Ammonia								TCLP-Herbicides			
Nitrate-Nitrite								TCLP-Pesticides			
Orthophosphate											
Total Phosphorous											
<input type="checkbox"/> TPN <input type="checkbox"/> TKN				Asbestos							

Comments: Enter the number of samples in the appropriate box(es) above.  
 W = water S = soil/sediment O = other (please specify) W<sub>TR</sub> = water total W<sub>D</sub> = water dissolved



<b>Matrix Codes</b>	<b>Source Codes</b>	<b>Code Description</b>
<p><b>Code Description</b>  10 Water  11 Field Filtered Water  12 Filter from Water  13 Water to be filtered upon receipt at lab  40 Soil/Sediment  41 Frozen Soil/Sediment (PSEP)  45 Semi-Solid/Sludge  70 Tissue  80 Oil/Solvent  90 Waste  00 Other (Use only if no other apply)</p>	<p><b>Code Description</b>  00 Unspecified Source  01 Unknown Liquid Media (Drum/Tank)  02 Unknown Liquid Media (Spill Area)  03 Unknown Liquid Media (Waste Pond)  <b>10 Water (General)</b>  12 Ambient Stream/River  13 Lake Reservoir  14 Estuary/Ocean  15 Spring/Seepage  16 Rain  17 Surface Runoff/Pond (general)  18 Irrigation Canal/Return Flow  <b>20 Well (General)</b>  21 Well (Industrial/Agricultural)  22 Well (Drinking Water Supply)  23 Well (Test/Observation)  24 Drinking Water Intake  25 Drinking Water (At Tap)  <b>30 Effluent Wastewater (General)</b>  31 Municipal Effluent  32 Municipal Inplant Waters  33 Industrial Surface Runoff/Leachate  34 Industrial Effluent  35 Industrial Inplant Waters  36 Industrial Surface Runoff/Pond  37 Industrial Waste Pond  38 Landfill Runoff/Pond/Leachate  <b>40 Sediment (General)</b>  42 Bottom Sediment or Deposit  44 Sludge (General)  45 Sludge (WastePond)  46 Sludge (Drum/Tank)  48 Soil (General)  49 Soil (Spill/Contaminated Area)</p>	<p>50 Bore Hole Material  <b>60 Air (General)</b>  61 Ambient Air  62 Source or Effluent Air  63 Industrial or Workroom Air  <b>70 Tissue (General)</b>  71 Fish Tissue  72 Shellfish Tissue  73 Bird Tissue  74 Mammal Tissue  75 Macroinvertebrate  76 Algae  77 Periphyton  78 Plant/Vegetation  <b>80 Oil/Solvent (General)</b>  81 Oil (Transformer/Capacitor)  82 Oil/Solvent (Drum Tank)  83 Oil/Solvent (Spill Area)  84 Oil/Solvent (Waste/Pond)  <b>90 Commercial Product Formulation</b>  95 Well Drill Water  96 Well Drill Mud  97 Well Sealing Material  98 Gravel Pack Material</p>

