Golder Associates

# Technical Procedure

Number: TP 1.2-26, Revision 0
Title: SURFACE WATER SAMPLING METHODS

| Prepared by | Approved by | Approved by | Effective Date | Rev. Level |
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## 1. PURPOSE

This document describes the sampling protocols used by Golder Associates to collect surface water samples. It contains sampling instructions and information concerning appropriate containers, preservation, and handling of water quality samples.

## 2. APPLICABILITY

This technical procedure is applicable to any persons involved in the collection of surface water samples. It is applicable to all geographic areas.

## 3. DEFINITIONS

### 3.1 Analytical Request Form

Standard form provided by analytical laboratories. This form is filled out by the person collecting samples and is used to indicate how each sample is to be analyzed. This form is often combined with the Chain-of-Custody Form in a single document.

### 3.2 Chain-of-Custody Form

Standard form used to track the movement of sample containers from the time they leave the field until they arrive at the specified laboratory. The Chain-of-Custody form provides a clear record of sample transport and handling, thereby reducing the risk of sample loss during transport. This form may be combined with the Analytical Request Form in a single document.

### 3.3 Chemical Analysis

Analytical procedure used to measure the *amount* of a certain compound, or group of compounds, present in a sample.

### 3.4 Preservatives

Preservatives are used to maintain sample integrity from the time a sample is collected until it is analyzed. Sample preservation may involve adding acid or other fixatives to collected waters or simply keeping them refrigerated. Sample-specific requirements are outlined in this document (Table 1); preservatives, when required, are provided by the analytical laboratory.

### 3.5 Sample Bottles

Sample bottles are containers specifically designed and prepared for storing liquid samples. Sample bottle type, material, size, and type of lid are specific for particular groups of analytes. Sample bottles must be properly cleaned and prepared by a laboratory or the manufacturer. Table 1 summarizes bottle type and preparation requirements.

## 3.6 Surface Water Sample

A surface water sample is defined as water acquired from a surface water body for chemical analyses that is representative of surface water within the cross-section of a lake, stream, or river being sampled.

## 3.7 Quality Assurance/Quality Control (QA/QC)

Quality Assurance refers to a detailed protocol used to produce high quality products, while Quality Control refers to the process by which this protocol is tested to ensure that final products are of the specified quality. With reference to water sampling, QA protocol includes the use trained personnel, proper sampling methods, clean containers and equipment, proper sample preservation and transportation and detailed documentation of the entire process; field, travel and other assorted test blanks are used for Quality Control testing.

## 3.8 Sample Types

### 3.8.1 Grab Samples

Sample containing water collected during a single sampling event (i.e., water taken from a given place at a given time).

### 3.8.2 Composite Samples

Sample containing a mixture of water collected from multiple locations or from different times at the same location.

### 3.8.3 Equipment Blanks

Equipment blanks are used to detect contamination from sampling equipment. They are prepared by rinsing precleaned equipment with deionized water and collecting the rinsate into an appropriate container.

### 3.8.4 Field Blanks

Field blanks are used to detect contamination during sample collection and transport. They are prepared during a sampling event by filling the appropriate container with deionized water. Field blanks are usually used in situations where there is reason to suspect that contamination will occur during sample collection and transport.

### 3.8.5 Travel Blanks

Travel blanks detect sample contamination during transport. Travel blanks consist of pre-filled bottles provided by the analytical lab. They accompany empty sample bottles to the field site,

where they are left intact and unopened inside the shipping cooler. The unopened travel blanks are then returned to the analytical lab to be analyzed along with collected samples.

### 3.8.6 Field Spikes

Field spikes are used to measure the performance of the complete analytical system, including sample handling, preservation and storage, as well as interference from the sample matrix. To generate a field spike, field personnel fill the usual sampling container with sample, leaving a small amount of space at the top. They then add a specified amount of the chemical or compound of interest to the bottle and submit it with the rest of the samples. In general, field spikes are not recommended due to the logistical difficulties of transporting concentrated solutions in the field. If there is reason to doubt the performance of the sampling system, then a separate study involving field spikes should be carried out.

### 3.8.7 Standard Reference Samples

Standard reference samples, or blind QA samples, are samples of known concentration that are submitted to the analytical lab as a normal sample. The lab is not informed about the identity of the sample until after all analyses are complete.

### 3.8.8 Replicate Samples

Replicate samples are used to evaluate within-site variation. Replicate samples are collected by filling multiple containers at a single site. They are labeled and preserved individually and are submitted separately to the analytical laboratory. Check the field sampling plan (FSP) for the number of replicate samples required per sampling site.

### 3.8.9 Split Samples

Split samples are used to check analytical variation. A single sample (e.g. grab) is collected and is split into two sample containers. These are labeled and preserved individually and are submitted separately to the analytical laboratory.

## 4. REFERENCES AND SUGGESTED READING

ASTM, 1994, *Annual Book of Standards, Volume 04.08, 1994*, American Society of Testing and Materials, Philadelphia, PA.

Clesceri, L.S., A.E. Greenberg and R.R. Trussell. 1989. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington, D.C.

Feldt, L., Editor, 1987, *A Compendium of Superfund Field Operations Methods*, U.S. Environmental Protection Agency Report No. 9355.0-14, Washington, D.C.

Golder Associates Inc. Quality Procedure QP-11.1, "Calibration and Maintenance of Measuring and Test Equipment."

Golder Associates Inc. Technical Procedure TP-1.2-23, "Chain of Custody."

U.S. Department of the Interior, 1977, National Handbook of recommended methods for water-data acquisition, Reston, VA.

U.S. EPA, 1994, *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganics Data Review*, EPA 540/R-94/013, U.S. EPA Office of Emergency and Remedial Response, Washington, D.C.

U.S. Geological Survey, 1982, Measurement and Computation of Streamflow: Volume 1 and 2. Washington, D.C.

U.S. EPA, 1986, *Test Methods for Evaluating Solid Waste - (SW-846)*, 3rd Edition (Final Update III, December 1996), U.S. EPA/Office of Solid Waste, Washington, D.C.

40 CFR 136, U.S. EPA, *Guidelines Establishing Test Procedures for the Analysis of Pollutants.* Title 40 Part 136 of the Code of Federal Regulations.

# 5. DISCUSSION

## 5.1 Sampling Procedures

Samples are collected as representative pieces of a larger puzzle. Ideally, they should describe all of the characteristics of the larger body from which they originate, which, by its very definition, is too large to analyze directly. As a result, it is very important to follow a well-organized sampling plan and to preserve sample integrity throughout the collection and transportation process.

### 5.1.1 General Practices

Usually, analytical laboratories will provide pre-cleaned sample containers, shipping containers, required forms for sample submission and specific sample shipping instructions. It is important to check with the lab that these arrangements have been made. Similarly, field crews should familiarize themselves with the FSP before initiating a sampling program. By reviewing the instructions, personnel can ensure that they have all of the equipment they require to fulfill the objectives of the sampling program. Field crews will also then be aware of the types of samples they are being asked to collect, be they grab samples, composite samples or QA/QC test blanks. Finally, sample crews should organize themselves such that samples will be collected and shipped during the early part of the work week to avoid delays caused by weekend shipping or make specific arrangements with laboratories to receive samples on the weekend.

**Sampling Locations.** General sampling locations are described in FSP. However, field crews will have a certain degree of freedom in choosing the exact locations from which to take the samples. When selecting these sites, personnel should consider the layout of the local

environment, project objectives and personal safety. They should then choose areas that are both easily accessible and representative of the target waterbody or waterbodies.

Once sampling sites have been identified, they must be described relative to permanent landmarks, such as groundwater wells, outfalls or distinctive landscape features; measuring the distance from permanent landmarks to each site with an appropriate compass heading is recommended. Ideally, one should try to use the Global Positioning System (GPS), but locations can also be recorded as the perpendicular distance from the shoreline and the distance upstream or downstream of a permanent landmark.

**Sample Collection.** Where possible, start sampling at the least contaminated site (i.e., the reference site) and move from there to the more contaminated areas.

If sampling equipment must be used, then it must be cleaned before and after use. This may involve rinsing with ambient water, cleaning with soap and water, acid washing, rinsing with organic solvents or pure water, or a combination of these. Refer to the FSP for details.

Each sample bottle must be labeled at the time of collection with either waterproof, permanent marker or using pre-printed waterproof labels. See section 5.3.2 for details of label format.

When sampling, it is important to rinse sample containers 3 times before taking a sample. Rinse each bottle by partially filling it with ambient water, loosely attaching the cap and shaking the bottle; drain the water and repeat the process. As a general rule, rinse plastic bottles unless instructed otherwise by the analytical laboratory. Bottles that already contain the appropriate preservatives and containers for the following analyses should *not* be rinsed prior to taking the sample:

- volatile organic compounds (VOCs), including total volatile hydrocarbons (TVH),
- total extractable hydrocarbons (TEH),
- BTEX (benzene, toluene, ethylbenzene and xylene)
- total petroleum hydrocarbons (TPH; includes TVH, TEH and BTEX); and
- bacteriological testing (e.g., fecal coliforms).

Carefully fill sample containers, without splashing, leaving only enough space for preservatives (if required - see Table 1 ). Be sure to keep hands and fingers downstream of bottle opening and sample upstream of bridges, boats and yourself to prevent sample contamination. The samples will be collected in flowing water, unless otherwise specified in the FSP, from areas where the flow is well mixed. If no preservatives need to be added, completely fill the bottles and cap tightly. There should be as little air in the containers as possible, as it can affect sample integrity.

Whenever possible, fill sample containers directly from the source, without using an intermediate container to transfer the sample. This avoids potential sample contamination due to carry-over from one sample to the next. Also, take care to avoid contaminating sample

waters through contact with rubber, oil, gasoline and other machinery fluids, metal-based paints, cigarette ash, paper tissues and other such material.

Sample bottles should then be stored appropriately (Table 1). In most cases, this will involve keeping the sample cool (4°C) and dark. Samples should never be allowed to freeze and should be shipped as soon as possible to the appropriate analytical lab, in coolers with reusable ice packs. Avoid using bags of ice purchased from convenience stores; the water that leaks out of these bags as the ice melts may ruin sample labels.

Chain-of-Custody and Analytical Request forms must accompany all samples (one set of forms per sample shipment). Prior to shipping, the person submitting the sample should inform the analytical lab by telephone, e-mail, or fax that the samples will be arriving. As well, he or she should check back later to confirm arrival of the samples and to explain analysis requests if needed.

### 5.1.2 Sampling for Metals

When collecting samples for a metals analysis, it is important that sample waters do not come into contact with any metal products. Samples for metals analysis also have other stringent collection and preservation requirements (Table 1). For example, waters collected for dissolved metal analysis have to be field-filtered using a 0.45 $\mu$m polycarbonate or cellulose acetate filter and then preserved with acid. Field-filtering should be conducted as soon as possible after sampling. If field-filtering is not possible, then acid preservatives should not be added and the laboratory should be notified to filter the sample as soon as possible after sample receipt.

Field crews need to be aware of these restrictions to ensure that samples are taken correctly and that they maintain their integrity until they can be analyzed. Special sampling and preservation instructions should be included in the FSP.

### 5.1.3 Sampling for Organic Chemicals

In addition to the general principles outlined above, there are specific protocols associated with sampling for organic measurements. As described above, sample bottles should *not* be rinsed prior to taking samples for certain organics analyses. It is also very important to completely fill each bottle, as certain organics will volatilize into the overlying air space and will be lost after opening the bottle. Finally, proper containers must be used when sampling for organics, since some bottles will release or absorb organic compounds when filled with water. Generally, glass containers are used, but certain tests may require other materials; be sure to obtain the appropriate sample bottles from the analytical laboratory and refer to the FSP.

## 5.2 Sample Documentation

Proper sample documentation is important because lack of careful documentation can lead to misunderstandings and questionable test results. Components of proper documentation of field activities are described below.

### 5.2.1 Field Notebooks

Field notebooks must be kept, describing all field activities. Format of field notes and information to be recorded should follow Golder Associates' specific guidelines. During the field survey, field notes must be maintained in a permanent, safe location at the field site where samples are collected. If possible, new entries in the field note book should be photocopied at the end of each field day and copies should be stored in a safe place.

### 5.2.2 Sample Labels

Sample labels must contain the following information:

- Sample identifier (name of site or sample code);
- Date (written as day/month/year; month abbreviated as three letters) and time (24 hour clock) of collection;
- Initials of collector; and
- Analysis requested (this is usually done by the analytical laboratory in the form of a code on the sample bottle).

Fill out labels at the time of collection using waterproof ink and affix a label to each sample container. Plastic bottles may be labeled by writing directly on the bottle using a waterproof marker; however, this approach is not recommended if samples are transported over long distances (friction may rub label off) or if bags of ice are used to keep the samples cool (water may damage label information).

### 5.2.3 Custody Seals

Numbered seals should be used (when required by the FSP) to detect tampering with samples in transit. Attach the seal in a way that it is necessary to break it to open the cooler containing the samples. The number on the custody seal should be recorded in the field note book and on the Chain-of-Custody and Analytical Request forms

### 5.2.4 Chain-of-Custody Forms and Analytical Request Forms

Chain-of-Custody and Analytical Request forms must accompany all samples submitted for analysis in accordance with procedure TP1.2-23, "Chain of Custody". These forms are usually combined as a single document. An example of Golder Associates' combined Chain-of-Custody and Analytical Request Form is provided in Exhibit 1.

The combined form must be filled out completely and the white and yellow copies should be sent along with the samples being submitted. Field personnel should retain the pink copy after it is signed by the shipper. Depending on the shipping container, these forms can either be enclosed inside the sealed container or attached firmly to the outside of the container. In either

case, it is advisable to enclose the forms within a waterproof plastic bag to guard against damage. It is important that each person having custody or control of the samples identify themselves on this form. This means the person collecting the sample; intermediate persons involved in packaging, storing or transporting the sample; and the person accepting the sample on behalf of the analytical lab must all be identified.

### 5.3 Sample QA/QC

The main goal of sample QA/QC is to monitor for various sources of contamination during sample collection, transport and analysis. This process will involve the use of field, travel and other test blanks. QA/QC programs are designed on a project-specific basis. Details of individual QA/QC programs are described in the FSP.

## 6. EQUIPMENT AND MATERIALS

### 6.1 Sampling

The following is a list of sampling equipment generally recommended for surface water sampling:

- Pre-cleaned sample bottles and required preservatives (usually supplied by the analytical laboratory)
- Coolers and reusable ice packs
- Waterproof labels and permanent markers
- Sampling equipment (e.g. Kemmerer or Van Dorn bottles)

### 6.2 Site Location and Sample Documentation

For proper sample site identification and sample documentation, field crews may need:

- Bound, water-proof field logbooks
- Maps
- Air photos
- Indelible ink pens and pencils
- Long tape measure
- Survey flagging tape
- Compass
- GPS unit
- Combined Analytical Request and Chain-of-Custody forms

## 6.3 Health and Safety

The following health and safety equipment is recommended for surface water sampling:

- Waders and waterproof gloves
- Heavy socks, warm pants, rain gear and other articles of clothing suitable for prolonged water work
- Extra set of clothes
- First aid kit
- Approved personal floatation device for deep water or boat work

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TABLE 1

SAMPLE CONTAINER CODES, TYPES, VOLUMES, PREPARATION,
SPECIAL HANDLING, PRESERVATION, HOLDING TIMES


| Analysis | Cont. Code | Containers, Water | Handling and Preservation | Holding Time |
|---|---|---|---|---|
| Volatile Organics | V | 2, 40ml glass vial teflon lined septum | Store 4±2°C; handle upwind from equip. Fumes, no headspace permitted; Pres with HCl to pH <2 for volatile aromatics | 7 days<br>14 days (HCl pres.) |
| Base/Neutral and Acid Extractable Organics | SV | 2, 1 liter amber glass, teflon lined cap | Store 4±2°C; handle upwind from equip. fumes; no contact with plastics, gloves | 7 days until extraction<br>40 days thereafter |
| Organochlorine Pesticides and PCBs | P | 2, 1 liter amber glass, teflon lined cap | Store 4±2°C; handle upwind from equip. fumes; no contact with plastics, gloves | 7 days until extraction<br>40 days thereafter |
| Herbicides | H | 2, 1 liter amber glass, teflon lined cap | Store 4±2°C; handle upwind from equip. fumes; no contact with plastic, gloves | 7 days until extraction<br>40 days thereafter |
| Total Fuel Hydrocarbons (Fuel Fingerprint) | TH | 1, 125 ml amber glass, teflon lined septum | Store 4±2°C; handle upwind from equip. fumes, no headspace permitted; pres with HCl to pH <2 | 14 days |
| Total Petroleum Hydrocarbons or Oil and Grease | OG | 1, 1 liter glass, teflon lined cap | Store 4±2°C; handle upwind from equip. fumes, no contact with gloves or plastics; pres with HCl to pH <2 | 28 days |
| Cyanide (total) | CN | 1,1 liter plastic | Store 4±2°C; pres with NaOH to pH >12 | 14 days |
| Sulfide (total) | S | 1, 1 liter plastic | Store 4±2°C; pres with ZnOAC/NaOH to pH >12 | 7 days |
| Chloride, Sulfate, pH Conductivity and Total Dissolved Solids | MA | 1,1 liter plastic | Store 4±2°C. | 28 days (Chloride, sulfate and conductivity)<br>Analyze on-site (pH)<br>7 days (TDS) |

TABLE 1

SAMPLE CONTAINER CODES, TYPES, VOLUMES, PREPARATION,
SPECIAL HANDLING, PRESERVATION, HOLDING TIMES,


| Analysis | Cont. Code | Containers, Water | Handling and Preservation | Holding Time |
|---|---|---|---|---|
| Major Cations and Metals | TM | 1,1 liter plastic | 0.45 um filter, pres with $HNO_3$ to pH <2 | 6 months (28 days for mercury) |
| Gamma Emitting Radionuclides | GR | 2, 1 liter plastic | 0.45 um filter, pres with $HNO_3$ to pH <2 | 6 months (record exact date/time of sampling for calculation of half-life decay) |
| Alpha Emitting Radionuclides | AR | 2, 1 liter plastic | 0.45 um filter, pres with $HNO_3$ to pH <2 | 6 months (record exact date/time of sampling for calculation of half-life decay) |
| Beta Emitting Radionuclides | BR | 2, 1 liter plastic | 0.45 um filter, pres with $HNO_3$ to pH <2 | 6 months (record exact date/time of sampling for calculation of half-life decay) |
| Total Phosphorus, Ammonia-N, Nitrate/nitrite-N, COD and TOC | TP | 1, 1 liter plastic | Store 4±2°C; pres with $H_2SO_4$ to pH <2, store in dark | 28 days |
| Orthophosphate | OP | 1, 1 liter plastic | 0.45 um filter, store 4±2°C | 48 hours |

# CHAIN OF CUSTODY RECORD

| PROJ. NO. | SITE/LOCATION |
|---|---|
| SAMPLERS: *(Signature)* | |

| STA. NO. | DATE | TIME | SAMPLE TYPE | MEDIA | SAMPLE IDENTIFICATION | NO. OF CON-TAINERS | AMOUNT/ PRESERVATIVE | | | | | | SEAL NO. | SEAL INTACT ? (Y or N) | REMARKS (with initials) |
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| Relinquished by: *(Signature/Firm)* | Date/Time | Received by: *(Signature/Firm)* | Relinquished by: *(Signature/Firm)* | Date/Time | Received by: *(Signature/Firm)* |
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| Relinquished by: *(Signature/Firm)* | Date/Time | Received by: *(Signature/Firm)* | Date/Time | Remarks (attachments if necessary) | |

EXHIBIT 1

**CHAIN OF CUSTODY FORM**

DEPUE/SURFACE WATER/IL

**Golder Associates**

PROJECT NO. 953 8222.3.3 DRAWING NO. 77288 DATE 3/23/98 DRAWN BY EA