Water Quality Monitoring Field Manual

Yukon River Inter-Tribal Watershed Council • Science Department • 2020

"to once again drink water directly from the Yukon as our ancestors did"

ONE PEOPLE-ONE RIVER

Yukon River Inter-Tribal Watershed Council

www.yritwc.org

Yukon River Inter-Tribal Watershed Council

The Yukon River Inter-Tribal Watershed Council (YRITWC) is an Indigenous grassroots organization, consisting of 74 First Nations and Tribes, dedicated to the protection and preservation of the Yukon River watershed. The YRITWC accomplishes this by providing Canadian First Nations and Alaskan Tribes in the Yukon watershed with technical assistance, such as facilitating the development and exchange of information, coordinating efforts between First Nations and Tribes, undertaking research, and providing training, education and awareness programs to promote the health of the watershed and its Indigenous peoples.

Manual Overview

This manual is a reference tool for technicians conducting water sampling under the YRITWC protocols. The YRITWC protocols were developed using the United States Geological Survey (USGS) protocols as a benchmark for quality (USGS, TWR Book 9). The structure set forth here will be one that focuses on end-user functionality. Throughout the manual key points will be noted with special characters and text boxes in the body of the text. This will highlight essential material and give resources for additional research.

Acknowledgements

This work would not be possible without the collaboration of many individuals, communities, government agencies and funding sources. Through this collaboration, the YRITWC has established a long-term database of water quality monitoring that covers the entire Yukon River Watershed. At several sites, monitoring began as early as 2001.Through consistent sampling you benefit your community and also other communities upstream and downstream. The YRITWC greatly appreciates all the hard work and dedication of the Environmental Coordinators, Lands and Resources Departments, and their staff to collect water quality samples throughout the summer and winter. Without their (your) dedication, this network would not exist. The YRITWC would also like to recognize the contribution of the Environmental Protection Agency's Indian General Assistance Program that funds many of the Environmental Programs to collect and report this data. The YRITWC also greatly appreciates the collaboration with the U.S. Geological Survey (USGS) Water Resource Mission Area and Alaska Climate Adaptation Science Center. For over ten years now, the USGS has provided an immense contribution to this network by providing almost all of the laboratory analysis for the water quality samples. Since, 2019 we have been delighted to welcome the University of Alaska Fairbanks (UAF) project partners with their expertise that will contribute to the Indigenous Observation Network (ION) chemical laboratory analysis and active layer dynamics research capacity. The National Science Foundation, Administration for Native Americans, Health Canada, the Yukon Government, Environment Canada, and the Gordon Foundation have all provided substantial funding to assure the sustainability of the ION and its water quality program. Finally, we would like to thank USGS, National Geographic, and BSCS Science Learning for the development of our water quality database.

TABLE OF CONTENTS

Getting Started

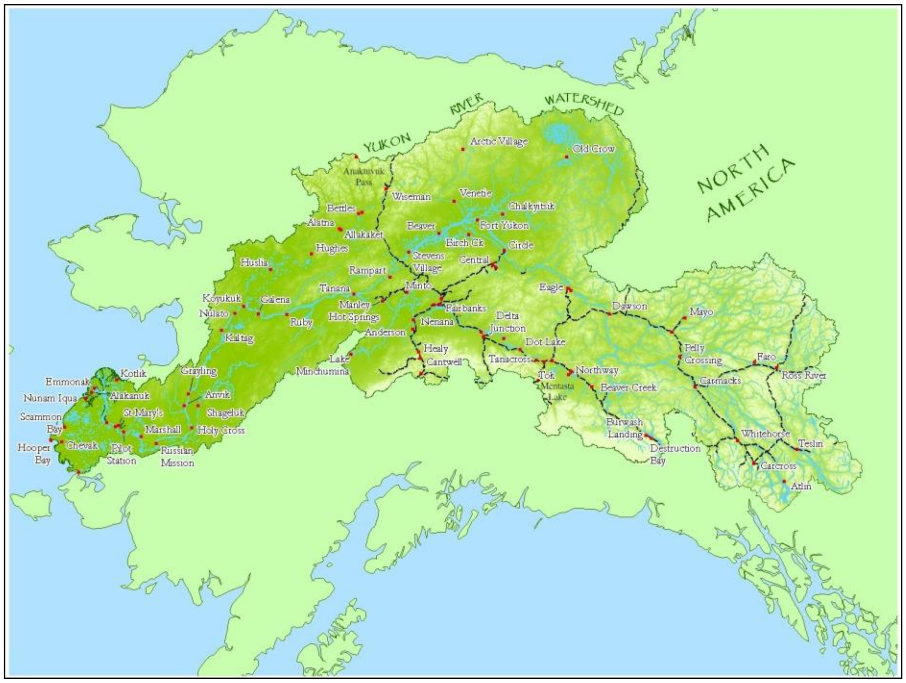
Asking a Question

All science research starts by someone asking a question. Most questions that we receive revolve around water and if you are reading this manual the odds are that you and your community are interested in what is going on in the Yukon River watershed.

The Water Quality Monitoring Program managed by the YRITWC Science Department was started because people of the Yukon River Watershed asked questions about the water quality. ***What is happening to the fish? Is the water safe to drink? Why is the water quality changing?*** All these questions, and more, led to the development of a baseline watershed study that has been operating continuously since 2006.

Developed through collaboration and assistance by the USGS, the baseline Water Quality Monitoring Project has spread to over 54 communities across the entire Yukon River watershed.

Map of communities in the Yukon River Watershed



Yukon River Basin Map with YRITWC signatory Tribes/First Nations highlighted

This project focuses on collecting information on basic water quality parameters (see Appendix D) that give a picture of the overall health of the water system, including fish habitat and responses to climate change. Long-term baseline studies are important for several reasons. They provide a basis for comparison against possible contaminants in the river, as well as document long-term trends that can be useful in highlighting natural versus unnatural changes in the water system. You can access the ION database for the long-term baseline data at the USGS ScienceBase https://www.sciencebase.gov/catalog/item/573f3b8de4b04a3a6a24ae28 or check out the FieldScope online platform site at http://yukon.fieldscope.org/. All community water quality reports and USGS factsheets and reports can be uploaded directly from YRITWC website https://www.yritwc.org/reports.

If you have a question about the ION database or community reports, please feel free to contact us. We would also like to hear from you, if there are any water quality concerns around your community to explore how we help to find answers to those concerns. Maybe you can even help start a new initiative in the watershed. Sometimes answers take time to reveal themselves, but be patient and have fun taking observations and learning more about the environment you live in!

Quality Assurance Project Plan (QAPP)

The YRITWC Science Department has revised a Quality Assurance Project Plan (QAPP) for the ION water quality baseline project that covers the sampling conducted by communities and YRITWC staff in spring 2020. A QAPP is specifically required by projects funded through the Environmental Protection Agency (EPA) to ensure that the project and tasks are documented and reviewed before work is started.

If your project is addressing additional questions or require protocols for site specific contaminant sampling, please contact us and we help you to develop your own QAPP or amend the existing one to include all the criteria within your project.

The QAPP describes the quality assurance procedures, quality control specifications and other technical activities that must be implemented to ensure that the results of the project or task to be performed will meet project specifications (https://www.epa.gov/r10-tribal/quality-assurance-project-plans-tribes-region-10 and https://www.epa.gov/quality/quality-assurance-project-plan-development-tool).

Contact YRITWC

Once you have asked a question and desire to pursue projects that will help to give insight to the topic, contact the YRITWC! We can assist at multiple levels to help you meet your community goals. Whether you need to develop your project or would like to take part in the ION program, the YRITWC will do our best to assist communities in answering their question(s).

The YRITWC office in Anchorage is staffed with knowledgeable employees who are eager to talk with you about ways your community can participate in YRITWC programs. The Science Department will assist in guiding you towards programs that will best answer the questions from your community.

Anchorage Office:

Science Staff:
Edda Mutter (emutter@yritwc.org)
Kari Young (kyoung@yritwc.org)

Address:

725 Christensen Drive, Suite 3
Anchorage, AK 99501
Phone: (907) 258-3337 Fax: (907) 258 3339

Next Steps

Training

Once you have your question and have decided which projects best fit your community needs, it's time to attend training! The Science Department offers annual training in water quality sampling. Contact the YRITWC to find out when the next training opportunity will be. Generally, the water quality trainings are held in spring. We are often able to work around schedules and provide on-site training in a community if necessary.

Purchasing Equipment & Supplies

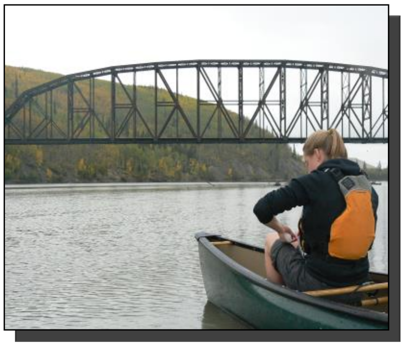
Your equipment and supply needs will be met through participation in the Science Department's projects. The YRITWC can typically provide equipment and basic maintenance, as well as provide most of the necessary supplies to complete project goals. This service is entirely funded through grant opportunities, which vary from year to year. If your project budget is designed to support (even partially) the equipment, supply and shipping needs you can be assured that your project will be sustainable throughout your participation (*see budget recommendation in Appendix F*). We are constantly seeking new funding to support the long-term projects and goals of the YRITWC and the Science Department, so please do not let shortfalls in your budget stop you from participating.

There are several manufacturers of water quality instruments currently on the market. Manufacturers include: Hydrolab, YSI Inc., Eureka, Oakton, Hanna, and Hach. Each manufacturer produces several types of equipment, from single parameter probes to multi-parameter and sondes*. The level of sophistication of each probe depends on the type of parameters being measured and the needs of the user (see Appendix D for explanation of parameters). The type of probe selected for each project will depend on the time and frequency of data collection. This manual explains how to calibrate the meter you will be using this field season. Calibration directions begin on page 8 of this manual. Also, technical manuals can often be found online for each meter.

****If you are considering buying equipment for your IGAP program please talk with the YRITWC Science Department staff and we will be glad to explore options on equipment that will fit the long term needs of your community (see Appendix E for equipment suppliers)**.*

Choosing a Site

Site location is extremely important when collecting water samples. The flow of the river, the location relative to the community, potential contaminants, accessibility and the question(s) you are asking all need to be taken into consideration when choosing the site.



Leah Mackey, collects water sample by canoe on the Tanana

When participating in the baseline project, YRITWC staff will assist in choosing a site that best meets all criteria. The initial site will be located above the community in the main channel of the river. This sample will provide the most accurate information on the water flowing past your community.

Naming the Site

Each site is assigned a unique name based on the river, community and location relative to the community (see Appendix B for list of current sites). The naming convention was developed as a method to efficiently identify the river, the community, and the site through a single reference. The structure of the system is in four distinct parts. First, the river is identified using the first two letters of the river from which the sample was taken. Second, the community is identified by the three-letter airport code from where the sample will be shipped. Third, the site number is identified using chronological numbers starting at 1. The fouth component is the letter **"a"** or **"b",** which identifies the site as being **above** the community**, "a", or** **below** the community**, "b",** from where the sample was taken**.**

An example of the naming convention would be: Yukon River (**yu**), Village of Eagle (**eaa**), site number (1), above Eagle (**a**). This site would be written on the field sheet as: **yueaa1a**.

Calibration

Introduction

Calibration is the act of comparing the readings of an instrument with those of a known/reference standard to check the instrument's accuracy. Adequate documentation of standards and procedures is essential for any use of environmental instrumentation to conduct physical measurements. Correctly following the calibration procedures and providing accurate documentation allows the measured data to be checked using quality assurance methods, and is essential to assuring high quality data.

When to Calibrate: Calibration of the Hanna meter will occur once just right before using the meter in the field to collect the measurements/readings from the river or water source. Documenting the calibration is equally important as going through the calibration procedures. Documentation is completed on the field sheet that is provided with the sample bottle kits send to you. On the field sheet you will find a designated section for recording the calibration data (see Appendix C). Carefully follow the instructions described in the following pages! While calibration and documentation are essential for collecting high quality and accurate data, basic care is equally important to ensure the meter performs high-level work.

The equipment we use are top-of-the-line scientific instruments that will display high quality data points when calibrated correctly and cared for respectfully. Meters should be stored inside a heated building and care should be taken to protect and preserve all working parts. Further details will be outlined for each instrument in the following sections.

Hazel Lolnitz, Koyukuk Tribal Council, calibrates a YSI 63 during a water quality training in Fairbanks.

The calibration of equipment is essential to collecting field measurements accurately!

Bad Calibration
=
Bad Data

Instrument - Hanna Pocket Meter

Calibrating Conductivity

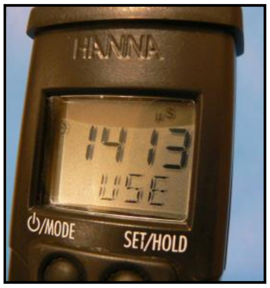
You will need: 1 small jar, distilled/DI water and 1413 solution.

1. Rinse the jar twice with distilled water and once with a small amount of Conductance standard - **1413µS***. After rinsing is complete, fill the jar halfway with the conductance standard.

2. Press the **Set/Hold** to change modes. In the upper right hand corner of the display **"µS"**** will appear; indicating the specific conductance mode.

3. Rinse the tip of the meter with a small amount of conductance standard 1413.

4. Hold down the **Power/Mode** button until **"CAL"** appears. Release the button immediately when **"CAL"** appears.



5. The screen will display **"1413 USE"**

6. Place the tip of the meter in the conductance standard 1413.

7. When the screen <u>does not</u> display **"USE"** the calibration is complete. **Record the displayed conductance and temperature values on the Hanna meter section of the field sheet** (see example below pH section).

8. Rinse the tip of the meter with water and replace the cap.

* *The Hanna Meter will always use the 1413 conductivity standard.*
** *Microsemens (µS) are a unit of measurement for the electrical conductance of water. It is essentially a measure of the total amount of solutes in the water.*

Calibrating pH

You will need: 2 small jars, pH 7, pH 10 and distilled/DI water.

1. Rinse the 2 jars that will be used for pH calibration with distilled water. Rinse one jar with a small amount of pH 7. Rinse the other jar with small amount of pH 10.

2. Place about 2 inches of pH 7 solution in the pH 7 jar. Place about 2 inches of pH 10 solution in the pH 10 jar.

3. Power on the unit by pressing the **Power/Mode** button. Wait for the unit to fully power on.

4. Press the **Set/Hold** button to change the display to pH. In the upper right corner of the display a **"pH"** will appear.

5. Remove cap from meter

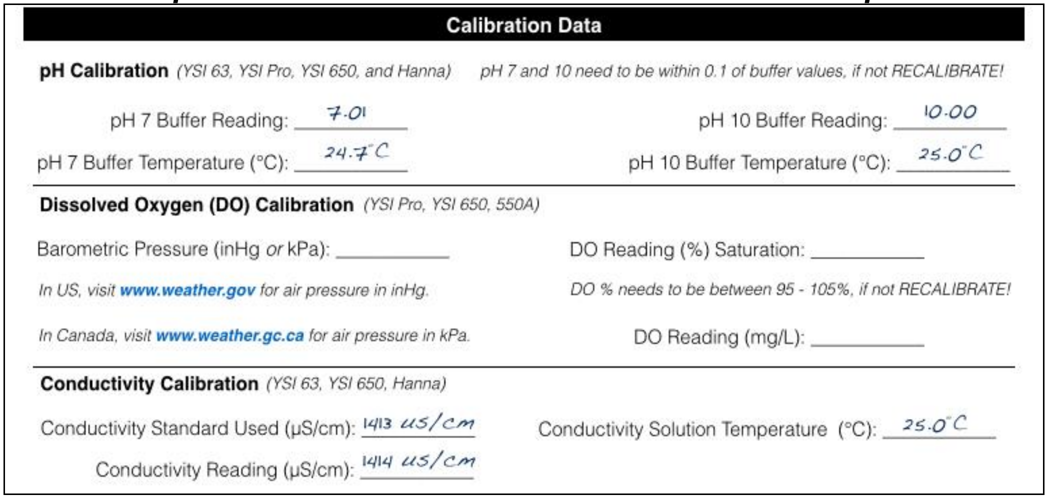
6. Press and hold down the **Power/Mode** button. **"OFF"** will appear on the screen, keep holding down the button until **"CAL"** appears on the screen. Release the button immediately when **"CAL"** appears. **"USE"** will appear at the bottom of the screen.

7. Rinse the meter tip with a small amount of pH 7, place the meter in the pH 7 when "USE" is displayed on the bottom of the screen.

8. When the screen displays "4.01 USE" rinse the tip of the meter with a small amount of pH 10.

9. Place the tip of the meter in the pH 10 jar. The meter will automatically calibrate to pH 10. After a few seconds the display will read 10.03 or very close to this number. Record this number under the Hanna meter calibration section of the field sheet. The pH calibration is now complete (see example).

Example of field sheet with calibration section completed



Calibration Data

pH Calibration *(YSI 63, YSI Pro, YSI 650, and Hanna)* *pH 7 and 10 need to be within 0.1 of buffer values, if not RECALIBRATE!*

pH 7 Buffer Reading: 7.01
pH 10 Buffer Reading: 10.00
pH 7 Buffer Temperature (°C): 24.7°C
pH 10 Buffer Temperature (°C): 25.0°C

Dissolved Oxygen (DO) Calibration *(YSI Pro, YSI 650, 550A)*

Barometric Pressure (inHg *or* kPa): ___________
DO Reading (%) Saturation: ___________
In US, visit ***www.weather.gov*** *for air pressure in inHg.*
DO % needs to be between 95 - 105%, if not RECALIBRATE!
In Canada, visit ***www.weather.gc.ca*** *for air pressure in kPa.*
DO Reading (mg/L): ___________

Conductivity Calibration *(YSI 63, YSI 650, Hanna)*

Conductivity Standard Used (µS/cm): 1413 uS/cm
Conductivity Solution Temperature (°C): 25.0°C
Conductivity Reading (µS/cm): 1414 uS/cm

Field Sample

Elli Matkin records sampling information on the field sheet.

Introduction

After successfully calibrating your instrument you are ready to go collect your water sample! There are several steps to take to ensure you are collecting the best sample possible.

Field Sheet (Appendix C)

Field Sheet Documentation:

Filling out the field sheet completely is very important. The field sheet serves as a quality assurance method by documenting the calibration and is also a hard copy documentation of the data collection. Keeping consistent and reliable records are important in long-term data collection. If you make any mistakes, remember not to erase, just draw a line through the mistake and write the correction as close as possible.

Date and Time:

To work toward the standardization of protocols across the watershed, the YRITWC Science Department uses the International Standards Organization (ISO) standard for date and time records. This standard is accepted as the format for international trade. In our application, Indigenous peoples of the Yukon Basin are engaging in the trade of information to sustain their traditional way of life.

The international standard for recording the date, as set by the ISO, ranks the priority of information from the most important to least important; the year being the most important, the month being second in priority, and the day being of the lowest priority. The format for the date would be: ***yyyy-mm-dd***. This format should be used when recording the date on the field sheet and sample bottles.

The use of 24-hour time is standard practice in scientific data collection. Using 24-hour time reduces the potential for transmission error when recording field data into a database and allows for accurate record keeping when samples are taken at multiple times in a single day. ***On the field sheet record the time you collected the water sample from your site.*** Use this same time for documentation throughout the duration of your samples (i.e., labeling bottles).

Site Naming Convention:

The naming convention was developed as a method to efficiently identify the river, the community, and the site with a single reference. This method is described earlier in the manual under the “Next Steps” section (for a list of all existing sites see Appendix B).

An example of the naming convention would be: Yukon River (yu), Eagle (eaa), site number (1), above Eagle (a). This site would be written on the field sheet as: yueaa1a.

General Information: Technicians, Waterbody Name, Meter and Elevation:

Fill out these sections of the field sheet completely. It is important to know who is taking the sample. The technicians are *you* and any volunteers, assistants, youth or boat drivers. The water body name refers to the name of the river, lake or slough that the sample is being taken from. In the example below, the sample is from the Tanana River. The meter type is important for us to know for many reasons, largely because the YRITWC has multiple kinds of meters that samplers use and different ones are capable of measuring different parameters. After you circle which type of meter you are using, locate the number written on the side of the meter with a permanent marker. This is the meter number. Every YRITWC meter has a different number; this helps us keep track of which specific meter is in what location in the watershed.

ONE PEOPLE-ONE RIVER

Yukon River Inter-Tribal Watershed Council

Fairbanks: 907-451-2530 • Whitehorse: 867-393-2199

Date (yyyy-mm-dd): 2014 - 05 - 30

Sample Time (24 hrs): 13:00

Site Name ID: tafai2a

Waterbody Name: Tanana River below Fairbanks

Technician(s): Tom Minnow

Meter Type(s) (circle): [✓ **Hanna**] **YSI Pro** **YSI 63/550A** **YSI 650** **Meter ID(s) #:** 04

Site Coordinates: Latitude, Longitude, and Elevation:

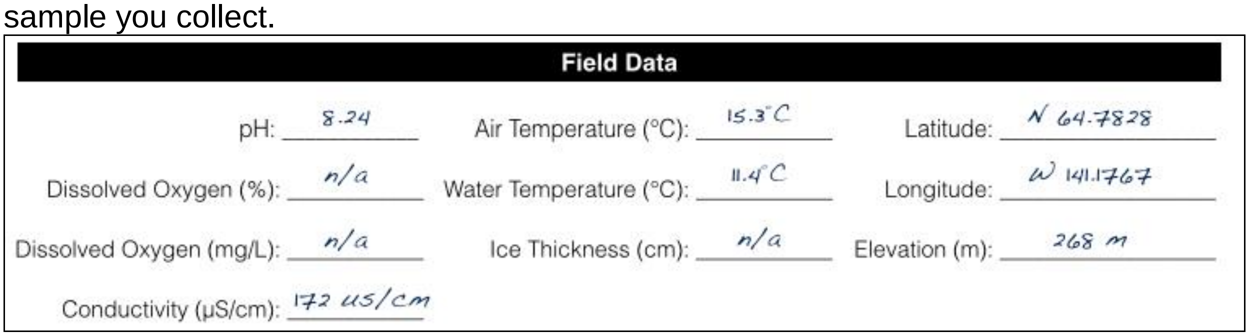
Before you put your meter in the water, write down the coordinates and elevation of your site at each visit. The latitude, longitude and elevation for each site are listed in Appendix B. If you have a GPS (sorry, the YRITWC does not provide one) we recommend that you check the accuracy of the coordinates listed in the appendix, this way we can be sure that you are sampling in exactly the same place week after week, year after year. Fill out the Latitude/Longitude section on your field sheet - especially if you are sampling a new location, adding a site or need to alter your location for any reason. If you sample from the riverbank once or twice (due to weather, boat problems, etc.) it is also helpful for us to know the GPS coordinates of that shore location since it is different from your usual sample site.

Calibration:

The calibration section of the field sheet is explained in more detail for each meter in the Calibration section of the manual (starting on page 9). Your field sheet will look like one below:

Field Measurements:

The field measurements are the reward for all your work calibrating and collecting the samples. These measurements provide real-time information to supplement the water sample you collect.



Field Data

pH: 8.24
Air Temperature (°C): 15.3°C
Latitude: N 64.7828
Dissolved Oxygen (%): n/a
Water Temperature (°C): 11.4°C
Longitude: W 141.1767
Dissolved Oxygen (mg/L): n/a
Ice Thickness (cm): n/a
Elevation (m): 268 m
Conductivity (µS/cm): 172 us/cm

Comments & Observations:

The reverse side of the field sheet provides an opportunity for you to write any additional comments or observations that you have during your sample trip. There are some guided questions that you may find useful. Documenting observations alongside instrument data helps in explaining or understanding the numbers produced from the meters and laboratory analysis. Your first-hand experience, knowledge and observations are a very important part of the documentation process. To the right is an example of answers for questions on the field sheet.

RIVER AND WEATHER

Weather conditions now (circle): [✓ overcast] / clear / partly cloudy / cloudy • heavy / steady / intermittent rain • [✓ calm] / breezy / windy
Weather in past 24 hours (circle): overcast / [✓ clear] / partly cloudy / cloudy • heavy / steady / intermittent rain • [✓ calm] / breezy / windy
Sample location (circle): [✓ mid-channel] / bank / other • riffle / pool / eddy
Flow description (circle): < 19 L (5 gal) per second / [✓ > 19 L (5 gal) per second] / under ice
Water clarity (circle): [✓ clear] / cloudy (greater than 4" visibility) / murky (less than 4" visibility)
Site odor (circle): [✓ none] / fresh algae / chlorine / rotten eggs / sewage / other:
Other (circle): [✓ litter] / foams or suds / oily sheen / algae and/or aquatic plants

Anything different happening with the river since the last sample (flooding, erosion, flow change)?

First sample of the season. Ice still floating down the river.

How does the river height compare to two weeks ago?

First sample of the year but it looks to be slightly higher by a few inches.

How does the river height compare to this time last year?

Similar in height.

Anything noteworthy happening with the weather?

Warm spring.

WILDLIFE

Any specific concerns the YRITWC should know about wildlife?

Bears disturbed by warm winter.

Any noteworthy wildlife or fish species traveling through your community or nearby?

Moose spotted in town.

CONTAMINANTS

Has anything occurred since the last sampling that might have affected the water quality at your site?

Fuel spill occurred upstream from site.

Is there any *other* site that your community wants monitored? Please explain why you're concerned…

South of Fairbanks.

OTHER

Anything else interesting? Please write your comments or observations…

Very excited to sample again!

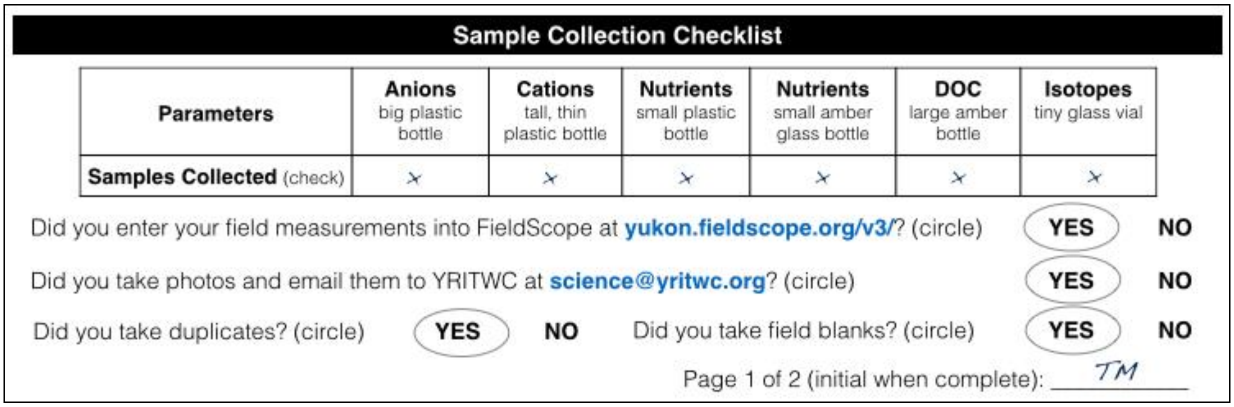
Are there any issues with this sample that we should know about?

Had to recalibrate a couple of times but meter seems to be functioning okay.

Page 2 of 2 (initial when complete): TM

Bottle Check List:

The final section of the field sheet provides a space to double check that all the sample bottles were filtered and filled correctly. The checklist provides a description of each sample bottle and the parameter to be analyzed in the laboratory. Check off each bottle as you complete the filtering process. If you encounter any issues during your sampling, please make a note on the field sheet.



Sample Collection Checklist

Parameters	**Anions** big plastic bottle	**Cations** tall, thin plastic bottle	**Nutrients** small plastic bottle	**Nutrients** small amber glass bottle	**DOC** large amber bottle	**Isotopes** tiny glass vial
Samples Collected (check)	x	x	x	x	x	x

Did you enter your field measurements into FieldScope at **yukon.fieldscope.org/v3/**? (circle) [✓ **YES**] **NO**

Did you take photos and email them to YRITWC at **science@yritwc.org**? (circle) [✓ **YES**] **NO**

Did you take duplicates? (circle) [✓ **YES**] **NO** Did you take field blanks? (circle) [✓ **YES**] **NO**

Page 1 of 2 (initial when complete): TM

FieldScope:

The YRITWC would like to introduce BSCS Science Learning FieldScope, an interactive online map and database. This new database stores your water quality field data and observations. This exciting tool allows you to add your site's pH, dissolved oxygen, conductivity, temperatures, photos, videos, field observations, and local knowledge. We hope FieldScope will be a very useful tool for samplers to share water quality data with all ION participants across the Yukon River watershed. You can choose to make your community's information private or open to all public viewers. Tell us what you think of FieldScope. We would love your feedback! Visit the Yukon River watershed at yukon.fieldscope.org/v3/.

Pictures:

Please take pictures while you are out in the field to record any changes occurring at the site and email them to Science staff at emutter@yritwc.org or kyoung@yritwc.org. We also love to see pictures from you in action! We really would appreciate it, if you are open to letting us use your pictures for reporting and publication purposes. Please clarify that in your email and we will send you a consent form. We hope to continue assisting the Indigenous Observation Network for years to come, and for funders, pictures are powerful evidence of the program's success! Feel free to add your photos to FieldScope as well.

Field blanks and Duplicates:

Once or twice a season you will have to fill field blanks and duplicates. This will usually happen at the very beginning of the open water sampling season and the very end. See section "Open Water", below, for specific instructions on how to complete this task.

Field Measurements

Open Water:

Gear Check List

- ✓ Meter
- ✓ Sample kit (cooler, bottles & frozen ice pack)
- ✓ Thermometer
- ✓ Field sheet
- ✓ Nitrile Gloves
- ✓ Clip board with pencil
- ✓ Holding bottles
- ✓ Syringe
- ✓ 3-way valve & rubber tubing (optional)
- ✓ Sampling Rod (optional – for safety and convenience)
- ✓ Filters
- ✓ Life jacket
- ✓ GPS (highly recommended if you have one!)
- ✓ Camera

From Boat:

The ideal location to collect a water sample is from the main flow, typically in the middle of the river. If you have access to a boat to collect your water sample, your site will be located in the main channel and flow of the river. Position the boat as close to the center of the river as possible pointing the bow upstream and holding the same position. If the river velocity is high, you may have to let the boat drift with the current. <u>Make all field measurements upstream from the boat and away from the motor</u>, if the boat is equipped with one.

Once you have your boat or body positioned correctly and have recorded your latitude, longitude and elevation on your field sheet, you are ready to collect meter measurements.

From the Riverbank:

If you are unable to sample from the main flow of the river, a sample is better than no sample, so collecting from the riverbank is acceptable (make sure to note the location on your field sheet). Pick a location where river flow is not affected by eddies (straight river reach) or contaminated by upstream point source pollution (sewage effluent, docks, boat landings, bridges, etc.). Wearing a life jacket, wade out into current as far, but as safely as possible. Always make field measurements with probes positioned upstream of you! This avoids influencing the water samples and field readings.

Hanna Meter Measurements:

1) Remove the casing that covers the end of the meter. Since the Hanna meter does not have a separate probe attachment to stick into the river, it is safest and easiest to collect water in your glass holding jar and take the measurements from the jar. Make sure to rinse both your jar and the meter before taking the measurements (see "Water Sample Collection" section).

2) Power **On** the meter. Press **Mode** until **"pH"** shows up in the upper right hand corner of the screen. Allow values to stabilize for at least 60 seconds.

3) Record the value on the screen in the **"Field Sample"** section of the field sheet.

4) Press Mode until µS shows up in the upper right hand corner of the screen. Allow value to stabilize for at least 60 seconds.

5. Record the value on the screen in the **"Field Sample"** section of the field sheet.

Water Sample Collection:

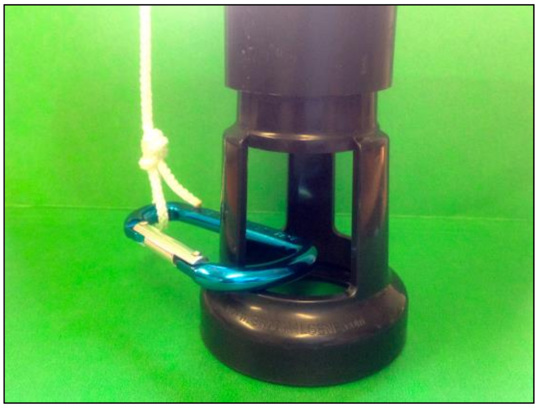
Wear Latex or Nitrile disposable gloves during water sample collection. Avoid touching the boat or anything besides sampling equipment. If the gloves become compromised, dispose and put on a new pair. The sample should be taken in the same location and similar manner as the meter values (see meter measurement descriptions from the boat and shore). Always collect the sample upstream from you and/or the boat engine.

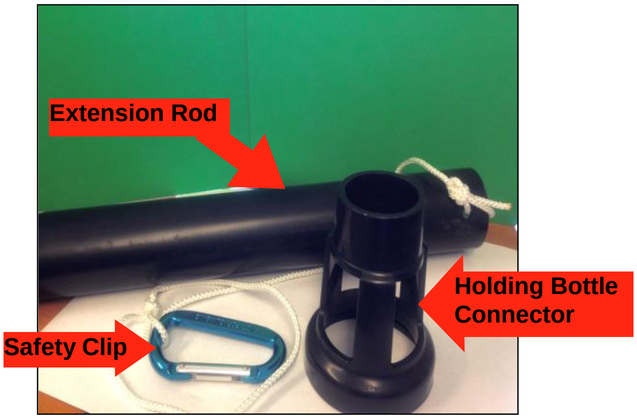
Sample Rod

Sample Rod Assembly:

If a sample rod is provided with your equipment, use this to collect a sample. By attaching the holding bottle to this extension you will be able to more easily collect the sample below the surface level. This method also allows for safer sample collection by reducing the amount of reach required over the side of the boat. The set-up with the 4-foot extension is also very useful for under-ice sampling.

To assemble the sample rod, slide the ***extension rod*** onto the ***holding bottle connector***. Press firmly to secure the attachment. Attach the ***safety clip*** to the ***holding bottle connector*** (see picture below). The holding bottle will screw directly to the ***holding bottle connector***.





Collecting Water Sample from a Boat or Riverbank:

The sample will be collected using the holding bottle attached to a 4-ft plastic rod. It is important that the bottle fills with water from below the ice level.

1) Connect bottle to the sample rod (see picture and description on 16). Not applicable for glass jar.

2) Rinse the holding bottle/jar with river water and discard water three (3) times.

3) To fill the bottle/jar, submerge below the surface of the water (approximately 12 inches if possible) and allow the bottle to completely fill with water (large air bubbles will stop rising to the surface when it is full).

4) Disconnect holding bottle/jar from the sample rod (if applicable).

5) Replace lid and get ready to transfer water into sample bottles (See **"Filling Sample Bottles"** section on page 20).

The water sample is now ready to be filtered into the sample bottles. If the weather is below freezing, this will be easier to complete inside. Take the sample back to a warm place and immediately filter and fill the sample bottles. Keep the sample refrigerated or chilled at all times.

**** This is a good time to rinse your syringe too! It must be rinsed three (3) times with river water before using it to fill your sample bottles. For detailed description on how to rinse your syringe see page 20.***

Under Ice:

Collecting samples in the winter only adds a few more steps (and several more layers of clothing!), but generally follows the same procedures as open water sampling. Safety is a top priority any time during sampling, but be especially careful when traveling on the ice. Be aware of ice conditions and safe routes to the sample location. If in doubt, don't go out!

Gear Check List

- ✓ Meter
- ✓ Sample kit (cooler, bottles & frozen ice pack)
- ✓ Thermometer
- ✓ Field sheet
- ✓ Nitrile Gloves
- ✓ Clip board with pencil
- ✓ Holding bottle
- ✓ Long Rod
- ✓ Syringe
- ✓ 3-way valve & rubber tubing (optional)
- ✓ Sampling Rod (optional – for safety and convenience)
- ✓ Filters
- ✓ GPS (highly recommended if you have one!)
- ✓ Camera
- ✓ Ice Auger with spare blades
- ✓ Auger fuel (Most augers take mixed fuel. Read instructions carefully)
- ✓ Warm Clothing

Drilling the Ice Hole:

1) Using an ice auger, drill a hole in the ice until you reach water.

2) Use the auger to "clean the hole" by dipping it into the water and pulling out several times. This pulls water up and out onto the ice and helps remove some of the ice chunks from the open hole.

Brendan Mulligan drills an ice hole on the Tanana River.

Meter Measurements:

The under ice measurement will be taken in the same location as the open water sample. Use a GPS or landmarks to find the sample location in the winter. You still want to be in the general location of the main flow of the river, even though it is under ice. Take care not to let the sensors on the instruments freeze! Ice build-up will cause inaccurate readings and has the potential to break the sensors. ***Note, keep the instrument warm, if it is cold!***

Ice Thickness Measurements:

The thickness of the ice is important data to collect in the winter and it allows us to see if there are variations year after year. We are still perfecting the best method to measure how thick the ice is so you may be equipped with any number of measuring tools. However, the following instructions apply to all measuring rods.

1. You should have a long rod (up to 7 meters in length) with centimeters marked out. On one end of the rod there is a nail protruding outward. Lower this end down into your ice hole.
2. Hook the protruding nail under the bottom of the ice. Make sure it doesn’t move.
3. Look at where the top of the ice (the surface on which you are standing) meets the rod. Using this as a reference, mark on your field sheet how many centimeters thick the ice is.

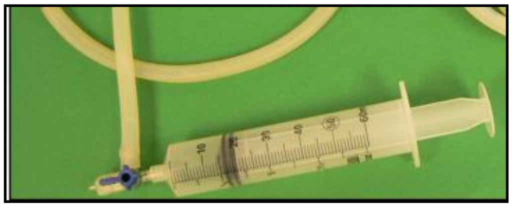
Filling Sample Bottles

Now that you have collected the water sample in the holding bottle, you are ready to transfer the water into the individual sample bottles. This can be done immediately on-site or as soon as possible in another location that may be more convenient (i.e. office, vehicle, riverbank, etc.).

The following method for filling the sample bottles will be the same for under-ice and open water sampling. ***Always wear Latex or Nitrile disposable gloves when handling and filling sample bottles***.

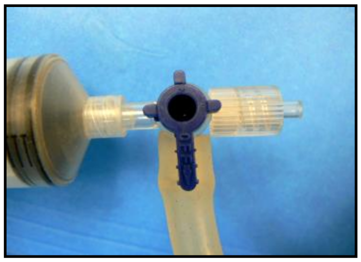
Rinsing the Syringe:

The syringe and connecting tube should be rinsed at the beginning of each new sample location. Do not stick the syringe directly into the holding bottle. If this is your only option (i.e., no tubing or valve), make sure the syringe is rinsed (inside and out) before proceeding.

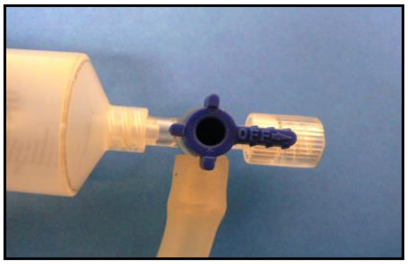


1) Connect the syringe to the 3-way valve & hose.

2) To rinse, place the end of the rubber tube into the river or holding bottle. Turn the 3 way valve position so that **“off”** is in-line with the dispensing tip.



When the “off” position is pointing towards the tube, water can be expelled through the dispensing tip.



With the 3-way valve in this position, the syringe will draw water through the tube and into the syringe.

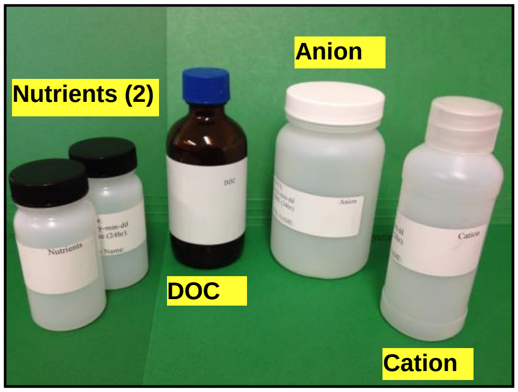
3) Draw a small amount of water (about 25 mL) into the syringe. Turn the valve position so that “off” is pointing towards the tube.

4) Continue to draw the syringe end all the way out. At this point only air should be entering the syringe. Shake to rinse the syringe, and then squirt all of the water out the dispensing tip. Repeat 2 more times.

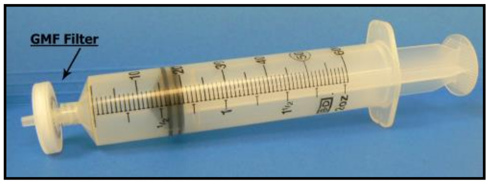
Filtered Bottles:

~ Nutrient, DOC, Anion and Cation

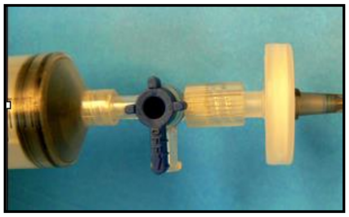
All of the sample bottles will be filled with filtered water. The water is filtered using a GMF (glass microfiber) filter that is connected to the end of the syringe. The filter can either be connected directly to the syringe or to the 3-way valve connected to the syringe.



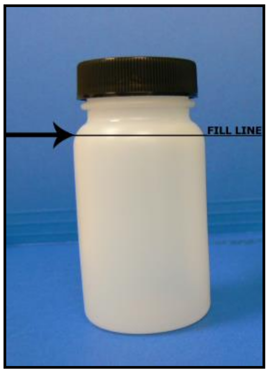
1) Fill the syringe completely from the holding bottle of sample water using the 3-way valve connection (if applicable).



OR



2) Place the GMF filter onto the syringe.
3) Remove cap from bottle and place face-up in a safe place.
4) One at a time, fill each bottle with filtered water up to the shoulder (Anion, Cation, 2 Nutrients, and DOC). Securely replace the cap on the bottle.
5) Re-fill the syringe as needed throughout the filtering process. Each filter can be used until it is too difficult to filter water through. Always use new filters at a new site location.
6) Record any observations or procedural mishaps in the comment section of the field sheet.



The "shoulder" of the bottle is where it starts to curve at the top.

Isotopes ~ O18:

The isotopes glass vial is filtered, but is filled completely to the top until a meniscus forms (round curve of water). There should be no air bubbles in the vial.

1) Using the 3-way valve (if applicable), fill the syringe with sample water from the holding bottle.

2) Place a GMF filter on the syringe.

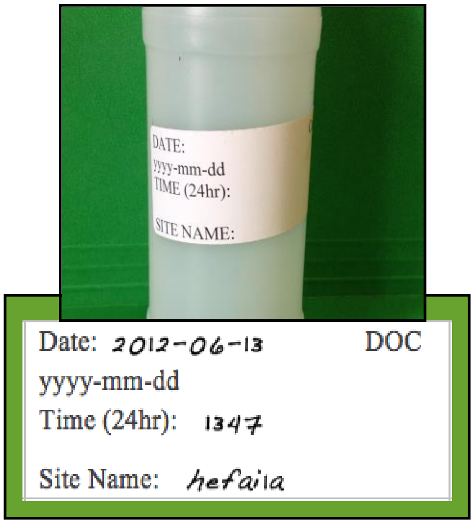
3) Remove cap from the vial and place face-up in a safe place.

4) Fill with filtered water completely to the top. Replace the cap carefully and securely. (There should be no air bubbles in this sample once the cap is in place; you can check by turning the bottle upside-down. No air bubbles should appear.)

5) Record any observations or procedural mishaps in the comments section of the field sheet.

Labeling Sample Bottles:

Labeling each bottle in the sample is very important. The bottles have white labels that need to be filled out with the <u>Date, Time and Site Name.</u> This label will be identical to the information on the top right hand corner of the field sheet. When the bottles are sent to the USGS lab they are split up and sent with hundreds of other bottles to different labs to be analyzed. The label is an important part of the tracking and identification of your sample, so writing clear and consistent information on each bottle is extremely helpful.



Date: 2012-06-13 DOC
yyyy-mm-dd
Time (24hr): 1347
Site Name: hefaila

Jay Hootch & Earl Alstrom, Yupiit of Andreafski, assist with lab work at USGS Boulder, CO.

Quality Control

When we collect water samples, we always work to reduce any sources of error that might affect our measurements. There are two types of error that we work to reduce: **bias** and **variability**.

Bias is systematic, directional error. We can work to reduce bias by calibrating our field meters with reference materials (such as pH buffers and conductivity standard solutions) and by collecting blank samples.

Variability is random error. We can work to reduce variability by standardizing our methods and by collecting replicate samples.

The goal of quality control **(QC)** sampling is to identify, quantify, and document bias and variability in data that result from the collection, processing, shipping, and handling of samples. The bias and variability associated with environmental data must be known for the data to be interpreted properly and to be scientifically defensible!

Blank Samples

The primary purpose of a blank sample **("blank")** is to measure the concentration of anything that might have been introduced into the sample as a result of sampling-related activities: collection, processing, shipping, and handling. Blank water is specially prepared in a quality-controlled laboratory and always carries a special certificate. It is not the same as the distilled/deionized water we use to rinse our sampling equipment. It is really important to wear gloves and to use caution when working with blanks: blank water is expensive!

Blank Samples should be collected the first and last time
we visit our sampling sites every season.

How to collect a Blank Samples?

1) Ensure that you're wearing gloves!

2) Rinse your sampling equipment (holding bottle, syringe, three-way valve, and tubing) three times with DI water.

3) Rinse your sampling equipment (holding bottle, syringe, three-way valve, and tubing) once with blank water.

4) Fill the holding bottle with blank water.

5) Follow the normal procedure for filtering water outlined on Page 21. Before filling your sample bottles, be sure to push some blank water through the filter.

Duplicate Samples:

The primary purpose of duplicate or replicate samples is to identify and/or quantify the variability associated with sample collection and processing. Duplicate samples are collected simultaneously or close in time with the associated water sample, using identical procedures.

Duplicate Samples should be collected from each sampling site once every season. Duplicate samples should be collected twice from a site only if more than 10 samples are collected at the site in a single season.

How to collect a Duplicate Samples?

1) Use identical sampling procedures and supplies to collect two samples, one immediately after the other, using the normal sampling procedure. Remember to rinse your sampling equipment (holding bottle, syringe, three-way valve, and tubing) before collecting the second sample, just as you did before you collected the first sample.

2) Label the samples using the site name you always use, but add **"DUP 1"** to the first sample collected and **"DUP 2"** to the second sample collected. It's that easy!

Shipping Samples

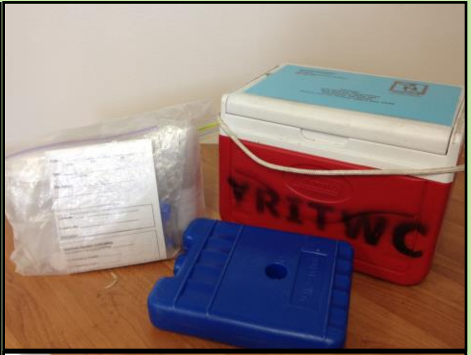
Pack samples **CAREFULLY**! Use foam sleeves for glass vials and place all bottles in the large Ziploc bag. Field sheets should be folded in quarters with the date, time, and site name facing out. Place the folded field sheet in the small Ziploc bag and place the small Ziploc bag inside the large Ziploc bag so the date, time, and site name is visible through the bags. Place a frozen ice pack in the bottom of the cooler with the sample! Turn the shipping label over so it reads **"TO: YRITWC Science Program".** Tape the cooler shut and drop the sample off for the flight out. Give the YRITWC Science staff a call or email to let them know the sample is on the way and what flight it was sent on.

**** If you are unable to ship the sample the same day you collect it, please keep the sample refrigerated!***

***** Plan your field day so that you are sampling at the beginning of the week and shipping out your sample(s) by the middle of the week or early in the week for Yukon communities.***

1. Double check field sheet & bottle labels. Place glass bottles in protective sleeves & field sheet in Ziploc bag.

2. Pack gallon size bag with sample bottles and field sheet. Gather cooler and frozen ice pack.



3. Place a frozen ice pack in the bottom of the cooler. Place a sample kit in the cooler with the field sheet facing out.

4. Secure shipping label to cooler and send via freight collect to YRITWC staff. Notify staff of shipment.

Appendices

Appendix A: Solution Temperature Chart

Conductance

Temp °C	Temp °F	µS
5	41	896
10	50	1020
15	59	1147
16	60.8	1173
17	62.6	1199
18	64.4	1225
19	66.2	1251
20	68	1276
21	69.8	1305
22	71.6	1332
23	73.4	1359
24	75.2	1386
25	77	1413
26	78.8	1440
27	80.6	1467
28	82.4	1494
29	84.2	1521
30	86	1548
31	87.8	1575

pH 10

Temp °C	Temp °F	pH
0	32	10.33
5	41	10.25
10	50	10.18
15	59	10.11
20	68	10.05
25	77	10.00
30	86	9.95
35	95	9.92
40	104	9.88
45	113	9.85
50	122	9.82
55	131	9.9
60	140	9.77
70	158	9.73
80	176	9.69
90	194	9.66

pH 7

Temp °C	Temp °F	pH
0	32	7.12
5	41	7.09
10	50	7.06
15	59	7.04
20	68	7.02
25	77	7.00
30	86	6.99
35	95	6.98
40	104	6.98
45	113	6.97
50	122	6.97
55	131	6.98
60	140	6.98
70	158	6.99
80	176	7.00
90	194	7.02

Appendix B: Water Quality Sites

Water Quality Sites (Alphabetical Order)

Site ID	Water body Name	Lat. (DD)	Long. (DD)	Elevation (m)	Location
akhpb1a (ukhpb1a)	Akuliqutaq Slough	61.538106	-166.11165	0	AK
alaet1a	Alatna River	66.570038	-152.627086		AK
ananv1a	Anvik River	62.6667	-160.281666	30	AK
anksm1a	North Fork Andreafski River	62.0538	-163.143034	20	AK
atysq1a	Atlin Lake above Atlin	59.43835	-133.6704	670.6	BC
atysq1b	Atlin Lake below Atlin	59.5988	-133.8151	671	BC
bctal1a	Bear Creek	65.261203	-151.939132	1188	AK
bcyxq1a (WFN08)	Beaver Creek	62.363469	-140.867188		YT
becfa1a	Bennett Lake Outlet	60.162931	-134.715083	671	YT
bihpb1a	Big Lake at Hooper Bay	61.504682	-166.125352	0	AK
blcik1a	Black River	66.654696	-143.711580		AK
bohpb1a	Bone Pond at Hooper Bay	61.500405	-166.110114	1.55	AK
chfai1b	Chena River mouth	64.80247	-147.915335	137	AK
chfai5a	Upper Chena River at Doug's	64.8458	-147.3306	138.99	AK
chfai6a	Upper Chena River above FAI	64.847033	-147.40735	136.55	AK
chvee1a	Chandlar River above Venetie	67.019133	-146.430367	174.95	AK
chvee2a	Chandlar River above Venetie	67.02187	-146.53297	201	AK
chvee3a	Chandlar River above Venetie	67.02171	-146.58717	201	AK
clsmk1a	Clear Lake at St. Michaels	63.4934	-162.1697	3.41	AK
cld661a (cldbb1a)	Clear Water Creek	64.0537	-145.4306	320	AK
clwbb1a	Clear Lake at Stebbins	63.4982	-162.2311	1.83	AK

Site ID	Water body Name	Lat. (DD)	Long. (DD)	Elevation (m)	Location
crarc1b	Chandlar River at Arctic Village	68.12965	-145.5378	650	AK
doydb1a (WFN07)	Donjek River	61.6787	-139.75583	845	YT
emcfa1a	Emerald Lake	60.26336	-134.75021	701	YT
hefai1a	Hess Creek	65.665797	-149.096603	137	AK
hohsl1a	Hog River	65.731591	-156.549833	67	AK
hstal1a	Hay Slough	65.13805	-151.68367	68	AK
klyda1a	Klondike River	64.05661	-139.04849	381	YT
klydb1a (KFN03)	Kluane Lake	61.28275	-138.85597	827	YT
kohsl1a	Koyukuk River above Huslia	65.700264	-156.420615	161	AK
kohsl2a	Koyukuk River above Huslia	65.9936	-156.3995	61	AK
kokyu1a (kogal1a)	Koyukuk River	64.922139	-157.541389	36	AK
licfa1a	Little Atlin Lake	60.29758	-133.98729	684	YT
nahpb1a	Naparyaraq Slough	61.542056	-166.078857	0	AK
nettw1a	Nenana River	63.54082	-148.80773	603	AK
nivak1a	Ninglivvak River	61.546145	-165.574104	9.1	AK
pecfq1a	Pelly River at Pelly Crossing	62.82325	-136.54056	464	YT
pofyu1a	Porcupine River	66.592778	-145.278611	419	AK
pofyu2a	Porcupine River at Hubert Camp	66.989764	-143.139644	164	AK
styma1a	Stewart River	63.45391	-136.94199	549	YT
spcfa1a	Spirit Lake	60.246954	-134.743623		YT
tacfa1b	Tagish River	60.293428	-134.262472	653	YT
tacfa1a	Tagish River	60.28056	134.606861	659	YT
tafai1b	Tanana River below FAI	64.7895	-147.9593	137	AK
tafai2a	Tanana River above FAI	64.546864	-147.05393	188	AK

Site ID	Water body Name	Lat. (DD)	Long. (DD)	Elevation (m)	Location
tafai3a	Tanana River above Eilson	64.3378	-147.8682	337	AK
tantal1a	Tanana above Tanana	65.165752	-152.063433	68	AK
tanen1a	Tanana River at Nenana	64.5662	-149.0914	112	AK
tatok2a	Tanana above Tok	63.317304	-142.649344		AK
tayxy1a	Takhini River	60.841586	-135.187375	455	YT
teyzw1a	Teslin Lake	60.0866	-132.6006	688	YT
teyzw1b	Teslin River	60.4819	-133.5917	681	YT
teyzw2b	Teslin River	60.485073	-133.30155	681	YT
tomnt1a	Tolovana River	65.161952	-149.129826	347	AK
tomnt2a	Tolovana River	65.470881	-148.269057		AK
wacfa1a	Watson River	60.17986	-134.73723	660	YT
whyda1a	White River	61.198717	-140.55804	366	YT
yuanv1a	Yukon River above Anvik	61.671712	-160.196997	36	AK
yuauk1a	Yukon River at Alakanuk	62.684716	-164.618425	9.6	AK
yubri1a	Yukon River at Bridge	65.876033	-149.717917	80	AK
yucex1a	Yukon River at Carmacks	62.117628	-136.262678	652	YT
yucrc1a	Yukon River at Circle	65.824603	-144.053665	211	AK
yueaa1a	Yukon River at Eagle	64.7828	-141.1767	268	AK
yuemn1a	Yukon River at Emmonak	62.758767	-162.479	0	AK
yufyu1a	Yukon River at Fort Yukon	66.5588	-145.2776	130	AK
yugal1a	Yukon River at Galena	64.719778	-156.752639	142	AK
yukal1a	Yukon River at Kaltag	64.343999	-158.710299	37	AK
yukot1a	Yukon River at Kotlik	63.041389	-163.669722	3	AK
yuksm1a	Yukon River at St. Mary’s	62.0521	-163.4067	7	AK
yukyu1a	Yukon River above Koyukuk	64.874555	-157.719206	34	AK
yumll1a	Yukon River at Marshall	61.83875	-162.141806	4	AK

Site ID	Water body Name	Lat. (DD)	Long. (DD)	Elevation (m)	Location
yupqs1a	Yukon River at Pilot Station	61.945429	-162.835091	7	AK
yupqs1b	Yukon River at Pilot Station	61.93036	-162.88005	5.9	AK
yurby1a	Yukon River at Ruby	64.745433	-155.488733	42	AK
yursh1a	Yukon River at Russian Mission	61.841914	-161.305256	8	AK
yurmp1a	Yukon River at Rampart	65.53022	-150.131556	68	AK
Yusvs1a	Yukon River at Steven Village	65.992962	-149.05644	87	AK
yutal1a	Yukon River at Tanana	65.165752	-152.063433	68	AK
Yuwbq1a	Yukon River at Beaver Village	66.352713	-147.358952	100	AK
yuyda1a	Yukon River at Dawson	64.028337	-139.478131	320	YT
yuyxy1a	Yukon River above Whitehorse	60.5735	-134.6696	652	YT
yuyxy1b	Yukon River below Whitehorse	60.839186	-135.180167	633	YT

Appendix C: Field Sheet

Page 1 of 2

ONE PEOPLE-ONE RIVER

Yukon River Inter-Tribal Watershed Council

Fairbanks: 907-451-2530 • Whitehorse: 867-393-2199

Date (yyyy-mm-dd): ___________ - ___________ - ___________

Sample Time (24 hrs): ______________________________

Site Name ID: ______________________________

Waterbody Name: ______________________________

Technician(s): ____

Meter Type(s) (circle): **Hanna** **YSI Pro** **YSI 63/550A** **YSI 650** **Meter ID(s) #:** ___________

Calibration Data

pH Calibration *(YSI 63, YSI Pro, YSI 650, and Hanna)* *pH 7 and 10 need to be within 0.1 of buffer values, if not RECALIBRATE!*

pH 7 Buffer Reading: ___________

pH 10 Buffer Reading: ___________

pH 7 Buffer Temperature (°C): ___________

pH 10 Buffer Temperature (°C): ___________

Dissolved Oxygen (DO) Calibration *(YSI Pro, YSI 650, 550A)*

Barometric Pressure (inHg): ___________

DO Reading (%) Saturation: ___________

*Visit **www.weather.gov** and type in your community's zip code.*

DO % needs to be between 95 - 105%, if not RECALIBRATE!

DO Reading (mg/L): ___________

Conductivity Calibration *(YSI 63, YSI 650, Hanna)*

Conductivity Standard Used (µS/cm): ___________

Conductivity Solution Temperature (°C): ___________

Conductivity Reading (µS/cm): ___________

Field Data

pH: ___________

Air Temperature (°C): ___________

Latitude: _______________

Dissolved Oxygen (%): ___________

Water Temperature (°C): ___________

Longitude: _______________

Dissolved Oxygen (mg/L): ___________

Ice Thickness (cm): ___________

Elevation (m): _______________

Conductivity (µS/cm): ___________

Sample Collection Checklist

Parameters	**Anions** big plastic bottle	**Cations** tall, thin plastic bottle	**Nutrients** small plastic bottle	**Nutrients** small amber glass bottle	**DOC** large amber bottle	**Isotopes** tiny glass vial
Samples Collected (check)						

Did you enter your field measurements into FieldScope at **yukon.fieldscope.org/v3/**? (circle) **YES** **NO**

Did you take photos and email them to YRITWC at **science@yritwc.org**? (circle) **YES** **NO**

Did you take duplicates? (circle) **YES** **NO** Did you take field blanks? (circle) **YES** **NO**

Page 1 of 2 (initial when complete): ___________

Appendix C: Field Sheet cont.

Page 2 of 2

RIVER AND WEATHER

Weather conditions now (circle): overcast / clear / partly cloudy / cloudy • heavy / steady / intermittent rain • calm / breezy / windy

Weather in past 24 hours (circle): overcast / clear / partly cloudy / cloudy • heavy / steady / intermittent rain • calm / breezy / windy

Sample location (circle): mid-channel / bank / other • riffle / pool / eddy

Flow description (circle): < 5 gallons per second / > 5 gallons per second / under ice

Water clarity (circle): clear / cloudy (greater than 4” visibility) / murky (less than 4” visibility)

Site odor (circle): none / fresh algae / chlorine / rotten eggs / sewage / other:

Other (circle): litter / foams or suds / oily sheen / algae and/or aquatic plants

Anything different happening with the river since the last sample (flooding, erosion, flow change)?

How does the river height compare to two weeks ago?

How does the river height compare to this time last year?

Anything noteworthy happening with the weather?

WILDLIFE

Any specific concerns the YRITWC should know about wildlife?

Any noteworthy wildlife or fish species traveling through your community or nearby?

CONTAMINANTS

Has anything occurred since the last sampling that might have affected the water quality at your site?

Is there any *other* site that your community wants monitored? Please explain why you’re concerned…

OTHER

Anything else interesting? Please write your comments or observations…

Are there any issues with this sample that we should know about?

Page 2 of 2 (initial when complete): ___________

Appendix D: General Explanation of the Water Quality Parameters

Water Quality Parameters: Definitions along with Environmental, Human, and Drinking Water Impacts

pH

Definition: pH is a measure of the basic or acidic nature of a solution and varies inversely with the amount of hydrogen ions present in water. Low values of pH indicate acidic waters whereas high values of pH indicate basic waters. The number seven is right in the middle so it is considered neutral. pH can affect the concentration of the anions, cations and nutrients (see below) that are dissolved in the water so it is a very important indicator of water quality.

Drinking Water and Human Health: The pH level of drinking water does not have human health impacts. However, the Environmental Protection Agency (EPA) does *recommend* pH levels between 6.5 and 8.5 for drinking water.

Environmental Impact: Animals have a pH range that they thrive in. If their living environment fluctuates outside of that range they could die or become ill. A pH range of 6.0 to 9.0 provides a healthy environment for freshwater fish and invertebrates.

Dissolved Oxygen

Definition: An analysis of dissolved oxygen tests the amount of dissolved oxygen that is in the water. Oxygen gets into water by aeration (rapid movement), by diffusion from the air, and as a product of photosynthesis.

Drinking Water and Human Health: A high level of dissolved oxygen in drinking water is good because it makes the water taste better. However, high levels of dissolved oxygen speed up corrosion of water pipes.

Environmental Impact: If the concentration levels of total dissolved gas in water go over 110% it is harmful to aquatic life. Fish and aquatic invertebrates can -however rarely - experience “gas bubble disease” and die. Even though too much can be bad, some dissolved oxygen is entirely necessary for good water quality because life depends on oxygen. The amount of DO that an aquatic organism needs is dependent on the species of the animal, the water temperatures, the animals’ physical state, and the pollutants present in the water. At higher water temperatures fish species are using more oxygen because their metabolic rate increases. Research suggests that 4-5 mg/L is the minimum amount of DO that can support a large and diverse fish population. Good fish habitat generally averages around 9 mg/L of DO. Fish die when DO levels fall below 3 mg/L or climb above 17 mg/L.

Conductivity

Definition: Water’s conductivity refers to its ability to conduct electricity. Electrical current is transported by the ions that are present in the water. The concentration of ions in a water source is commonly called *total dissolved solids* or *TDS*. All of the dissolved solids in water are either negatively charged ions - **anions** (such as bicarbonate, sulfate, chloride, silica, nitrate, carbonate, fluoride, and boron) or positively charged ions - **cations** (such as sodium, calcium, magnesium, potassium, iron, strontium). The conductivity of water increases as the number of ions increases, therefore a higher TDS reading, or conductivity reading, means that there are more anions and cations present in the water. Generally, pure water has a low conductance whereas seawater has a high conductance.

Drinking Water and Human Health: Total Dissolved Solids are not known to cause many human health problems, but are more likely to have aesthetic influences; they can contribute to the corrosion of plumbing. TDS can cause drinking water to taste unpleasant and/or to look murky in appearance. Water becomes saline at extremely high levels of TDS, therefore, water is not recommended for drinking when the TDS reads above 500 mg/L or when specific conductance is above 750 μS/cm. In some cases high levels of TDS can cause gastrointestinal irritation.

Environmental Impact: Excess TDS can destroy food necessary for certain plants and animals. Also, high levels of dissolved solids can cause metallic surfaces to corrode or become encrusted.

Temperature

Definition: Temperature tells us how hot or cold the water is. Temperature can affect the ability of water to conduct an electrical current, to hold oxygen and certain dissolved solids, and to undergo various reactions.

Drinking Water and Human Health: None

Environmental Impact: While temperature can vary greatly (seasonal or even within the day), consistently high water temperatures are detrimental to most fish species (salmon, whitefish, shellfish, etc.).

Nutrients

Definition: A nutrient is a chemical that an organism needs to live and grow. There is a long list of the different kinds of nutrients that can exist in a body of water. Natural sources of nutrients include soils and decaying plants materials (fallen leaves, grass etc.). Sometimes nutrients dissolved in water come from human and animal wastes, fertilizers, or industrial wastewater. Phosphorus and Nitrogen are often closely tested for because they are good indicators of the health of a watershed. There are two nitrogen-bearing nutrients that we analyze:

Nitrate: Small amounts of nitrate (NO3) dissolve in the water when it reacts with decaying plant and animal material in the soil. Sometimes nitrate dissolved in water comes from human or animal wastes and fertilizers.

Ammonium: As with nitrate, small amounts of ammonium (NH4) dissolve in the water when it reacts with decaying plant and animal material in the soil. Sometimes ammonium dissolved in water comes from human or animal wastes and fertilizers.

Other nutrients: Other nutrients that we analyze include sulphate (discussed below) and dissolved organic carbon (or “DOC”; discussed below).

Drinking Water and Human Health: Nutrients are essential for life but too many of them can pollute drinking water. Extremely high levels of nitrate (a type of nutrient that we test for) can be toxic, especially to young infants. There is very little risk from ammonium (the other type of nutrient that we test for) at the low levels normally encountered in the Yukon River watershed.

Environmental Impact: Nutrients are important for aquatic animals to live, but too many nutrients degrade aquatic habitat because they can cause algae to grow excessively and lower the dissolved oxygen in the water. This is called eutrophication. Most nutrient tests will look for total oxidized nitrogen (NO_2 + NO_3) because NO_2 is poisonous to fish and is known to contribute to the overgrowth of algae. Ammonium (NH_4) is also measured because in high concentrations it can be toxic to fish and other animals.

Stable Water Isotopes

Definition: Some molecules of water are lighter or heavier than others because of something called “isotopes.” We measure the isotopes in water to understand where the water comes from (ice? snow? rain? groundwater?) and how the water is moving from one place to another.

Drinking Water and Human Health: Stable water isotopes pose no risk to human health.

Environmental Impact: Stable water isotopes pose no risk to the health of the river. They can help us understand long-term trends in the watershed, including the effects of climate change. Different isotopes behave differently. Lighter water molecules (that is, water with more light isotopes) are more easily evaporated. Heavier water molecules (that is, water with more heavy isotopes) are more easily precipitated as rain or snow. Isotopes can also be used to trace the origin of water due to the way it fluctuates based on factors such as amount of precipitation, altitude, geothermal activity, snow melt, tree presence, location (O18 levels tend to decrease farther from the coast), temperature, and much more.

Dissolved Organic Carbon (DOC)

Definition: DOC or dissolved organic carbon merely refers to a wide range of organic molecules that exist in a water system. In general, organic carbon compounds come from the decomposition of plants and other dead organic matter.

Drinking Water and Human Health: DOC attaches to metals when it comes in contact with them. Some heavy metals like cadmium and mercury are toxic. When fish eat the DOC that has toxic metals attached, these toxins are carried onto the consumer…us!

Environmental Impact: DOC is a nutrient and varies in every body of water. DOC is important and essential for life, especially for microorganisms: tiny life forms like algae, bacteria and fungi. These tiny life forms are the start of the food chain! Our health depends on the health of the fish, which depends on the health of these microorganisms. Most DOC occurs naturally, but sometimes high concentrations are a result of human influence. What is important to note about DOC measurements are large or sudden changes. Such changes could be signaling to a bigger problem.

Anions

Definition: Ions are dissolved particles that have charge. Anions are negatively charged ions. There are three anions that we measure:

Alkalinity: Alkalinity is a measure of the capacity of water to neutralize acids.

Sulphate: Sulphate is a nutrient. Usually the source of sulphate dissolved in water is natural, but sometimes it comes from fertilizers, mining operations, pulp and paper mills, canneries or other sources.

Chloride: Some chloride dissolves in the water when it reacts with salts in the rocks and the soil. However, chloride dissolved in water often comes from other sources such as human or animal wastes, which are high in salt, or from salt used on roads for snow and ice control.

Drinking Water and Human Health: High concentrations of the anion chloride usually cause water to taste bad and could cause pipes to corrode.

Environmental Impact: The anion Alkalinity is important for fish and aquatic life because it can help prevent rapid pH changes. Remember that living organisms generally function best in a pH range of six to nine.

Cations

Definition: Ions are dissolved particles that have charge. Cations are positively charged ions. There are four cations that we measure:

Calcium: Calcium dissolves in the water when rain falls, infiltrates the ground, and reacts with rocks and soil.

Magnesium: Magnesium, like calcium, dissolves in the water when rain falls, infiltrates the ground, and reacts with rocks and soil.

Sodium: Sodium, like calcium and magnesium, dissolves in the water when rain falls, infiltrates the ground and reacts with rocks and soil. Sometimes sodium dissolved in water comes from human or animal wastes, which are high in salt, or from salt used on roads for snow and ice control. In lower river communities, it is possible that sodium comes from seawater that the tides are pushing up into the river.

Potassium: Potassium, like the other cations, dissolves in the water when rain falls, infiltrates the ground, and reacts with rocks and soil. Sometimes potassium dissolved in water comes from fertilizers.

Drinking Water and Human Health: There is currently no evidence of negative health effects on humans caused by calcium, magnesium, or potassium in water. When sodium concentrations are very high, the water usually tastes bad. When water does not contain much calcium and magnesium, we say that it is “soft water.” When water contains a lot of calcium and magnesium, we say that it is “hard water.” Hard water requires a lot of soap to produce lather. It can also form white deposits called “scale” that can clog hot water pipes, boilers and other household appliances.

Environmental Impact: There is currently no evidence of negative health effects on aquatic life caused by calcium, magnesium, or potassium in water.

Greenhouse Gasses

Definition: A greenhouse gas can absorb and release energy from the sun and ultimately cause the greenhouse effect that keeps our planet warm. Increasing amounts of greenhouse gases contribute to climate change. Greenhouse gases are in the air but they can also dissolve into the water, just like oxygen does. We measure two greenhouse gases:

Carbon dioxide: Every time we breathe out, we are putting some carbon dioxide into the air. Carbon dioxide is also produced whenever we burn fossil fuels like gas, coal or diesel. When the climate warms, the permafrost can melt and release carbon dioxide.

Methane: Methane is the main ingredient in what we call “natural gas.” It naturally occurs underground but can also come from manure, landfills, and other places. When the climate warms, the permafrost can melt and release methane.

Drinking Water and Human Health: Carbon dioxide and methane are typically found in small amounts in natural water samples, so they generally pose no risk to human health.

Environmental Impact: It’s important to monitor how much carbon dioxide and methane are in our water samples because it helps us determine how much climate change is occurring and how climate change is affecting our watershed. Carbon dioxide and methane are typically found in small amounts in natural water samples, so they generally pose no risk to the health of the river.

Appendix E: Resources

Equipment Retailers:

TTT Environmental, LLC
4201 B St.
Anchorage, AK 99503
Phone: 907-770-9041
Fax: 907-770-9046
Website: www.tttenviro.com
Email: info@tttenviro.com

TTT Environmental, LLC
915 – 30th Ave., Unit 103
Fairbanks, AK 99701
Phone: 907-374-9040
Fax: 907-374-9045

Instrumentation Northwest
19026 72nd Ave. S
Kent, WA 98032
Phone: 253-872-0284
Fax: 253-872-0285
Website: www.inwusa.com
Email: sales@inwusa.com

YSI Inc.
Integrated Systems & Services
Phone: 1-877-392-9950
Website: www.ysi.com/system
Website: system@ysi.com

Online Tools:

www.yritwc.org/science

- Field Manual
- Published Open File Reports
- USGS-YRITWC Fact Sheet
- Link to USGS ScienceBase water quality database and FieldScope

Appendix F: IGAP Budget Recommendations for Site Specific Contaminant Sampling

	Item	**Cost**		**Description**
		Open Water (8 samples)	**Year-round (12 samples)**	
Sampling Cost:	Lab Analysis for Cation & Anions	$2,720	$4,080	Anions and Cations, including heavy metals scope per sample $340
	Calibration Solution	$45.00	$90.00	$10 per liter (pH 7, pH 10)
	Shipping	$280.00	$420.00	$35 per sample (This is a current estimate. Your location does dictate exact cost)
	YSI meters	$50.00	$50.00	Rental cost for season, this cost covers maintenance!
	YSI Multiparameter Probe purchase			$2,480 - call if you would like to purchase
	TOTAL	**$3,095.00**	**$4,640.00**	
ION Training Cost Anchorage:	Item	Cost		Description
	Transportation	$1,200.00		Round trip ticket *please adjust according to location
	Per diem	$375.00	$75/day	
	Lodging	$580.00	$145/night	
On-site visit:	Transportation			covers trainer's travel to your location *adjust to location
	TOTAL (est.)	**$2,155.00**		