New Mexico Environment Department
Surface Water Quality Bureau

Standard Operating Procedure (SOP)

for

Chemical Sampling in Lotic Environments – Equipment, Collection Methods, Preservation, and Quality Control

Approval Signatures

4/20/15

Douglas Eib
Subject Matter Expert
Date

4/20/15

Jodey Kougioulis
Quality Assurance Officer
Date

4.20.15

James Hogan
Acting Program Manager
Date

1.0 Purpose and Scope

The purpose of this SOP is to describe the sample collection techniques, preservation and acidification requirements, equipment, and quality control activities associated with the chemical sampling of surface water in lotic environments. Aside from some aspects of sample collection, the content of this SOP applies to chemical sampling in lakes but it does not cover chlorophyll *a* sampling, or biological sampling activities in either lentic or lotic environments. Procedures for these activities are addressed in their respective SOPs.

2.0 Responsibilities

Bureau personnel who conduct chemical sampling activities or who supervise those who do are responsible for implementing this procedure.

3.0 Background and Precautions

All chemical water sampling field activities in lotic waters shall conform with this SOP. Methods of sample collection, preservation, and handling used in this SOP shall confirm with methods described in the following references or otherwise approved by EPA:

- "Guidelines establishing test procedures for the analysis of pollutants under the Clean Water Act," 40 CFR Part 136 or any test procedure approved or accepted by EPA using procedures provided in 40 CFR Parts 136.3(d), 136.4 and 136.5;
- Standard Methods for the Examination of Water and Wastewater, latest edition, American Public Health Association;
- Methods for Chemical Analysis of Water and Waste, and other methods published by EPA Office of Research and Development or Office of Water;

- Techniques of Water Resource Investigations of the USGS;
- Annual Book of American Society for Testing and Materials (ASTM) Standards. Volumes 11.01 and 11.02, Water (I) and (II), latest edition, ASTM International;
- Federal Register, latest methods published for monitoring pursuant to Resource Conservation and Recovery Act regulations;
- National Handbook of Recommended Methods for Water-Data Acquisition, latest edition, prepared cooperatively by agencies of the U.S. Government under the sponsorship of the USGS; or
- Federal Register, latest methods published for monitoring pursuant to the Safe Drinking Water Act regulations.
- State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC). Most current amendments.

Site conditions or project-specific data collection objectives may necessitate the use of alternative field procedures not included in this SOP. The use of field methods other than those presented in this SOP must be approved by the Program Manager and alternative methods must be accurately documented.

If other stream sampling work is to be done simultaneously with, or prior to, the collection of water samples, collect water samples at a sufficient distance upstream to prevent interference or contamination or wait for disturbed water to flow past the collection site.

Use gloves when handling caustic and acidic substances and waters suspected to have high bacterial contamination. Do not wade in a stream if the depth (ft) of the stream times the stream velocity (cfs) is greater than ten (The “RULE OF 10”).

4.0 Definitions

Analyte-Free Water – Water free of, or with the lowest attainable concentrations, of the analytes tested for in the requested analyses for a blank. Usually deionized, polished water obtained from the SLD Organics Section.

Sample – The medium, the sample bottle and preservative or growth reagents. It includes those materials that cannot be readily separated from the medium that is sampled.

Sampling equipment – Anything the medium contacts before becoming a sample.

Field blank – A sample of analyte-free water and preservative, if required, that is exposed to ambient environmental conditions at the sampling site and to transportation and storage conditions. Field blanks are prepared in the field to check for contamination from the sampling equipment, added reagents, and from the environment. *E.coli* and SWQB nutrient blanks are examples of field blanks.

Trip blank – A sample of analyte-free water and preservative that is prepared at the analytical facility, sealed, transported and analyzed with environmental samples. Trip blanks are not exposed to ambient environmental conditions at the sampling site. Trip blanks are currently run only for volatile organic compounds (VOCs).

Reagent blank – A sample of analyte-free water and reagent that is prepared in the lab but not exposed to ambient sampling conditions. Reagent blanks check for contamination from sampling equipment and reagents. Reagent blanks are currently run only for *SLD* nutrient blanks.

Equipment blank – A sample of analyte-free water and preservative, prepared in the field, that has contacted all sampling equipment. Equipment blanks serve as a control for sample contamination from the sampling equipment and preservative, but they also include contributions from the ambient environment at the sampling site. Equipment blanks are currently run only for dissolved metals.

Duplicate – A sample that is split after collection and analyzed as two routine samples.

Replicate – A sample that is collected within 15 minutes and within 1 meter of routine sample and analyzed as a routine sample.

Run/Sampling Run – A period of time used to represent and define the most common collecting period or grouping of sampling activities that are indicative of SWQB MASS sampling operations. Typically, most samples are collected during multi-day collection events that depart and return to the office in a given week (M-F). Blanks associated with a run are assumed to collectively represent a grouping of samples whereby the staff, equipment, vehicle, reagents, preservation, and storage remain constant. When multiple single day trips are planned within a given week that maintain constant variables as described above, the single day trips may be considered collectively as a run, provided that the number of blank QC samples collected represents at least 10% of ambient samples collected, preferably at a one blank sample per ten ambient sample frequency to allow for QC blank distribution.

5.0 Equipment and Tools

The following list (Table 1) includes equipment that may necessary for surface water chemical sampling in lotic waters:

Table 1. Sampling equipment for lotic waters.

SAMPLING SUPPLIES	**GENERAL**
Field sheets	Access authorization documents
Submittal forms	Defensive driving certificate
RID stickers	Camera
Cartridge filters (0.45 μm and 10 μm)	Cell phone
Acid washed silicon tubing	Coolers
Cubitainers (quarts, gallons)	First aid kit
Geo pump, with appropriate power cord(s)	Flashlight
Kimwipes	GPS unit
Acid kit with concentrated sulfuric and nitric acid,	Maps
Pipettors and bagged pipettor tips	NMED ID
Nitric Acid	Business cards
Sulfuric Acid	Shovel
Nitrile gloves	Toolbox
Organics sample bottles (vials/bottles)	Calculator
Pencils	Vehicle Kit
Sharpies (fat and fine point)	Hat
Pipettor repair kit	Sun screen
Wash bottles with analyte-free water and/or ethanol	Neoprene gloves
Analyte-free water for preparing blanks	Rain gear
Hammer	Sunglasses/polarized glasses
Measuring tape (in feet and/or meters)	Clipboard
Wading rod	Boots/waders/sandals
Flow meter and cable	Garbage bags
Potassium iodide (KI) starch Test Paper	Apron
Nylon rope	
Metal bucket	**EQUAL WIDTH SAMPLING**
Plastic bucket	Churn splitter
Ice	measuring tape or tagline (feet and metres)
Coolers	Isokinetic samplers

Pre-acidified containers	DH-48
pH paper	DH-95
Sodium hydroxide pellets	DH-81
10% HCl for acidifying VOC samples	nozzle (5/16-inch)
Whirl-Packs	Teflon or polypropylene 1L collection bottle
Reference ID stickers	Disposable bailer
Ascorbic acid	Winch
Sodium thiosulfate	1/2-in diameter wading rod
VOC trip blanks	Bridge Board
Safety glasses	Orange Cones and Vests

6.0 Collecting a Water Sample (Process Description)

Collect water samples by immersing the sample container beneath the surface of the water with the container mouth facing upstream and all exposed flesh below or downstream from the opening of the container. Collect water samples from near-surface water, in most streams this is representative of the water mass. Attempt to sample where the stream is flowing, well mixed and preferably more than 6 inches deep. Sample as far away from the bank as possible if there is reason to believe the water is not well mixed, and remain downstream of the sampling bottle when sampling. Avoid getting streambed sediment or water surface materials in the sample. For Equal-Width-Increment (EWI) and Depth-Integrated (DI) Sample Collection Methods see Appendix**.** A.

Collect all water samples in new sample containers. Do not rinse sampling containers with distilled or sample water before collecting the sample. Consult the SWQB Chemical Hygiene Plan (CHP) and/or the SWQB Lab Safety Officer regarding acceptable practices for transferring concentrated acid in the Runnels Building Laboratory. Containers can be pre-acidified up to 1 week before use. Pre-acidified containers should be stored in secondary containment, such as coolers with the lid propped open to minimize vapor buildup. Pre-acidified containers should not be opened in a closed area or near the face.

Label all sample containers with the sample site location and sample type and place pre-printed SLD reference ID stickers on the lid. Write the RID number on the container with a Sharpie. A summary of the containers, sample preservatives, and holding times for various analyses is given below (Table 3). Use self-adhering labels for organic bottle. Fill out labels on organics bottles and label cubitainers before sampling to avoid having to write on wet surfaces.

Use a bucket or disposable bailer and nylon rope to collect water if sampling containers cannot be dipped directly in the water. Avoid contaminating the sample with debris from the rope and bridge, or other sampling platform. Use the first bucketful of water to rinse the bucket and the sampler's hands. Use the second and third buckets of water to collect the sample. Use a metal bucket when collecting organic samples and a plastic bucket when collecting metals samples. Do not let the metallic sonde components touch the sample water prior to collecting the sample from a bucket if sampling for metals.

6.1 Sample Collection and Processing for Specific Parameters. Refer to the SLD interactive submission form for analytical suite compositions.

(http://www.sld.state.nm.us/Documents/SLD_CB_Analytical_Request_Form_Interactive.pdf).

6.1.1 Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Chloride (Cl) and Sulfate (SO_4)

Fill a 1-quart cubitainer or a 500 ml HDPE bottle if only TSS and or TSS samples are needed. Keep sample on ice, at 6°C or less.

6.1.2 Nutrients

Fill a 1-quart cubitainer and acidify with approximately 2 ml concentrated sulfuric acid or enough to adjust the pH to < 2. If using a pre-acidified container, do not overfill. Samples may also be collected in 500 ml, high density polyethylene bottles acidified with 1 ml concentrated sulfuric acid. Keep sample on ice, at 6°C or less.

6.1.3 Total Metals

Fill a 1-quart cubitainer and acidify with 5 ml of concentrated nitric acid. Deliver two - 2.5 ml aliquots of acid to minimize exposure of metal pipettor parts to the acid. If using a pre-acidified container, do not overfill. Keep sample at ambient temperature.

6.1.4 *Total Recoverable Aluminum*

If stream turbidity is 30 NTUs or below, follow the instructions for total metals samples. If stream turbidity is greater than 30 NTUs, follow the instructions for dissolved metals samples but use a 10 μm filter instead of a 0.45 μm filter. If there are equipment problems prohibiting the measurement of turbidity in the field and the water has any cloudiness as determined by visual inspection, then the total recoverable Al sample should be filtered using a 10 micron filter. Keep sample at ambient temperature.

6.1.5 *Hardness/Dissolved Metals*

Fill a 1-quart cubitainer and set up the Geo Pump by connecting a power cord to a cigarette lighter, a 110 VAC outlet or a 12 V battery and clamping a piece of acid-washed, 0.19 inch internal diameter silicone tubing in to the pump head. Avoid touching the ends of the tubing even with gloved hands and do not let the ends of the tubing contact metal. Attach a 0.45 μm filter to one end of the tubing by pulling the plastic bag containing the filter over the barbed fittings until they rupture the bag and pushing the tubing onto the fitting on the upstream end of the filter. Insert the opposite end of the tubing into the cubitainer. Pump approximately 50 ml of sample water through the filter, discard and collect the remainder in a second, 1-quart cubitainer. Keep the filter to the side of the neck of the receiving cubitainer to prevent dirt and dust from falling into the sample. Reduce the pumping rate when sample is turbid. Acidify with two 2.5 ml aliquots of concentrated nitric acid. Keep sample at ambient temperature.

6.1.5 Radionuclides

Fill two, 1-gallon cubitainers. Preserve samples with sufficient nitric acid to adjust the pH to below 2. Typically, 7-10 ml per cubitainer is adequate. Check pH with pH paper on an aliquot of the acidified sample if unsure. If pH paper is not available, use at least 10 ml of nitric acid to preserve.
Keep sample at ambient temperature.

6.1.6 Cyanide

Fill a 1-quart cubitainer. Evaluate the sample water for the presence of chlorine. Samples from streams that are not immediately downstream from outfalls are unlikely to contain chlorine. If the chlorine is suspected to be present, samples can be checked using potassium iodide (KI)-starch test paper. A blue color indicates the presence of chlorine.

If chlorine is present, it must be removed using ascorbic acid. To do this, add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the starch test paper then add one additional crystal.

After adding ascorbic acid (if necessary), preserve samples for cyanide analysis with sodium hydroxide. Determine the pH of the sample on an aliquot (after adding ascorbic acid) using pH test paper. Preserve the sample with sufficient NaOH to produce a pH of 12 or greater. Most samples will require about 0.5 g solid NaOH per liter, approximately five pellets. Handle the pellets with wooden or plastic utensils, or pour directly from the container. Keep samples on ice, at 6°C or less.

6.1.7 Organic Chemicals

Project coordinators are responsible for obtaining organics sample containers from the SLD Organics Section (505-383-9031) and should contact them at least 1 week prior to sample collection to ensure extractions and analyses can be carried out within holding times. When collecting samples for organic compounds, wear nitrile gloves. Gloves are worn to prevent organic compounds that may be present on skin from contaminating samples. Avoid the false sense of security gloves may give; a gloved hand can still spread contamination. Put gloves on as close to the time of sample collection as possible. Use sampling equipment with fluorocarbon polymer, glass, or metal components if components will directly contact samples to be analyzed for organic compounds. Do not use plastics other than fluorocarbon polymers. Organic compounds tend to concentrate on the surface of sampling devices or containers, therefore do not rinse the sampling device and sample container with native water before being. Store VOC preservative at 20° C and use within 1 month. Store and transport all organic samples on ice at approximately 6°C.
.
Free chlorine will oxidize organic compounds in the water sample even after it is collected. If in-stream residual chlorine is suspected, measure the residual chlorine using a separate water subsample. If residual chlorine is above a detectable level (i.e., the pink color is observed upon adding the reagents), immediately add 100 milligrams (mg) of sodium thiosulfate to the pesticides, herbicides, semivolatiles, and volatile organic samples; invert until the sodium thiosulfate is dissolved. Record the residual chlorine concentration on the field sheet. If residual chlorine is below detectable levels, no additional sample treatment is necessary.

6.1.8 Volatile Organic Compounds (VOCs)

For each sample planned, obtain two-40 ml vials in a whirl pack from the SLD Organics Section. Fill the vials by submersion. Add 5 drops of 10% HCl (also obtained from the SLD Organics Section and less than 30 days old) to each vial. Fill the caps with sample water and cap the vials without leaving a headspace. Keep the vials together in a closed Whirl-Pack, on ice, at 6°C or less.

6.1.9 Semivolatile Organics Compounds (SVOCs), Herbicides, Pesticides

For each sample planned, obtain two 1L glass, amber colored bottles with Teflon lined caps and a bubble wrap sleeve for each from the SLD Organics Section. Fill both bottles by submersion and replace the lids underwater if possible. If the stream is not deep enough to submerse the sample container, use a third 1-L glass amber bottle or other glass container to fill the two sample bottles. A headspace is acceptable with SVOC samples. Keep jars in bubble-wrap sleeves before and after filling to avoid breakage. Store samples in the dark and on ice, at 6°C or less.

6.1.10 Total Residual Chlorine (TRC)

Collect samples for residual chlorine measurements directly below waste water treatment plant outfall when sampling for NPDES purposes. Fill the 10-ml sample cell bottles provided in the HACH Chlorine Pocket Colorimeter kit to the line either directly from stream or from an aliquot of sample water. Wipe off excess water from the outside of sample bottles with lens paper or a KimWipe and ensure that the glass is dry and clean (no fingerprints or smudges). Add the content of one DPD Total Chlorine Powder Pillow to one 10-ml sample cell and gently shake for 20 seconds. Let it stand for 3 to 6 minutes before reading. During this period, place the other 10-ml cell bottle (the blank) into the colorimeter cell holder, with the diamond mark facing you. Tightly cover the cell with the instrument cap and press zero. Remove the blank sample cell bottle from colorimeter cell holder. Place the cell bottle with reagent into the colorimeter cell holder and cover tightly with instrument cap. Between 3 and 6 minutes after adding the reagent to the sample press READ and record the total residual chlorine value (in mg/L) in the comment section of field sheet.

6.2 Ambient Water Toxicity Testing

The USEPA Houston laboratory conducts aquatic toxicity tests of water as part of the EPA Region 6 Ambient Toxicity Monitoring Program. An application process is required by EPA before selecting and scheduling ambient water toxicity testing. All sampling should follow the current EPA procedures.

6.3 Compliance Sampling

Collect effluent and compliance samples according to procedures outlined in this SOP. Collect samples from the facility outfall sampling location if practical and appropriate; and from existing stations, if available. If pre-existing stations are not available, then select stations that are representative of the effluent discharge quality. Select an accessible station far enough upstream from the discharge point to eliminate any possibility of influence from the discharge and a downstream station at a point where the effluent is completely mixed in the receiving water if a mixing zone is allowed or immediately below the discharge if collecting samples not subject to mixing zone limitations (e.g.samples for acute aquatic life criteria – see 20.6.4.11.NMAC E.1-5 for a complete list). The point where the effluent is mixed with the receiving water can be determined by checking the specific conductance of a transect taken completely across the receiving water. When the readings are consistent, (±10 µmhos/cm) the effluent is considered to be completely mixed for sampling purposes. Sampling frequency is once per compliance sampling inspection event and the number of samples taken is one for all parameters except bacteria, which has a sample size of two. Document any deviations from the sampling plan.

6.4 Quality Control Activities

Prepare and submit blanks at a frequency of one per sampling run, unless specifically indicated by the field sampling plan. See Section 4.0 for definitions of quality control samples.

Table 2. Blank types and frequencies. Analytes not listed do not require blanks.

Analytical Suite	21* Field Blank	26* Trip Blank	27* Reagent Blank	28* Equipment Blank	Submittal Frequency (per run**)
TSS/TDS/ Cl/SO_4	X				1

Analytical Suite	21* Field Blank	26* Trip Blank	27* Reagent Blank	28* Equipment Blank	Submittal Frequency (per run**)
SLD Nutrients			X		1 (recommended)
SWQB Nutrients	X				1
E.coli	x				1
Dissolved Metals				X	1
SVOCs/ Herbicides/ Pesticides	X				1
VOCs		X			1

* Numbers refer to Water Quality Exchange (WQX) activity type. ** Run is usually equivalent to a sampling trip. Some surveys are composed of multiple day trips in which case blanks should be collected at a rate of 10% of the total number of samples for each parameter

6.4.1 SWQB Nutrient Field Blank

Fill a 1-quart cubitainer with analyte-free water from an SLD nutrient blank in the field. If the environmental nutrients samples are collected in pre-acidified cubitainers, use a pre-acidified container for the blank. If acidifying in the field, add 2 ml of concentrated sulfuric acid when acidifying the environmental samples. Keep blank on ice, at 6°C or less and avoid exposure to UV light to the extent possible.

6.4.1.1 SLD Nutrient Reagent Blank

Obtain a 1-quart cubitainer filled with analyte-free water from SLD and prepared within 30 days of acidification. The blank should be kept at 6 C or less, Avoid exposure to UV light to the extent possible. Acidify before leaving on the sample rune and return to the cold room. Submit with other samples from the run.

6.4.2 TSS/TDS/Cl/SO_4 Field Blank

Fill a 1-quart cubitainer in the field with analyte-free water and hold at 6 C or less.

6.4.3 Cyanide Field Blank

Fill a 1-quart cubitainer with analyte-free water in the field. Add the same number of sodium hydroxide pellets to the blank as were added to the environmental samples. Keep blank on ice, at 6°C or less.

6.4.4 Dissolved Metals Equipment Blank

Fill a 1 quart cubitainer with analyte-free water in the field. Follow the procedure for collecting a dissolved metals sample (6.1.5) but instead of inserting the tubing into the cubitainer containing the environmental sample water, insert it into the cubitainer containing the analyte-free water. Rinse the tubing and filter with approximately 50 ml of analyte-free water and collect the remainder in a 1-quart, pre-acidified cubitainer, if pre-acidified cubitainers were used for environmental samples, or into a clean, 1-quart cubitainer and acidify with 5 ml of concentrated nitric acid if the environmental samples are being acidified in the field. Keep blank at ambient temperature. After the blank has been prepared, transfer the tubing to the 1-quart cubitainer containing the environmental sample and proceed with method 6.1.5.

6.4.5 Volatile Organic Compounds (VOC) Trip Blanks

The SLD Organics Section prepares VOC Trip Blanks. They should be included with any request for VOC sample vials. They should be labeled by survey staff, kept in a Whirl-Pack and exposed to the same conditions as environmental VOC samples, except that the vial lids should never be removed.

6.4.6 Other Blanks

Collect blanks for ions, organics or total metals only if required by the field sampling plan. For other types of equipment blanks, pour analyte-free water into or over a sampling device (e.g., Van Dorn, Kemmerer, churn splitter, etc.) or pump the water through a sampling device. Collect the blank in the same type of container as the routine environmental sample, preserve and transport in the same manner and analyze for the same parameters.

6.4.6 Replicates and Duplicates

Collect replicate or duplicate samples only if required by the study or the field sampling plan.

6.5 Handling, Packaging, and Transporting Samples

After collection, place samples with temperature storage requirements in coolers. Ensure that all samples required to be kept cool are surrounded and in contact with enough ice to cool to approximately 6°C. It is important that containers are in an ice bath; i.e. in contact with water that is in contact with ice, especially in warm weather, to ensure adequate cooling. Make sure that all glass sampling containers are placed in bubble-wrap sleeves to protect from breaking. Bubble-wrap may insulate samples from cooling and it may be necessary to place additional ice in coolers. Check to see that samples are adequately labeled and that container lids are secure. Handling procedures and holding times are summarized below (Table 3).

6.5.1 Sample Custody

Two levels of sample custody are practiced at the SWQB: a sample tracking procedure used for ambient/assessment water quality monitoring samples and a formal chain of custody procedure used for compliance monitoring samples. Samples taken for ambient/assessment monitoring purposes do not require formal chain of custody procedures. However, to ensure the integrity and quality of these samples, the SWQB uses a sample tracking procedure that requires that the receiving laboratory

acknowledges receipt of the samples by date stamping the submittal forms and providing copies of the stamped forms to the person delivering the samples.

A formal chain of custody is required for compliance monitoring purposes only. Compliance samples require an additional handling step of sealing all samples collected for compliance monitoring purposes with evidence tape to prevent tampering or contamination. Samples taken in all cases involving a facility, permit, certificate, order or potential violation of a regulation or law shall follow chain of custody procedures provided by the contracted analytical laboratory.

Table 3. SWQB chemical sample handling procedures and holding times.

Sample Type	Sample Container	Processing, Preservation and Storage	Maximum Holding Time
TSS/TDS/Cl/SO_4	1-quart polyethylene cubitainer or 250 ml HDPE bottle if sample is only for TSS/TDS	On ice, approximately 6°C	7 days if TSS included; other-wise 14 days.
Total Nutrients	1-quart polyethylene cubitainer	2.0 ml concentrated sulfuric acid, on ice, approximately 6°C	28 days
Cyanide	1-quart polyethylene cubitainer	5-7 pellets NaOH, 0.6g ascorbic acid if chlorine present, on ice, approximately 6°C	14 days
Total Metals	1-quart polyethylene cubitainer	5.0 ml concentrated nitric acid	28 days
Total Recoverable Aluminum	1-quart polyethylene cubitainer	Filter (10 μm) within 15 min of sample collection; 5.0 ml concentrated nitric acid.	6 months
Dissolved Metals / Hardness	1-quart polyethylene cubitainer	Filter (0.45 μm) within 15 min; 5.0 ml concentrated nitric acid	28

Sample Type	Sample Container	Processing, Preservation and Storage	Maximum Holding Time
Semivolatile Organic Compounds, Herbicides, Pesticides	Two 1-liter glass amber bottles (lab)	On ice, approximately 6°C	7 days
Volatile Organic Compounds	Two 40-ml glass vials (lab) in a Whirl-Pack	5 drops 10% HCl per vial (HCl provided by lab and prepared within 30 days of use), on ice, approximately 6°C	14 days
Radionuclides	Two 1-gallon polyethylene cubitainers	7-10 ml concentrated nitric acid per gallon	6 months

7.0 Related Forms

Stream Field Data Form
Chemical Sampling Equipment Checklist
Total Residual Chlorine Data Upload Form

8.0 Revision History
Revision 4 - 4/6/2015 – Changes to blank definitions and types. Added TSS/TDS/Cl/SO_4 blanks
Revision 3 – 4/2/2013 – Minor edits to language and some clarification regarding preservation
Revision 2 – 12/20/12 – Updated Table 3 and additional language regarding total recoverable aluminum
Revision 1 – 1/23/2012 – Minor edits throughout SOP
Original – 3/21/2011

References

New Mexico Environment Department/Surface Water Quality Bureau (NMED/SWQB). 2010. Quality Assurance Project Plan for Water Quality Management Programs. Santa Fe, NM.

United States Environmental Protection Agency (US-EPA). 1994. *NPDES Compliance Inspection Manual*. EPA/300/B-94/014. Office of Enforcement and Compliance Assurance, Washington, DC. September.

United States Geological Survey (USGS). 1968. Techniques of water-the United States Geological Survey, General Procedure Chapter A6. US Government Printing Office, Washington, DC.

APPENDIX A - Equal-Width-Increment (EWI) and Depth Integrated (DI) Sample Collection Methods

Use EWI and DI sampling methods if a stream is large and not well mixed due to inflows from large tributaries, ephemeral channels, waste water treatment plants (WWTPs), and/or agricultural return flows. The preferred sampling technique is the EWI method (USGS 1999). Whether to sample only suspended sediments using EWI methods or to sample additional parameters using EWI methods is at the discretion of the study lead based on the level of mixing in the channel and the objectives of the study.

A.1 Determination of Verticals

String a measuring tape or tagline from bank to bank. Establish between 10 and 20 verticals, depending on the extent to which the stream is not well mixed, by dividing the stream width by the desired number of verticals. Locate the sample station within each width increment at the center of the increment (W/2). If the width increment results in a fraction, the number is rounded to the nearest integer to determine the initial station (Figure 1).

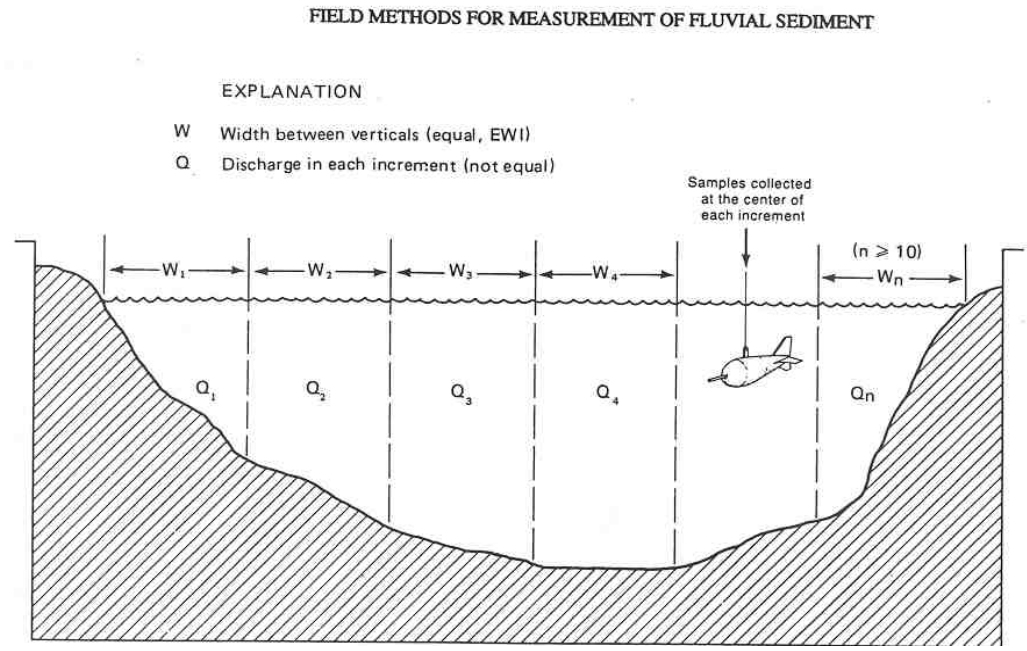


Figure 1. Equal-width-increment verticals (from USGS 1999).

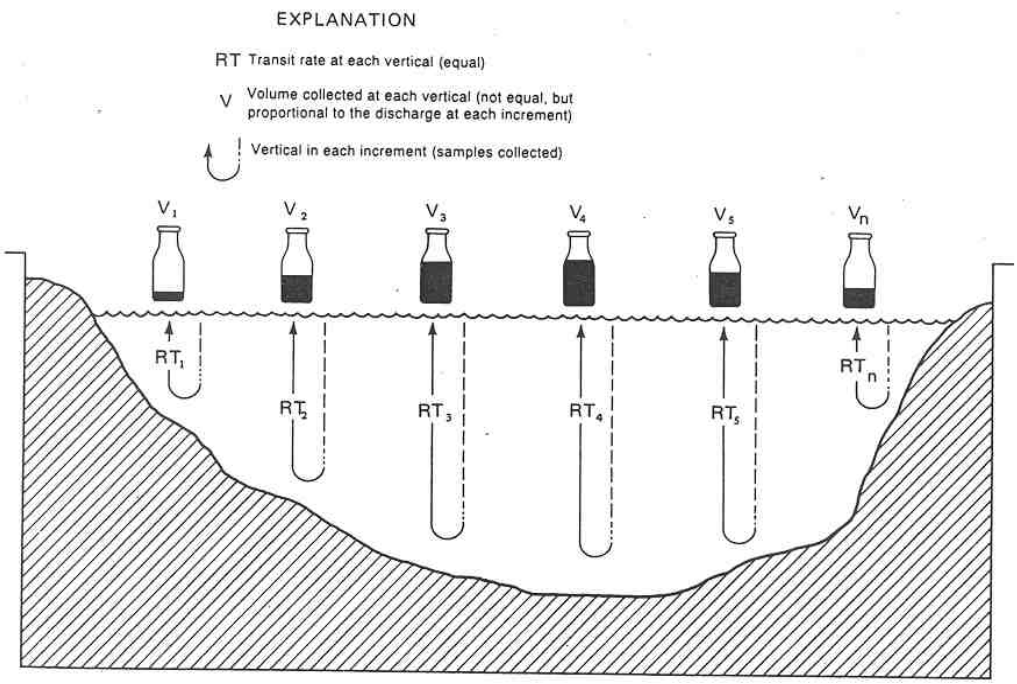


Figure 2. Sample collection at wadeable sites using DH-48 sampler

A.2 Determination of Transit Rate

The transit rate is the speed of lowering and raising the sampler in the sampling vertical. EWI methods require that all verticals be traversed using the transit rate established at the deepest and fastest vertical in the cross section. The descending and ascending transit rate are equal during the sampling traverse of each vertical, and are the same at all verticals, in order to collect a volume of water proportional to the flow in each vertical (Figure 2) (from USGS 1999). The transit rate must not exceed 0.4 times the mean ambient velocity in the vertical while being sufficiently fast to keep from overfilling the sample bottle. Mean stream velocity (measured or estimated), deepest sampling depth, and transit rate diagrams are used to approximate the necessary transit rate based on the equipment and nozzle used (FISP 1999). See below sections for details regarding determination of transit rate depending on equipment utilized.

Sampling procedures for the DH-48 are detailed in FISP 2000c. A cross section displaying relatively stable hydrologic characteristics and uniform depths over a water range of discharge is selected. The sampling device utilized by SWQB is a hand-held US DH-48. It is designed to sample isokinetically, meaning that water and sediment enters the nozzle at the same velocity as the stream being sampled in order to collect a representative sample. A pint milk bottle is held in place and sealed against a rubber gasket by a hand operated, spring tensioned clamp at the rear of the sampler. A brass 1/4-inch internal diameter intake nozzle extends horizontally from the nose of the sampler body. A standard 1/2-in diameter wading rod is threaded into the top of the sampler body for suspending the sampler. The DH-48 can sample to within 3.5 inches of the stream bed and can be used in velocities ranging from 1 to 9 ft/sec (FISP 2000c). Specifications and sampling instructions for the alternative DH-81 handheld sampler can be found in FISP 1999.

Prior to sampling, the transit rate is determined using the procedure described in Table 1 utilizing transit rate diagram for the US DH-48 presented in Figure 3 (from FISP 2000c). The wading rod should be held vertically with the sampler and nozzle pointing upstream and as far away from the sampler as possible to avoid interference with the flow from the person taking the sampler. In order to sample with a consistent

transit rate, the person collecting the sample determines a reference point above the water surface at the deepest vertical to be sampled at which the sampler is started and stopped. This reference point is used to start and stop all verticals, allowing the same amount of time to elapse during the round trip traverse of the sampler regardless of the stream depth encountered in the vertical. The USGS recommends a reference point on the body of the person collecting the sample, such as his/her hip. Using the determined transit rate, the sampler lowers the DH-48 until it touches the stream bottom, then immediately reverses the direction to raise the sampler until it clears the water surface. To avoid overfilling, the person collecting the sample periodically checks the volume that has been collected and switches out the sample bottle when the volume is approximately 420 mL.

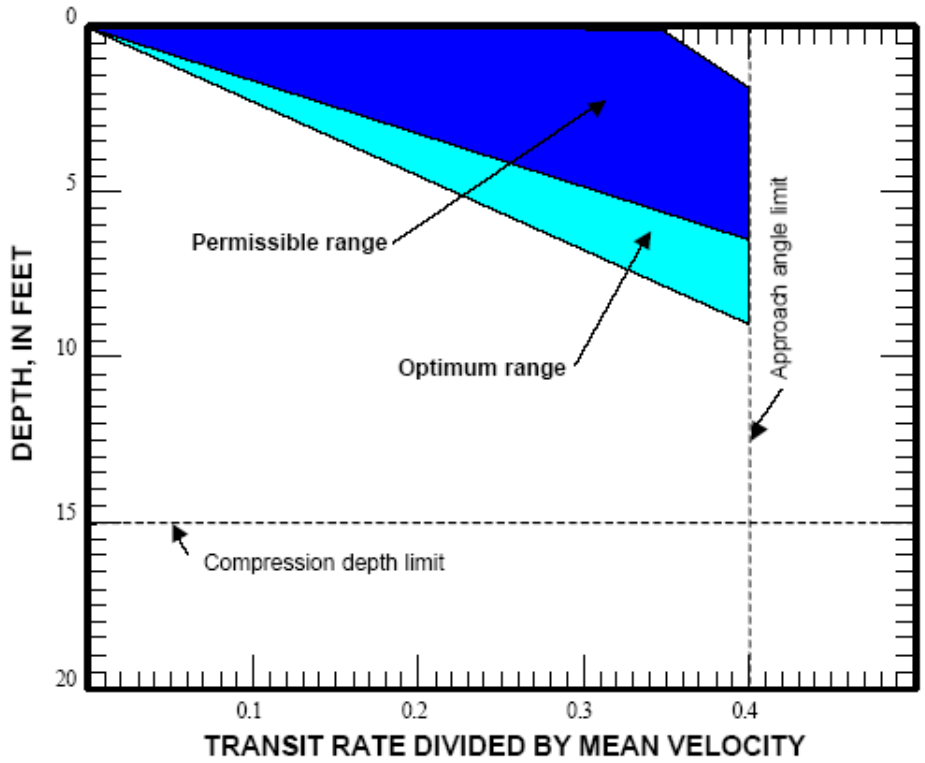
Compositing and/or multiple traverses of the cross section may be necessary. The person collecting the sample returns to the bank and empties the contents of the sampling device into a decontaminated churn or other clean sampling container depending on equipment availability, parameters to be analyzed, and necessary sample volume while agitating the sample to ensure particles are in suspension during the transfer. Before returning to the bank, the person collecting the sample makes notes of or marks his/her last collection vertical on the tagline with a clothespin or similar device. After emptying the sample bottle, the person collecting the sample returns to the marked location and resumes sampling. The procedure is repeated until the necessary volume has been collected and composited. The composited sample is then dispersed and filtered as necessary depending on the parameters to be analyzed. The agitator on the churn is slowly moved up and down while dispensing sample water from the spigot into the appropriate lab sample containers.

Table 1. Determining transit rate using transit diagram.

Using the appropriate transit diagram, draw a horizontal line from the maximum sampling depth on the Y-axis to the middle of the optimum range. Move vertically to intersect with the X-axis. Multiple this number on the X-axis times the mean stream velocity to determine the transit rate.

EXAMPLE FOR DH-48:

- Mean stream velocity = 4 ft/sec
- Maximum sampling depth = 2.5 feet
- Using transit diagram Figure 7.3 (from FISP 1999), 0.15 = corresponding x-axis value = " transit rate divided by mean velocity"
- 0.15 x 4 ft/sec = 0.6 ft/sec transit rate



Note: The following volumes were used to produce this diagram: The total volume of the sampler container was 470 mL. The maximum recommended volume was 420 mL. The minimum optimum volume was 300 mL.

Figure 3. Transit rate diagram for US DH-48 sampler

Sample Collection at Non-Wadeable Sites using DH-95 Sampler

When sampling from a bridge or cableway, SWQB utilized a US DH-95 with a 5/16-inch nozzle (FISP 2000a). The maximum sampling depth for this configuration is 13.3 ft and sampler velocity range is from 2.2 ft/sec to 7.0 ft/sec (FISP 2000b). The sampling device is connected to a hanger bar. The hanger bar is connected to a suspension cable on an “A” reel supported by a bridgeboard. The nozzle is screwed hand tight into the cap. The O-ring is lifted in order to place a triple rinsed Teflon or polypropylene 1L bottle into the sampler cavity. The O-ring fits over the neck of the bottle to hold it in place. The bottle-cap configuration is rotated until the air vent hole in the cap is vertical. The nozzle intake and air vent hole are checked for any obstructions. The person collecting the sample has a lid and extra sample bottle available. The transit rate is determined using the procedure described in Table 1 and the appropriate transit rate diagram (Figure 4) (from FISP 2000b). The sampler is lowered to immediately above the water surface without submerging the nozzle. Using the transit rate determined by the above procedures, the sampler is smoothly lowered into the flow. When the sampler almost touches the streambed, the reel direction is quickly reversed and the sampler is raised to the surface using the same constant transit rate (FISP 2000b). The person collecting the sample avoids hitting the streambed to prevent stirring up loose sediment that could bias the sample. To avoid overfilling, the person collecting the sample periodically checks the volume that has been collected and switches out the sample bottle when the volume is approximately 800 mL.

Compositing and/or multiple traverses of the cross section may be necessary. The person collecting the sample retrieves the sampler and empties the contents of the sampling device into a churn or other clean

sampling container depending on equipment availability, parameters to be analyzed, and necessary sample volume while agitating the sample to ensure particles are in suspension during the transfer. Before retrieving the sampler, the person collecting the sample makes notes of or marks his/her last collection vertical on the tagline with a clothespin or similar device. After emptying the sample bottle, the person collecting the sample returns to the marked location and resumes sampling. The procedure is repeated until the necessary volume has been collected and composited. The composited sample is then dispersed and filtered as necessary depending on the parameters to be analyzed. The agitator on the churn is slowly moved up and down while dispensing sample water from the spigot into the appropriate lab sample containers.

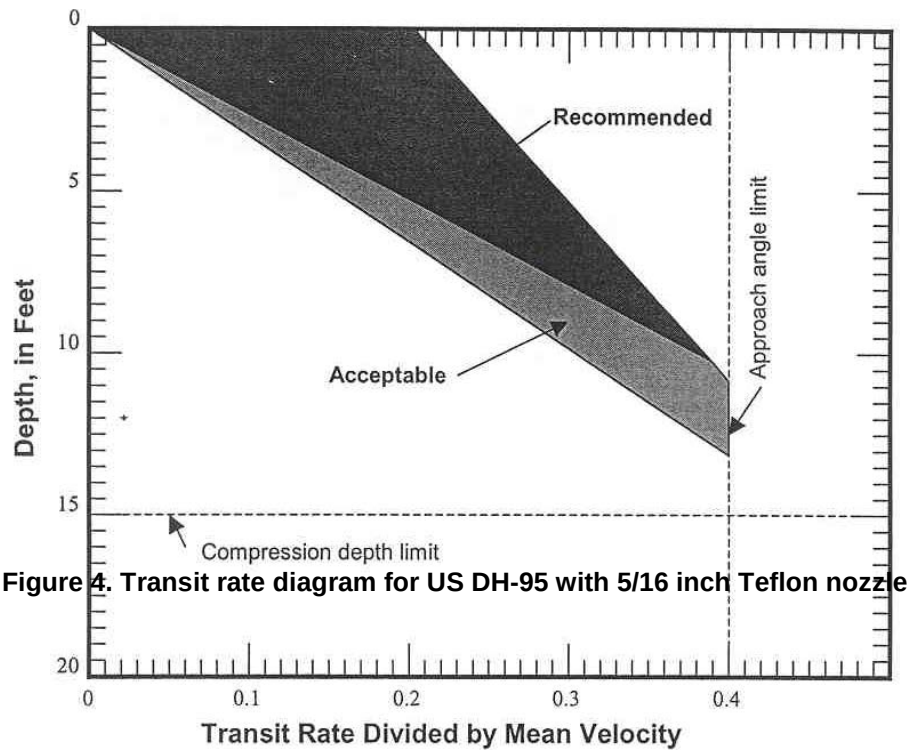


Figure 4. Transit rate diagram for US DH-95 with 5/16 inch Teflon nozzle

Note: The following configuration and volumes were used to produce this diagram. The total volume of the sampler container is 1265 mL., which includes a Teflon bottle, bottle adapter and US D-77 cap. The maximum recommended sample volume is 800 mL. The maximum acceptable sample volume is 1,000 mL.

REFERENCES

Edwards, T. K. and Glysson, G. D. 1999. Field methods for measurement of fluvial sediment. USGS Techniques of Water-Resources Investigation, book 3, chapter C2.3. Available at http://water.usgs.gov/osw/techniques/sedimentpubs.html).

Federal Interagency Sedimentation Project (FISP). 1999. *Operator's manual for the US DH-81 depth-integrating suspended-sediment sampler*. Available at http://fisp.wes.army.mil.

———. 2000a. Development *of the US DH-95 depth-integrating suspended-sediment sampler*. Report MM. Available at http://fisp.wes.army.mil.

———. 2000b. Sampling *with the US DH-95 depth-integrating suspended-sediment sampler*. Available at http://fisp.wes.army.mil.

———. 2000c. Sampling *with the US DH-48 depth-integrating suspended-sediment sampler*. Available at http://fisp.wes.army.mil

———. 2006. Collection and Use of Total Suspended Solids (TSS) Data. Technical Committee Memorandum 2007.01.