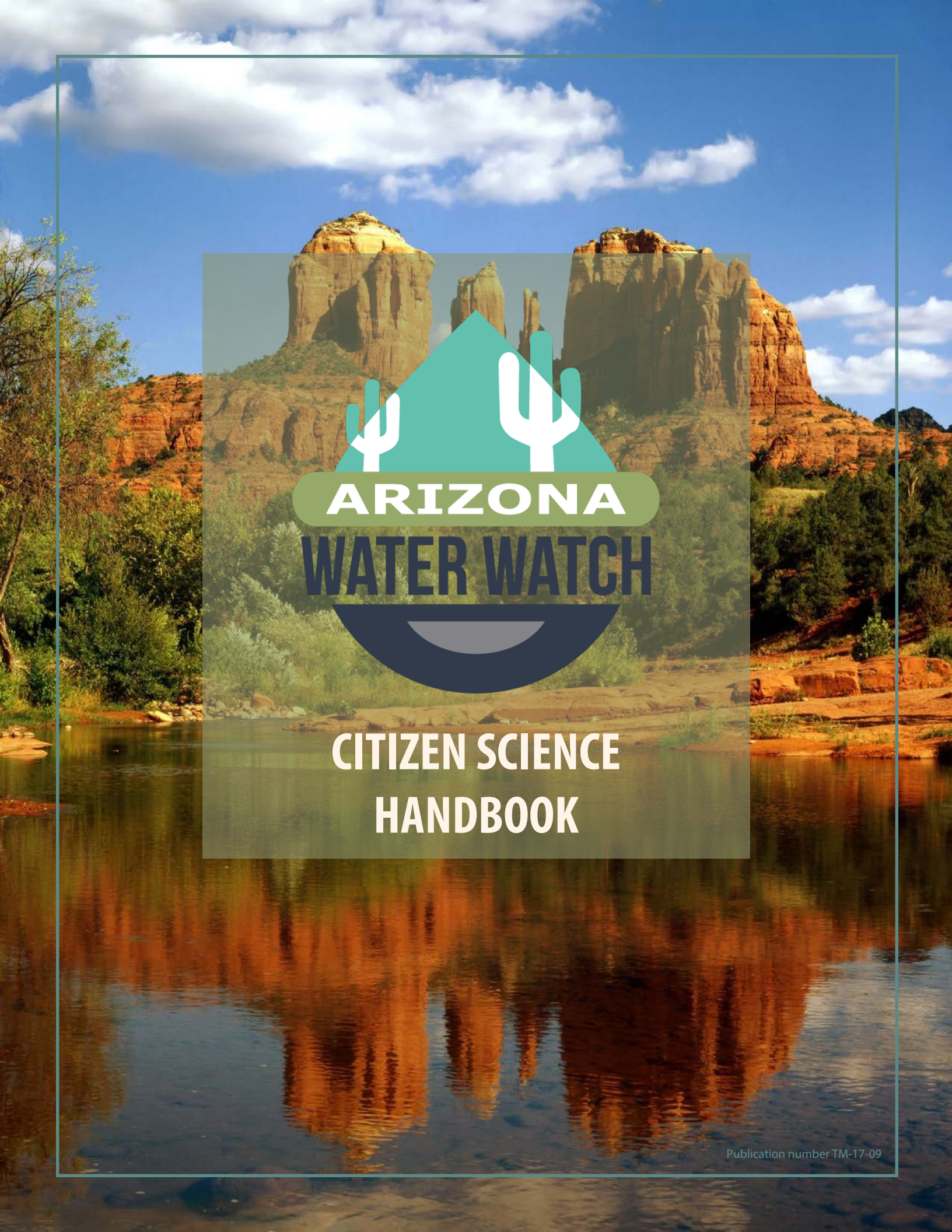

ARIZONA

WATER WATCH

CITIZEN SCIENCE HANDBOOK

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Arizona Department of Environmental Quality
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INTRODUCTION TO ARIZONA WATER WATCH

Arizona Water Watch (AWW) is a statewide citizen science water quality monitoring program lead by the Arizona Department of Environmental Quality (ADEQ). The program is designed to enable local volunteers and state scientists to collaboratively work together to collect high quality data on Arizona's streams, lakes, and wetlands.

The goal of AWW is to empower those who have a local interest in a watershed by providing training, equipment, and guidance to volunteers. By definition, volunteers collecting and analyzing data pertaining to the natural world are referred to as citizen scientists. With AWW citizen scientists and ADEQ staff partnering, more of Arizona's unique waterways can be studied!

The Arizona Water Watch program supports the citizen scientists by providing the following:

- TRAINING WORKSHOPS
- STANDARDIZED MONITORING PROTOCOLS
- TESTING EQUIPMENT
- GUIDANCE ON CREATING A WATERSHED SPECIFIC SAMPLE PLAN
- ONLINE DATABASE PORTAL FOR DATA STORAGE (COMING SOON!)

By participating in AWW as a citizen scientist, volunteers can directly contribute by collecting data that will plug into the assessment of Arizona's water, help identify areas of concern, and aid in the protection of outstanding waters. The volunteers are at the heart of the Arizona Water Watch Program. Thank you!

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has." -Margaret Mead

WHAT IS THIS DOCUMENT FOR?

The citizen science handbook is a reference guide for volunteers and is intended to be used after training has been completed.

This document contains Arizona Water Watch standard operating procedures and in depth details into water quality monitoring for the purposes of this program. The handbook will help ensure that data is collected in the same manner from all volunteers and ADEQ staff around the state.

Please refer to ADEQ's Arizona Water Watch Website: http://www.azdeq.gov/programs/azww for additional reference that will support this handbook including items like micro video lessons, upcoming training opportunities, field forms, and much more!

WATER QUALITY BACKGROUND

Water in Arizona is used for drinking, swimming, irrigating crops, fishing, and supporting wildlife and aquatic life (ex. bugs that live in the water).

For water quality purposes we take into account what the stream or lake is used for and apply "designated uses" to each waterbody in the state. In general different waterbodies have different uses or a combination of multiple uses.

Streams and lakes also have numeric values applied to the designated uses to ensure that a certain level of quality is met. Those values have been determined by years of data collection and analysis and we call those numeric values "standards."

ADEQ scientists assess Arizona's streams and lakes every two years to see if they are meeting water quality standards. More information can be found at http://www.azdeq.gov/programs/waterquality-division/page/0/1.

5 STEPS TO GETTING INVOLVED

To become certified in the Arizona Water Watch Program there are only five steps. Guidance and support from ADEQ will be provided at every step!

1. **CONTACT AWW COORDINATOR**
2. **SIGN UP FOR TRAINING**
3. **DO SCIENCE!**
4. **SUBMIT DATA**
5. **CELEBRATE!**

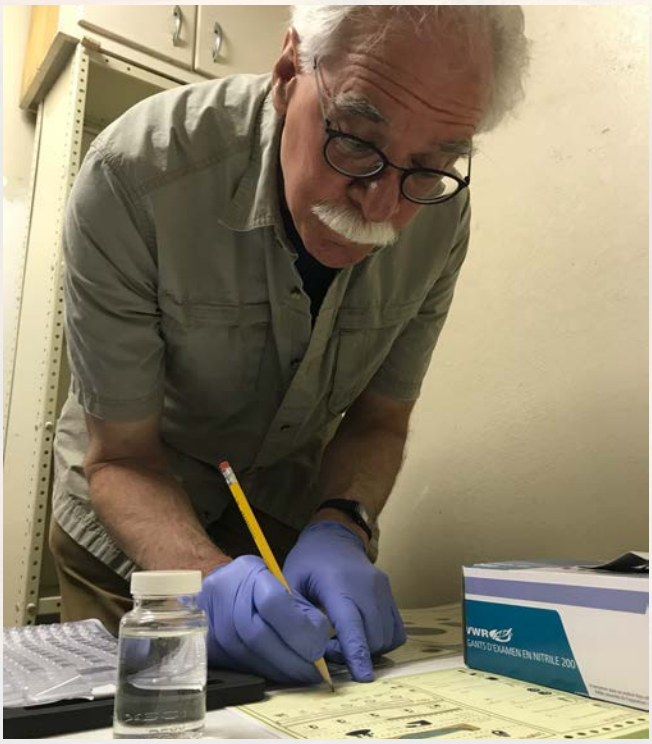
1. CONTACT AZ WATER WATCH COORDINATOR

Register to become a citizen scientist with Arizona Water Watch by visiting the ADEQ website at http://www.azdeq.gov/programs/water-quality-programs/arizona-water-watch. Fill out the volunteer registration/ photo release form and email the program coordinator at ms14@azdeq. gov. The coordinator in conjunction with the citizen scientist will help design a study specific to the waterway of interest.

The next step is to create a Sample and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP). The SAP and QAPP will be combined into one document and it has two benefits. It allows for volunteers and scientists to work together and target specific areas in need of data and secondly, it's a crucial step in collecting high quality data to be used in the state wide assessment per ADEQ's "credible data" requirements. The program coordinator will provided an example SAP/QAPP's and a template for volunteer groups or write the document for the volunteer to review. The document will include a specific sample design, identify sampling locations, and determine necessary equipment needed to collect the water quality data.

Included in the SAP/QAPP will be a section on safety. Personal safety of volunteers engaged in any citizen scince activity is the most important part of any trip into the field. Volunteers should never place themselves in dangerous or risky situations. Any hazards that are known by field personnel should be communicated to other members of the field crew. Field work should be postponed if there is any indication that field activity could be dangerous (lightening, bees, ect.).

All field work has some risk associated with it such as driving, hiking on uneven surfaces, wading in streams or working with chemicals while wearing appropriate personal protective gear. This is normal risk. Working during lightning storms, at night, during flash flood conditions, or during snowy weather is not considered "normal risk". Please refer to the specific study area SAP/QAPP for the closest hospital and other hazard information.



2. SIGN UP FOR TRAINING

ADEQ will host two large trainings in the fall and spring and will host other site specific trainings during the year based on the need of the volunteers. Please check the calender on the ADEQ website for upcoming training dates and locations. The trainings are intended to teach volunteers how to collect representative water quality samples, how to use scientific equipment properly, and how to document current conditions of the waterbody. Once a volunteer has gone through training they will become an official Arizona Water Watch Member and be ready to collect water quality data!

During trainings volunteers will be exposed to a large volume of information, video micro lessons are provided on our web page to help reinforce the information. The micro lessons will serve as a refresher and help answer any questions volunteers might encounter during the sampling season. Some examples of micro lessons are: "how to do a dilution," "how to collect a flow measurement," and so on. The videos will serve as a short, but visual reminder of techniques used to collect water quality samples. The citizen science coordinator at ADEQ will always be available to help answer questions and provide guidance for the Arizona River Watch Program.

A copy of the handbook will be available at the training, but can also be downloaded from the Arizona Water Watch website: https://azdeq.gov/programs/water-quality-programs/arizonawater-watch.

3. DO SCIENCE!

Once the sample plan has been submitted, and the volunteers have attended training, they are ready to collect data and do science!

Arizona Water Watch citizen scientists conduct monitoring by collecting all or some of the following records: water chemistry, E. coli, field parameters (DO, pH, Temperature, etc.), and habitat data. Volunteers are trained in standard methods of water quality sampling and processing. Combined with the equipment provided by ADEQ, volunteers can see the process from start to finish and directly contribute to making a difference!

An equipment loaner library with scientific equipment will be available to share with trained citizen scientist! Please visit the AWW website to view equipment and request supplies.

Within the first few months of training, citizen science groups will be contacted and asked to complete an in person or virtual field audit. In the case of a virtual filed audit a GoPro camera will be sent with directions and the volunteer group will be asked to document their sampling techniques and processing. The audit is required per ADEQ's credible data needs, but also provides an opportunity to fine tune and adjust sampling habits and identify site specific issues. The audit will help the AWW coordinator identity potential areas of concern and understand issues the volunteers are encountering.

The Arizona Water Watch program will have volunteers from all over the state collecting vital data on many important and significant waterbodies like the San Pedro, Verde River, Oak Creek, and many more! The collaborative effort will help ensure and protect our waterbodies for future generations!

4. SUBMIT DATA

Submitting and reviewing the data is a crucial step in the AWW program. The data collected by AWW citizen science volunteers will plug into the statewide assessment of our waterbodies and play a direct role into protecting and maintaining Arizona's beautiful waterbodies.

Submit field data sheets, site photos, and timesheets monthly to the coordinator by taking a photo or scanning the forms and sending all images via email to AWW coordinator Meghan Smart at ms14@azdeq.gov. At the end of the sampling season, the coordinator will arrange to have the hard copy of the data sheets picked up.

If a volunteer is sampling for E. coli and there is an exceedance over the state standard of 235 cfu/100 ml, please email the results and photos to the coordinator within 24 hours. The coordinator will then contact the County Health Department and the Department of Health Services of the E. coli exceedance in a timely manner.

Coming soon, volunteers can access their data via an online portal to ADEQ's water quality database! Data can be queried by site and be downloaded in excel format. Go to ADEQ's Arizona Water Watch website for up-to-date information on the progress of the portal!

5. CELEBRATE!

Volunteer appreciation is a main pillar of the AWW program. The citizen scientists are an essential resource to studying the health of Arizona's waterbodies. Taking time to celebrate a job well done and the collaborative efforts of volunteers and scientist working together is important. A team that celebrates together creates a bond and works together well on projects.

Recognition can come in many forms including receiving badges of expertise, certificate of completion for training, and an end of year appreciation of service award. Annual recaps and lessons learned are also encouraged as a way to ensure that volunteers have a direct feedback and suggestions for the program.

Through the hard work and dedication of committed citizens we can make a difference in protecting Arizona's beautiful waterbodies. ADEQ is committed to making this process as easy as possible while still collecting high quality data!

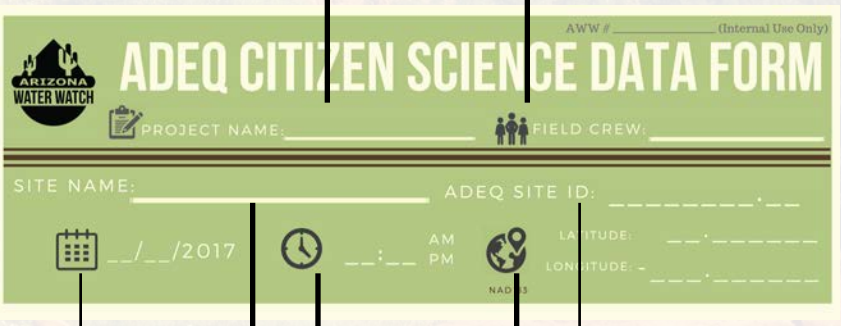
COLLECTING FIELD DATA

The citizen science data form is used by all volunteer groups across the state to help ensure the correct data is collected. If a parameter is not applicable to the local volunteers group's needs, that portion can be crossed out. Crossing out the blank portions will let the coordinator know it was intentionally left blank. The Arizona Water Watch citizen science form is a one page document (front and back) that can be printed in color or black and white. The data form can be found on the AWW webpage.

Site details are necessary pieces of information to relate the data to the collection location and time. All of this information is collected at the top of the form.

Project Name
If there is a project name identified, please write it on the tan line.

Field Crew
Add the initials of the samplers



Site Name
Add a descriptive site name. For example, "Wet Beaver Creek near the USGS gage".

Date
Month/Day/Year. For example: 06/25/2017

Time
Add the time in hour: minute format and circle AM or PM. For example: 08:30 AM

ADEQ Site ID
The citizen science coordinator will provide an ADEQ site ID. The site ID includes a numeric river value along with the watershed and stream code. For example: the East Verde River at 12.21 miles upstream from the confluence of the Verde would have a Site ID of "VREVR012.21".

Location
Using a GPS in the NAD 83 datum add the latitude and longitude in decimal format. If this site has already been geo-located, it's not necessary to fill out this information every sampling trip.

Field data parameters are collected by using specific scientific equipment including things like a multi-parameter probe, turbidity meter, and a thermometer. Each volunteer group will require different equipment, check in the ADEQ citizen science coordinator for information about our equipment loaner program. The equipment used should be identified in the SAP, properly calibrated, and maintained during the sampling season.

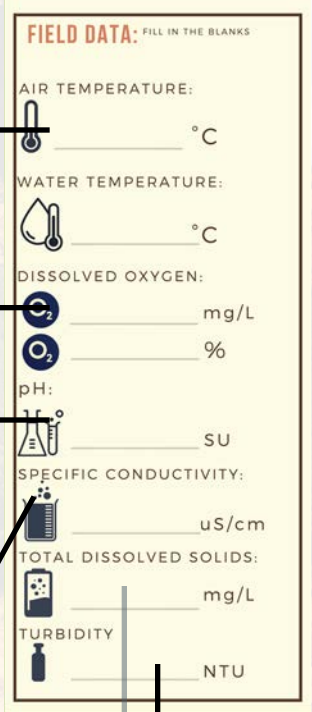
Fill in the field data section of the field form by writing down the values from the multi-parameter probe onto the datasheet (See Appendix A). Double check the units are the same on the probe as on the datasheet.

Temperature
A thermometer within the multi probe is used for water temperature and occasionally air temperature. A handheld thermometer can be used to collect air temperature if the multi-probe can't. Metric unit of degrees Celsius is used.

Dissolved Oxygen (DO)
This is the measurement of dissolved oxygen in water. Some multi-parameter meters report DO in ppm (parts per million) which is synonymous with mg/L as indicated on the field form. Collect both the mg/L and the % of oxygen available.

pH
This is the measure of hydrogen in water on a logarithmic scale from 0 (acidic) to 14 (basic). The unit used for pH is the Standard Unit (SU) due to the logarithmic scale.

Specific Conductivity
This measures the concentration of dissolved solids that has been ionized in water. The unit is micro-Siemens per centimeter us/cm.



Total Dissolved Solids (TDS)
This is the measurement of minerals, salts, or metals dissolved in water. Some multi-parameter meters report TDS in ppm (parts per million) which is synonymous with mg/L as indicated on the field form.

Turbidity
Is the measurement of the cloudiness of water typically caused by sediment particles in the water column. Turbidity is collected in a glass vile and is placed into a machine that shoots light though the vile and reports a value. Units used are Nephelometric Turbidity Units (NTU).

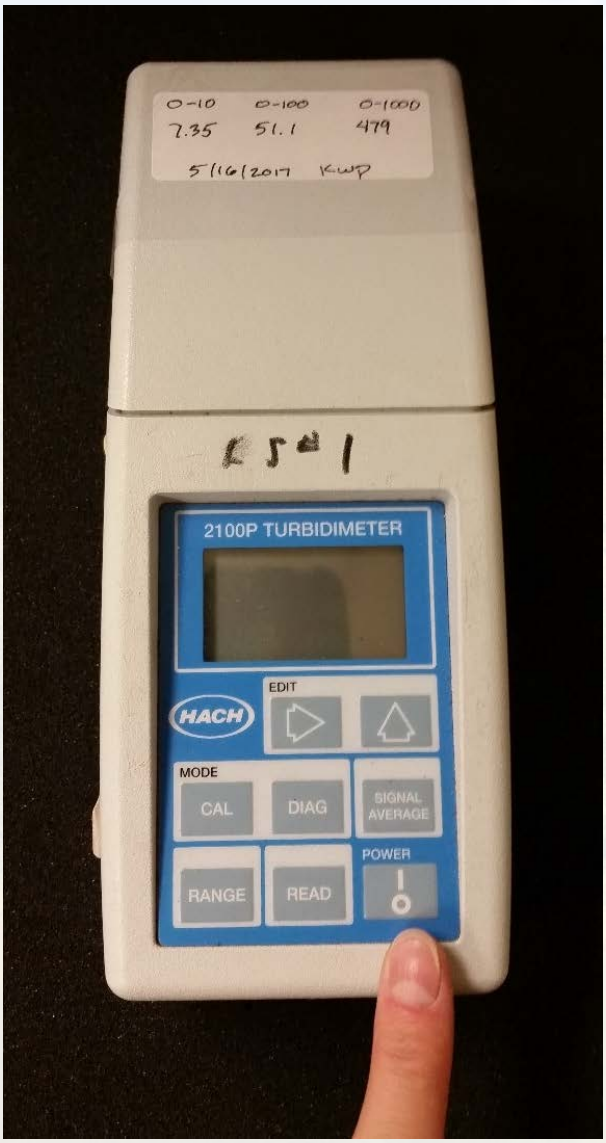
Field data are similar to vital signs for streams. It's the initial reading of what is going on in the system and can alert us to overarching problems that are occurring. Stream vital sign sheets have been created to aid volunteers on acceptable ranges for the specific parameters. Ranges were determined from analyzing data that ADEQ has collected over the past twenty years. It's okay to get a data point outside of the designated range, but ideally this will encourage us to take a second look to confirm that value is correct. Stream vital sign sheets can be downloaded from our webpage and will be continually updated.

USING THE MULTI-PARAMETER PROBE

The multi-parameter probes must be transported and stored in the hard plastic Pelican cases. Make sure the batteries are charged before heading out in the field. Proper care of the probes is essential for accurate readings. Each probe can be a little different, but at each site the Dissolved Oxygen (DO) will need to be calibrated (refer to APPENDIX B and C) and these steps will need to be done regardless of which probe is used:

1. Take the probe out of the protective case and assemble. Add the pH probe if using the SMARTROLL.
2. Turn the probe on.
3. Calibrate for DO (see APPENDIX B and C) for calibration protocol.
4. Put the flow through cell on the probe.
5. Place the probe facing upstream in a riffle or run. This allows water to move through the probe and obtain the most accurate data. Do not stand in front of the probe.
6. Take care not to get the electronic portions wet (iPod or hand held computer screen, or battery packs) of the multi-parameter probe.
7. Let the probe sit for a minute. The numbers will fluctuate and bounce around, but eventually start to level off.
8. Once the fluctuation of value slows down, just pick a value and write it on the field form.
9. Put the plastic cell with a wet sponge back on the probes, unassemble the cords, remove the pH probe if the SMARTROLL was used, and place the pieces back in the case.

USING THE TURBIDITY METER



The turbidity meter can be used back at the vehicle or "field office," but the sample will need to be collected in a glass vial in the field. The meter will need to be calibrated before every sample is read. Refer to APPENDIX A for calibration and processing.

1. Rinse a glass vial with stream water 3 times.
2. Fill the vial with the sample and tighten the cap.
3. Wipe the surface clean with a cotton cloth.
4. Keep in a safe location until the vial can be read in the meter.
5. Calibrate the instrument using a reference standard that closely matches your sample (see APPENDIX A) and write the value on the form.
6. Place the vial in the meter by aligning the white diamond/triangle to the raised mark on the instrument.
7. Press the read button.
8. Write the value on the field form.

SAMPLE COLLECTION INFO

This section provides detailed information about how and where the samples were collected. Circle the applicable information in each of the four subsections.

Sampling Method
To collect a water quality sample we use two methods: a grab sample is collected by dipping a bottle in the water with gloved hands or a reach pole is used to dip a bottle under water while standing on the bank. Please circle the appropriate method used.

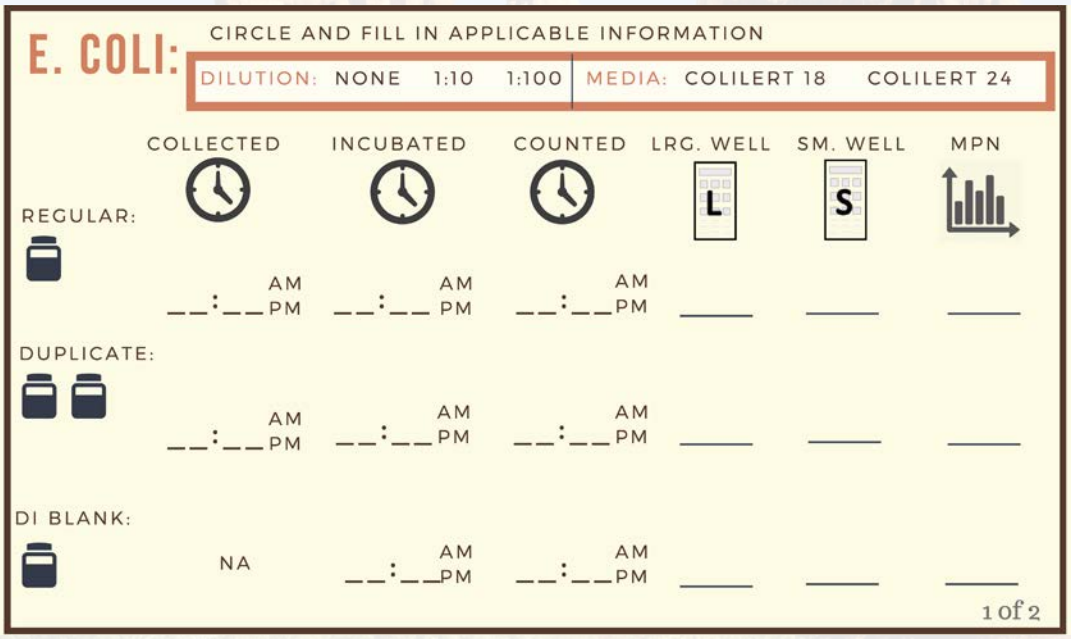
Sampling Location
Water samples are collected facing upstream so the water is flowing into the collection bottles. Samples can be collected at various stations of the stream, but most often are collected at the ½ point (midpoint). If the stream is unsafe to swim, collection can occur from the Left Edge of Water (LEW) or the Right Edge of Water (REW). Note that the REW and LEW is always determined by the sampler facing downstream and then determining which bank is on the right vs the left. Circle the correct sampling location as noted on the stream cross section diagram on the field form.

Sampling Location Habitat
A stream is made up of three habitats: riffles, runs and pools. A riffle is the portion of the stream with faster flow, shallow depth, and typically white capped water appears at the surface. A run is the portion of the stream that is visually moving with a smooth surface, but typically doesn't have white caps. A pool is an area of deposition and is deep in comparison to the riffle and runs. Riffles are the preferred location for water quality sampling, but both runs and pools can be sampled. Circle the appropriate habitat where the sampling occurred.

Samples Collected
Accounting for the different samples collected during a sampling trip helps keep track of data as it comes in from different labs and people. Some sites may only require that E. coli be collected at a site, while a different site will have E. coli, nutrients, and metals collected. Circle the applicable samples collected by circling the bottle and parameter name. If a quality assurance Duplicate (D) or Blank (B) was collected, note that by circling the appropriate letter to the right of the bottle icon on the form.

E. COLI SAMPLING AND PROCESSING

E. coli is a bacterial organism found in the guts of warm blooded animals. Through various ways, E. coli can make its way into waterbodies and can potentially cause illness. E. coli is also an indicator species for all waterborne diseases (viral, bacterial, and parasitic). We use E. coli as a water quality indicator to give us insight into all waterborne diseases in a waterbody.



E. COLI: CIRCLE AND FILL IN APPLICABLE INFORMATION

DILUTION: NONE 1:10 1:100 | MEDIA: COLILERT 18 COLILERT 24

	COLLECTED	INCUBATED	COUNTED	LRG. WELL	SM. WELL	MPN
REGULAR:	__:__ AM PM	__:__ AM PM	__:__ AM PM	____	____	____
DUPLICATE:	__:__ AM PM	__:__ AM PM	__:__ AM PM	____	____	____
DI BLANK:	NA	__:__ AM PM	__:__ AM PM	____	____	____

1 of 2

E. coli Sampling

Samples are collected wearing gloves and using a sealed, sterile 100ml bottle submerged in the stream while facing upstream. The bottle should be opened and recapped under water during sampling so that surface contaminants are not sampled. E. coli has a six hour holding time. Time starts when the sample is collected. Samples must be chilled and processed within six hours of sample collection.

1. Using a sharpie, label the bottle with site ID, date, and time.
2. Put gloves on.
3. Take the plastic seal off of the 100 ml plastic bottle.
4. Wade to the middle of the river and face your body upstream. If midstream cannot be safely accessed, collect E. coli (and other field parameters) in another location, but note it under the sample collection portion of the field form.
5. Exercise caution not to stir up sediment and prevent any cross contamination that might occur during the sampling process. Allow sediment to resettle if stirred up prior to collecting the E. coli sample.
6. Place the bottle roughly 6 inches below the surface of the water (facing upstream).
7. Open and recap the E. coli bottle under water during sampling so that surface contaminants are not sampled.
8. Place the E. coli bottle on ice as soon as possible for transportation to the lab.
9. Be sure to write on the field form what time the E. coli sample was collected. Keep in mind that the sample has a six hour holding time until it will need to be processed.

E. coli Processing

As mentioned before, E. coli has a six hour holding time and the clock starts ticking once the sample is collected in the 100 ml bottle. A laminated E. coli processing mat has been created to help the step by step process for E. coli samples. Lay the placemat on a table, wipe down the mat using a 70% ethanol solution, and then put all of the items on top of the icons as you process. Steps 3-7 on the placemat will need to be repeated per E. coli sample. The processing mat can be found on our website or you can request one from the program coordinator.

1. Turn on the sealer and incubator. Keep in mind that the incubator takes about 4 hours to heat up and you may want to turn it on prior to collecting the E. coli samples. Verify that the incubator is operating at 35 +/- 0.5° C.
2. Put gloves on.
3. Add site information on the back of the E. coli sampling tray. Information to include: site ID, date, time added to the incubator, and leave a space to add the time out (i.e., when you read the E. coli sample the following day). Be sure to add the time put into the incubator to the field form under the "incubated" clock icon.
4. Check the level of water in bottle against 100ml line, if too much water is present, decant to the 100ml line.
5. Add the 24 hour media to the sample. When opening the reagent packets, avoid inhaling the media.
6. Invert the. E. coli bottle and wait until all of the media has dissolved prior to adding the E. coli sample to the tray.
7. Confirm that the green light on the sealer is on and the machine has warmed up.
8. Use one hand to hold tray upright with the well side facing the palm. Gently pull foil tab to separate the foil from the tray. Avoid touching the inside of the foil or tray.
9. Pour the reagent/sample mixture directly into the tray avoiding contact with the foil tab. Tap the small wells 2-3 times to release any air bubbles.
10. Place the sample-filled tray onto the rubber mat of the tray sealer with the well side (plastic) of the tray facing down.
11. Remove the tray from the rubber mat and place the tray in the preheated incubator with the cells facing down.
12. After 24 hours remove the samples from the incubator. Turn off the incubator if sampling is complete for the week.
13. Using a UV light in a dark area identify fluorescing cells by taking a sharpie and marking on the cells. Wells that are yellow under plain light are positive for total coliforms. Wells that are yellow and then fluoresce under a uv black light are positive for E. coli. Sample results are obtained by counting and recording the number of large and small yellow, fluorescing wells. Once the number of large and small wells is obtained the "most probable number" (MPN) is recorded from the MPN table (See page 17; can also be downloaded from https://www.idexx.com/pdf/en_us/water/qt97mpntable.pdf).
14. Note the time the sample was read under the "counted" clock icon on the data sheet. Add the number of large wells, the number of small wells, and the MPN to the field data sheet.
15. The used E. coli bottles and trays are considered to be a biohazard and will need to be placed in a bucket with water and a 10% bleach solution for one hour for decontamination. Score the back of the tray with a knife and uncap the bottles so the bleach can get inside. After all trays and bottles have been bleached for an hour, they can be placed in the trash and the solution can be tipped down a drain with running water.

IDEXX Quanti-Tray®/2000 MPN Table *(per 100ml)*

# Large Wells Positive	# Small Wells Positive																								
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0	<1	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.1	15.1	16.1	17.1	18.1	19.1	20.2	21.2	22.2	23.3	24.3
1	1.0	2.0	3.0	4.0	5.0	6.0	7.1	8.1	9.1	10.1	11.1	12.1	13.2	14.2	15.2	16.2	17.3	18.3	19.3	20.4	21.4	22.4	23.5	24.5	25.6
2	2.0	3.0	4.1	5.1	6.1	7.1	8.1	9.2	10.2	11.2	12.2	13.3	14.3	15.4	16.4	17.4	18.5	19.5	20.6	21.6	22.7	23.7	24.8	25.8	26.9
3	3.1	4.1	5.1	6.1	7.2	8.2	9.2	10.3	11.3	12.4	13.4	14.5	15.5	16.5	17.6	18.6	19.7	20.8	21.8	22.9	23.9	25.0	26.1	27.1	28.2
4	4.1	5.2	6.2	7.2	8.3	9.3	10.4	11.4	12.5	13.5	14.6	15.6	16.7	17.8	18.8	19.9	21.0	22.0	23.1	24.2	25.3	26.3	27.4	28.5	29.6
5	5.2	6.3	7.3	8.4	9.4	10.5	11.5	12.6	13.7	14.7	15.8	16.9	17.9	19.0	20.1	21.2	22.2	23.3	24.4	25.5	26.6	27.7	28.8	29.9	31.0
6	6.3	7.4	8.4	9.5	10.6	11.6	12.7	13.8	14.9	16.0	17.0	18.1	19.2	20.3	21.4	22.5	23.6	24.7	25.8	26.9	28.0	29.1	30.2	31.3	32.4
7	7.5	8.5	9.6	10.7	11.8	12.8	13.9	15.0	16.1	17.2	18.3	19.4	20.5	21.6	22.7	23.8	24.9	26.0	27.1	28.3	29.4	30.5	31.6	32.8	33.9
8	8.6	9.7	10.8	11.9	13.0	14.1	15.2	16.3	17.4	18.5	19.6	20.7	21.8	22.9	24.1	25.2	26.3	27.4	28.6	29.7	30.8	32.0	33.1	34.3	35.4
9	9.8	10.9	12.0	13.1	14.2	15.3	16.4	17.6	18.7	19.8	20.9	22.0	23.2	24.3	25.4	26.6	27.7	28.9	30.0	31.2	32.3	33.5	34.6	35.8	37.0
10	11.0	12.1	13.2	14.4	15.5	16.6	17.7	18.9	20.0	21.1	22.3	23.4	24.6	25.7	26.9	28.0	29.2	30.3	31.5	32.7	33.8	35.0	36.2	37.4	38.6
11	12.2	13.4	14.5	15.6	16.8	17.9	19.1	20.2	21.4	22.5	23.7	24.8	26.0	27.2	28.3	29.5	30.7	31.9	33.0	34.2	35.4	36.6	37.8	39.0	40.2
12	13.5	14.6	15.8	16.9	18.1	19.3	20.4	21.6	22.8	23.9	25.1	26.3	27.5	28.6	29.8	31.0	32.2	33.4	34.6	35.8	37.0	38.2	39.5	40.7	41.9
13	14.8	16.0	17.1	18.3	19.5	20.6	21.8	23.0	24.2	25.4	26.6	27.8	29.0	30.2	31.4	32.6	33.8	35.0	36.2	37.5	38.7	39.9	41.2	42.4	43.6
14	16.1	17.3	18.5	19.7	20.9	22.1	23.3	24.5	25.7	26.9	28.1	29.3	30.5	31.7	33.0	34.2	35.4	36.7	37.9	39.1	40.4	41.6	42.9	44.2	45.4
15	17.5	18.7	19.9	21.1	22.3	23.5	24.7	25.9	27.2	28.4	29.6	30.9	32.1	33.3	34.6	35.8	37.1	38.4	39.6	40.9	42.2	43.4	44.7	46.0	47.3
16	18.9	20.1	21.3	22.6	23.8	25.0	26.2	27.5	28.7	30.0	31.2	32.5	33.7	35.0	36.3	37.5	38.8	40.1	41.4	42.7	44.0	45.3	46.6	47.9	49.2
17	20.3	21.6	22.8	24.1	25.3	26.6	27.8	29.1	30.3	31.6	32.9	34.1	35.4	36.7	38.0	39.3	40.6	41.9	43.2	44.5	45.9	47.2	48.5	49.8	51.2
18	21.8	23.1	24.3	25.6	26.9	28.1	29.4	30.7	32.0	33.3	34.6	35.9	37.2	38.5	39.8	41.1	42.4	43.8	45.1	46.5	47.8	49.2	50.5	51.9	53.2
19	23.3	24.6	25.9	27.2	28.5	29.8	31.1	32.4	33.7	35.0	36.3	37.6	39.0	40.3	41.6	43.0	44.3	45.7	47.1	48.4	49.8	51.2	52.6	54.0	55.4
20	24.9	26.2	27.5	28.8	30.1	31.5	32.8	34.1	35.4	36.8	38.1	39.5	40.8	42.2	43.6	44.9	46.3	47.7	49.1	50.5	51.9	53.3	54.7	56.1	57.6
21	26.5	27.9	29.2	30.5	31.8	33.2	34.5	35.9	37.3	38.6	40.0	41.4	42.8	44.1	45.5	46.9	48.4	49.8	51.2	52.6	54.1	55.5	56.9	58.4	59.9
22	28.2	29.5	30.9	32.3	33.6	35.0	36.4	37.7	39.1	40.5	41.9	43.3	44.8	46.2	47.6	49.0	50.5	51.9	53.4	54.8	56.3	57.8	59.3	60.8	62.3
23	29.9	31.3	32.7	34.1	35.5	36.8	38.3	39.7	41.1	42.5	43.9	45.4	46.8	48.3	49.7	51.2	52.7	54.2	55.6	57.1	58.6	60.2	61.7	63.2	64.7
24	31.7	33.1	34.5	35.9	37.3	38.8	40.2	41.7	43.1	44.6	46.0	47.5	49.0	50.5	52.0	53.5	55.0	56.5	58.0	59.5	61.1	62.6	64.2	65.8	67.3
25	33.6	35.0	36.4	37.9	39.3	40.8	42.2	43.7	45.2	46.7	48.2	49.7	51.2	52.7	54.3	55.8	57.3	58.9	60.5	62.0	63.6	65.2	66.8	68.4	70.0
26	35.5	36.9	38.4	39.9	41.4	42.8	44.3	45.9	47.4	48.9	50.4	52.0	53.5	55.1	56.7	58.2	59.8	61.4	63.0	64.7	66.3	67.9	69.6	71.2	72.9
27	37.4	38.9	40.4	42.0	43.5	45.0	46.5	48.1	49.6	51.2	52.8	54.4	56.0	57.6	59.2	60.8	62.4	64.1	65.7	67.4	69.1	70.8	72.5	74.2	75.9
28	39.5	41.0	42.6	44.1	45.7	47.3	48.8	50.4	52.0	53.6	55.2	56.9	58.5	60.2	61.8	63.5	65.2	66.9	68.6	70.3	72.0	73.7	75.5	77.3	79.0
29	41.7	43.2	44.8	46.4	48.0	49.6	51.2	52.8	54.5	56.1	57.8	59.5	61.2	62.9	64.6	66.3	68.0	69.8	71.5	73.3	75.1	76.9	78.7	80.5	82.4
30	43.9	45.5	47.1	48.7	50.4	52.0	53.7	55.4	57.1	58.8	60.5	62.2	64.0	65.7	67.5	69.3	71.0	72.9	74.7	76.5	78.3	80.2	82.1	84.0	85.9
31	46.2	47.9	49.5	51.2	52.9	54.6	56.3	58.1	59.8	61.6	63.3	65.1	66.9	68.7	70.5	72.4	74.2	76.1	78.0	79.9	81.8	83.7	85.7	87.6	89.6
32	48.7	50.4	52.1	53.8	55.6	57.3	59.1	60.9	62.7	64.5	66.3	68.2	70.0	71.9	73.8	75.7	77.6	79.5	81.5	83.5	85.4	87.5	89.5	91.5	93.6
33	51.2	53.0	54.8	56.5	58.3	60.2	62.0	63.8	65.7	67.6	69.5	71.4	73.3	75.2	77.2	79.2	81.2	83.2	85.2	87.3	89.3	91.4	93.6	95.7	97.8
34	53.9	55.7	57.6	59.4	61.3	63.1	65.0	67.0	68.9	70.8	72.8	74.8	76.8	78.8	80.8	82.9	85.0	87.1	89.2	91.4	93.5	95.7	97.9	100.2	102.4
35	56.8	58.6	60.5	62.4	64.4	66.3	68.3	70.3	72.3	74.3	76.3	78.4	80.5	82.6	84.7	86.9	89.1	91.3	93.5	95.7	98.0	100.3	102.6	105.0	107.3
36	59.8	61.7	63.7	65.7	67.7	69.7	71.7	73.8	75.9	78.0	80.1	82.3	84.5	86.7	88.9	91.2	93.5	95.8	98.1	100.5	102.9	105.3	107.7	110.2	112.7
37	62.9	65.0	67.0	69.1	71.2	73.3	75.4	77.6	79.8	82.0	84.2	86.5	88.8	91.1	93.4	95.8	98.2	100.6	103.1	105.6	108.1	110.7	113.3	115.9	118.6
38	66.3	68.4	70.6	72.7	74.9	77.1	79.4	81.6	83.9	86.2	88.6	91.0	93.4	95.8	98.3	100.8	103.4	105.9	108.6	111.2	113.9	116.6	119.4	122.2	125.0
39	70.0	72.2	74.4	76.7	78.9	81.3	83.6	86.0	88.4	90.9	93.4	95.9	98.4	101.0	103.6	106.3	109.0	111.8	114.6	117.4	120.3	123.2	126.1	129.2	132.2
40	73.8	76.2	78.5	80.9	83.3	85.7	88.2	90.8	93.3	95.9	98.5	101.2	103.9	106.7	109.5	112.4	115.3	118.2	121.2	124.3	127.4	130.5	133.7	137.0	140.3
41	78.0	80.5	83.0	85.5	88.0	90.6	93.3	95.9	98.7	101.4	104.3	107.1	110.0	113.0	116.0	119.1	122.2	125.4	128.7	132.0	135.4	138.8	142.3	145.9	149.5
42	82.6	85.2	87.8	90.5	93.2	96.0	98.8	101.7	104.6	107.6	110.6	113.7	116.9	120.1	123.4	126.7	130.1	133.6	137.2	140.8	144.5	148.3	152.2	156.1	160.2
43	87.6	90.4	93.2	96.0	99.0	101.9	105.0	108.1	111.2	114.5	117.8	121.1	124.6	128.1	131.7	135.4	139.1	143.0	147.0	151.0	155.2	159.4	163.8	168.2	172.8
44	93.1	96.1	99.1	102.2	105.4	108.6	111.9	115.3	118.7	122.3	125.9	129.6	133.4	137.4	141.4	145.5	149.7	154.1	158.5	163.1	167.9	172.7	177.7	182.9	188.2
45	99.3	102.5	105.8	109.2	112.6	116.2	119.8	123.6	127.4	131.4	135.4	139.6	143.9	148.3	152.9	157.6	162.4	167.4	172.6	178.0	183.5	189.2	195.1	201.2	207.5
46	106.3	109.8	113.4	117.2	121.0	125.0	129.1	133.3	137.6	142.1	146.7	151.5	156.5	161.6	167.0	172.5	178.2	184.2	190.4	196.8	203.5	210.5	217.8	225.4	233.3
47	114.3	118.3	122.4	126.6	130.9	135.4	140.1	145.0	150.0	155.3	160.7	166.4	172.3	178.5	185.0	191.8	198.9	206.4	214.2	222.4	231.0	240.0	249.5	259.5	270.0
48	123.9	128.4	133.1	137.9	143.0	148.3	153.9	159.7	165.8	172.2	178.9	186.0	193.5	201.4	209.8	218.7	228.2	238.2	248.9	260.3	272.3	285.1	298.7	313.0	328.2
49	135.5	140.8	146.4	152.3	158.5	165.0	172.0	179.3	187.2	195.6	204.6	214.3	224.7	235.9	248.1	261.3	275.5	290.9	307.6	325.5	344.8	365.4	387.3	410.6	435.2

09-63235-01

IDEXX Quanti-Tray®/2000 MPN Table *(per 100ml)*

# Large Wells Positive	# Small Wells Positive																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0	25.3	26.4	27.4	28.4	29.5	30.5	31.5	32.6	33.6	34.7	35.7	36.8	37.8	38.9	40.0	41.0	42.1	43.1	44.2	45.3	46.3	47.4	48.5	49.5
1	26.6	27.7	28.7	29.8	30.8	31.9	32.9	34.0	35.0	36.1	37.2	38.2	39.3	40.4	41.4	42.5	43.6	44.7	45.7	46.8	47.9	49.0	50.1	51.2
2	27.9	29.0	30.0	31.1	32.2	33.2	34.3	35.4	36.5	37.5	38.6	39.7	40.8	41.9	43.0	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8
3	29.3	30.4	31.4	32.5	33.6	34.7	35.8	36.8	37.9	39.0	40.1	41.2	42.3	43.4	44.5	45.6	46.7	47.8	48.9	50.0	51.2	52.3	53.4	54.5
4	30.7	31.8	32.8	33.9	35.0	36.1	37.2	38.3	39.4	40.5	41.6	42.8	43.9	45.0	46.1	47.2	48.3	49.5	50.6	51.7	52.9	54.0	55.1	56.3
5	32.1	33.2	34.3	35.4	36.5	37.6	38.7	39.9	41.0	42.1	43.2	44.4	45.5	46.6	47.7	48.9	50.0	51.2	52.3	53.5	54.6	55.8	56.9	58.1
6	33.5	34.7	35.8	36.9	38.0	39.2	40.3	41.4	42.6	43.7	44.8	46.0	47.1	48.3	49.4	50.6	51.7	52.9	54.1	55.2	56.4	57.6	58.7	59.9
7	35.0	36.2	37.3	38.4	39.6	40.7	41.9	43.0	44.2	45.3	46.5	47.7	48.8	50.0	51.2	52.3	53.5	54.7	55.9	57.1	58.3	59.4	60.6	61.8
8	36.6	37.7	38.9	40.0	41.2	42.3	43.5	44.7	45.9	47.0	48.2	49.4	50.6	51.8	53.0	54.1	55.3	56.5	57.7	59.0	60.2	61.4	62.6	63.8
9	38.1	39.3	40.5	41.6	42.8	44.0	45.2	46.4	47.6	48.8	50.0	51.2	52.4	53.6	54.8	56.0	57.2	58.4	59.7	60.9	62.1	63.4	64.6	65.8
10	39.7	40.9	42.1	43.3	44.5	45.7	46.9	48.1	49.3	50.6	51.8	53.0	54.2	55.5	56.7	57.9	59.2	60.4	61.7	62.9	64.2	65.4	66.7	67.9
11	41.4	42.6	43.8	45.0	46.3	47.5	48.7	49.9	51.2	52.4	53.7	54.9	56.1	57.4	58.6	59.9	61.2	62.4	63.7	65.0	66.3	67.5	68.8	70.1
12	43.1	44.3	45.6	46.8	48.1	49.3	50.6	51.8	53.1	54.3	55.6	56.8	58.1	59.4	60.7	62.0	63.2	64.5	65.8	67.1	68.4	69.7	71.0	72.4
13	44.9	46.1	47.4	48.6	49.9	51.2	52.5	53.7	55.0	56.3	57.6	58.9	60.2	61.5	62.8	64.1	65.4	66.7	68.0	69.3	70.7	72.0	73.3	74.7
14	46.7	48.0	49.3	50.5	51.8	53.1	54.4	55.7	57.0	58.3	59.6	60.9	62.3	63.6	64.9	66.3	67.6	68.9	70.3	71.6	73.0	74.4	75.7	77.1
15	48.6	49.9	51.2	52.5	53.8	55.1	56.4	57.8	59.1	60.4	61.8	63.1	64.5	65.8	67.2	68.5	69.9	71.3	72.6	74.0	75.4	76.8	78.2	79.6
16	50.5	51.8	53.2	54.5	55.8	57.2	58.5	59.9	61.2	62.6	64.0	65.3	66.7	68.1	69.5	70.9	72.3	73.7	75.1	76.5	77.9	79.3	80.8	82.2
17	52.5	53.9	55.2	56.6	58.0	59.3	60.7	62.1	63.5	64.9	66.3	67.7	69.1	70.5	71.9	73.3	74.8	76.2	77.6	79.1	80.5	82.0	83.5	84.9
18	54.6	56.0	57.4	58.8	60.2	61.6	63.0	64.4	65.8	67.2	68.6	70.1	71.5	73.0	74.4	75.9	77.3	78.8	80.3	81.8	83.3	84.8	86.3	87.8
19	56.8	58.2	59.6	61.0	62.4	63.9	65.3	66.8	68.2	69.7	71.1	72.6	74.1	75.5	77.0	78.5	80.0	81.5	83.1	84.6	86.1	87.6	89.2	90.7
20	59.0	60.4	61.9	63.3	64.8	66.3	67.7	69.2	70.7	72.2	73.7	75.2	76.7	78.2	79.8	81.3	82.8	84.4	85.9	87.5	89.1	90.7	92.2	93.8
21	61.3	62.8	64.3	65.8	67.3	68.8	70.3	71.8	73.3	74.9	76.4	77.9	79.5	81.1	82.6	84.2	85.8	87.4	89.0	90.6	92.2	93.8	95.4	97.1
22	63.8	65.3	66.8	68.3	69.8	71.4	72.9	74.5	76.1	77.6	79.2	80.8	82.4	84.0	85.6	87.2	88.9	90.5	92.1	93.8	95.5	97.1	98.8	100.5
23	66.3	67.8	69.4	71.0	72.5	74.1	75.7	77.3	78.9	80.5	82.2	83.8	85.4	87.1	88.7	90.4	92.1	93.8	95.5	97.2	98.9	100.6	102.4	104.1
24	68.9	70.5	72.1	73.7	75.3	77.0	78.6	80.3	81.9	83.6	85.2	86.9	88.6	90.3	92.0	93.8	95.5	97.2	99.0	100.7	102.5	104.3	106.1	107.9
25	71.7	73.3	75.0	76.6	78.3	80.0	81.7	83.3	85.1	86.8	88.5	90.2	92.0	93.7	95.5	97.3	99.1	100.9	102.7	104.5	106.3	108.2	110.0	111.9
26	74.6	76.3	78.0	79.7	81.4	83.1	84.8	86.6	88.4	90.1	91.9	93.7	95.5	97.3	99.2	101.0	102.9	104.7	106.6	108.5	110.4	112.3	114.2	116.2
27	77.6	79.4	81.1	82.9	84.6	86.4	88.2	90.0	91.9	93.7	95.5	97.4	99.3	101.2	103.1	105.0	106.9	108.8	110.8	112.7	114.7	116.7	118.7	120.7
28	80.8	82.6	84.4	86.3	88.1	89.9	91.8	93.7	95.6	97.5	99.4	101.3	103.3	105.2	107.2	109.2	111.2	113.2	115.2	117.3	119.3	121.4	123.5	125.6
29	84.2	86.1	87.9	89.8	91.7	93.7	95.6	97.5	99.5	101.5	103.5	105.5	107.5	109.5	111.6	113.7	115.7	117.8	120.0	122.1	124.2	126.4	128.6	130.8
30	87.8	89.7	91.7	93.6	95.6	97.6	99.6	101.6	103.7	105.7	107.8	109.9	112.0	114.2	116.3	118.5	120.6	122.8	125.1	127.3	129.5	131.8	134.1	136.4
31	91.6	93.6	95.6	97.7	99.7	101.8	103.9	106.0	108.2	110.3	112.5	114.7	116.9	119.1	121.4	123.6	125.9	128.2	130.5	132.9	135.3	137.7	140.1	142.5
32	95.7	97.8	99.9	102.0	104.2	106.3	108.5	110.7	113.0	115.2	117.5	119.8	122.1	124.5	126.8	129.2	131.6	134.0	136.5	139.0	141.5	144.0	146.6	149.1
33	100.0	102.2	104.4	106.6	108.9	111.2	113.5	115.8	118.2	120.5	122.9	125.4	127.8	130.3	132.8	135.3	137.8	140.4	143.0	145.6	148.3	150.9	153.7	156.4
34	104.7	107.0	109.3	111.7	114.0	116.4	118.9	121.3	123.8	126.3	128.8	131.4	134.0	136.6	139.2	141.9	144.6	147.4	150.1	152.9	155.7	158.6	161.5	164.4
35	109.7	112.2	114.6	117.1	119.6	122.2	124.7	127.3	129.9	132.6	135.3	138.0	140.8	143.6	146.4	149.2	152.1	155.0	158.0	161.0	164.0	167.1	170.2	173.3
36	115.2	117.8	120.4	123.0	125.7	128.4	131.1	133.9	136.7	139.5	142.4	145.3	148.3	151.3	154.3	157.3	160.5	163.6	166.8	170.0	173.3	176.6	179.9	183.3
37	121.3	124.0	126.8	129.6	132.4	135.3	138.2	141.2	144.2	147.3	150.3	153.5	156.7	159.9	163.1	166.5	169.8	173.2	176.7	180.2	183.7	187.3	191.0	194.7
38	127.9	130.8	133.8	136.8	139.9	143.0	146.2	149.4	152.6	155.9	159.2	162.6	166.1	169.6	173.2	176.8	180.4	184.2	188.0	191.8	195.7	199.7	203.7	207.7
39	135.3	138.5	141.7	145.0	148.3	151.7	155.1	158.6	162.1	165.7	169.4	173.1	176.9	180.7	184.7	188.7	192.7	196.8	201.0	205.3	209.6	214.0	218.5	223.0
40	143.7	147.1	150.6	154.2	157.8	161.5	165.3	169.1	173.0	177.0	181.1	185.2	189.4	193.7	198.1	202.5	207.1	211.7	216.4	221.1	226.0	231.0	236.0	241.1
41	153.2	157.0	160.9	164.8	168.9	173.0	177.2	181.5	185.8	190.3	194.8	199.5	204.2	209.1	214.0	219.1	224.2	229.4	234.8	240.2	245.8	251.5	257.2	263.1
42	164.3	168.6	172.9	177.3	181.9	186.5	191.3	196.1	201.1	206.2	211.4	216.7	222.2	227.7	233.4	239.2	245.2	251.3	257.5	263.8	270.3	276.9	283.6	290.5
43	177.5	182.3	187.3	192.4	197.6	202.9	208.4	214.0	219.8	225.8	231.8	238.1	244.5	251.0	257.7	264.6	271.7	278.9	286.3	293.8	301.5	309.4	317.4	325.7
44	193.6	199.3	205.1	211.0	217.2	223.5	230.0	236.7	243.6	250.8	258.1	265.6	273.3	281.2	289.4	297.8	306.3	315.1	324.1	333.3	342.8	352.4	362.3	372.4
45	214.1	220.9	227.9	235.2	242.7	250.4	258.4	266.7	275.3	284.1	293.3	302.6	312.3	322.3	332.5	343.0	353.8	364.9	376.2	387.9	399.8	412.0	424.5	437.4
46	241.5	250.0	258.9	268.2	277.8	287.8	298.1	308.8	319.9	331.4	343.3	355.5	368.1	381.1	394.5	408.3	422.5	437.1	452.0	467.4	483.3	499.6	516.3	533.5
47	280.9	292.4	304.4	316.9	330.0	343.6	357.8	372.5	387.7	403.4	419.8	436.6	454.1	472.1	490.7	509.9	529.8	550.4	571.7	593.8	616.7	640.5	665.3	691.0
48	344.1	360.9	378.4	396.8	416.0	436.0	456.9	478.6	501.2	524.7	549.3	574.8	601.5	629.4	658.6	689.3	721.5	755.6	791.5	829.7	870.4	913.9	960.6	1011.2
49	461.1	488.4	517.2	547.5	579.4	613.1	648.8	686.7	727.0	770.1	816.4	866.4	920.8	980.4	1046.2	1119.9	1203.3	1299.7	1413.6	1553.1	1732.9	1988.3	2419.6	>2419.6

09-63235-01

E. COLI QUALITY CONTROL

It's recommend to take a daily quality control (QC) sample for E. coli. This can be done in two ways. The first is a duplicate sample where two E. coli samples are taken at the same location and same time and the results should be within the 95% confidence interval of one another. A MPN generator software program can be downloaded for free from IDEXX at https://www.idexx.com/water/mpn-generator.html or you can email the coordinator to figure out what the 95% confidence interval should be. The second is a blank where an E. coli bottle is filled with deionized water and processed. The results should all be non-detect, otherwise it's an indication there was contamination during processing and all samples from that day are invalid. Note accordingly on the datasheet in the E. coli section.

E. COLI DILUTIONS

If an E. coli sample is very turbid (looks like chocolate milk) it will most likely read above what the MPN table can calculate. The max reading is >2419.6 MPN. High cfu counts may be experienced during storm run-off events, high recreational periods, and downstream of known fecal pollution sources. When performing dilutions two sample bottles are collected for each site.

Dilution	MPN Value	Multiplier	Result
100%	Too numerous to count	1	Too numerous to count
10%	Too numerous to count	10	Too numerous to count
1%	250.4	100	25,040 CFU/100 mL
0.1%	47	1000	47,000 CFU/100mL

Table 4.6 Example of dilution results using Colilert

1. The first bottle is processed following the standard processing procedures outlined above.
2. Using the second sample bottle, pipette 10ml of the sample into an empty E. coli bottle. Then repeat using a 1ml and 0.1ml pipette into separate E. coli bottles. Add deionized water to each bottle filling them to the 100ml line.
3. Prepare samples following the procedures outlined above.
4. Multiply the dilution ratio by the result for each sample (**Table 4.6**)
5. Circle which dilution was done on the field form and add the calculated MPN value under the MPN calculator icon.

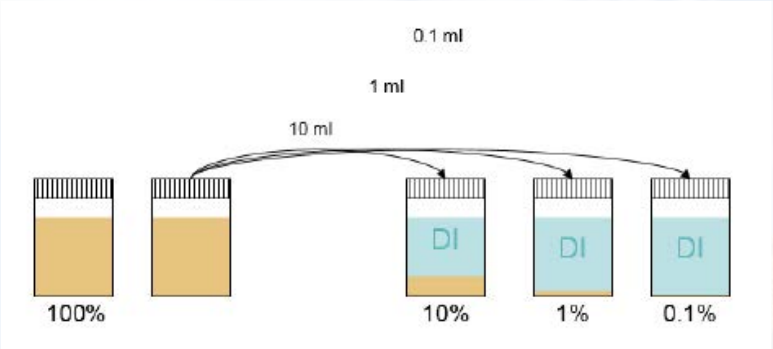
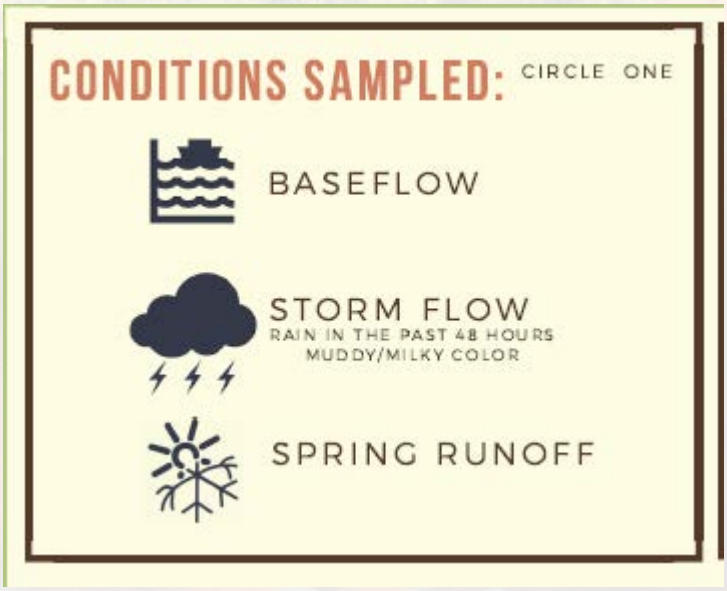


Figure 4.6
Bacteria dilutions of 100%, 10%, 1% and 0.1% for sites with bacteria that are expected to be greater than 2419.6 CFU/100 mL. The brown liquid is the sample, while the blue is deionized water.

CONDITIONS SAMPLED

It's important to note what the weather conditions were within the last 48 hours from the time of sampling. Rain can affect the chemical and biological values and needs to be noted on the form. Some projects require storm flow samples, like ephemeral streams that do not flow year round. Other projects require baseflow conditions to be sampled. Make sure to double check the projects sample and analysis plan to confirm which condition is best suited for the project.

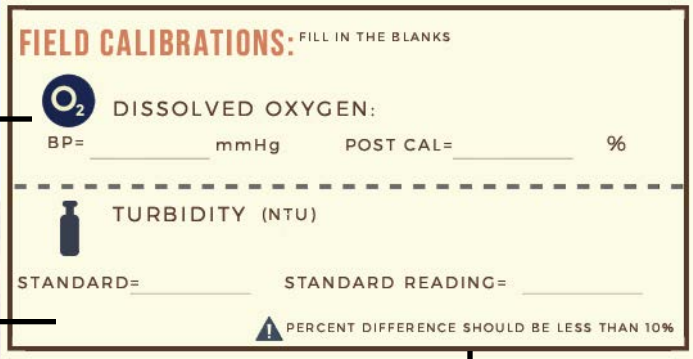
On the field form, circle one of the three options: baseflow (the typical flow of the stream, most likely clear), storm flow (heavy rains within the past 48 hours and the stream is turbid and muddy looking), or spring runoff (increased flow due to snow melt can be clear or slightly milky).



FIELD CALIBRATIONS

Different multi-parameter probes and turbidity meters will have different protocols for calibration. Dissolved oxygen and turbidity will need to be calibrated at every site for every sampling event. Refer to the appendices or the calibration manuals in the equipment case for details.

Dissolved Oxygen Calibration
In general for dissolved oxygen, every time you move up or down in elevation between sampling sites the barometric pressure (BP) will change and the dissolved oxygen will need to be recalculated. At the site read the BP and record the value in mmHg on the field form, then follow the calibration process (see Appendix B or C for instructions) and record the post calibration percentage on the field form. The post calibration result is usually close to 100%, if it's not try to calibrate again.


FIELD CALIBRATIONS: FILL IN THE BLANKS

O_2 DISSOLVED OXYGEN:

BP= _____ mmHg POST CAL= _____ %

TURBIDITY (NTU)

STANDARD= _____ STANDARD READING= _____

PERCENT DIFFERENCE SHOULD BE LESS THAN 10%

Turbidity Calibration
Similar to dissolved oxygen, turbidity will need to be optically calibrated at every site using the reference standards provided with the turbidity meter. Handle the glass cells with care. Smudging and scratches will affect the readings. Apply a small coat of silicone oil to the glass vial and use a dry soft cotton cloth to wipe clean. Refer to Appendix A for step by step instructions.

The reference standards will have a pre-determined calibrated number associated with that specific vial (typically written on the box, Arizona Water Watch Staff will calibrate quarterly). Each meter has three standards, 0-10, 0-100, 0-1000. Match the water sample with the standard that most likely resembles the sample. Write the value that's on the box to the applicable standard being used on the field form. After you place the standard in the turbidity meter and press read, put that "standard reading" value on the field form. This value should be within 10% of the standard number written on the box. If it's not, clean the glass vial off and try again.

Turbidity Dilutions
Dilutions may be necessary if a sample is extremely turbid. For very turbid waters the meter may display a flashing "1,000" value or E-3 error message. This indicates that the turbidity value is greater than 1,000 NTUs. There are two options with this condition: 1) perform a dilution, or record the results as >1,000 NTU. Note this on the field data sheet. Performing the dilution will give a more accurate turbidity value. Using deionized water, sample water, and a pipette can help accurately determine a turbidity value. Follow the steps listed below.

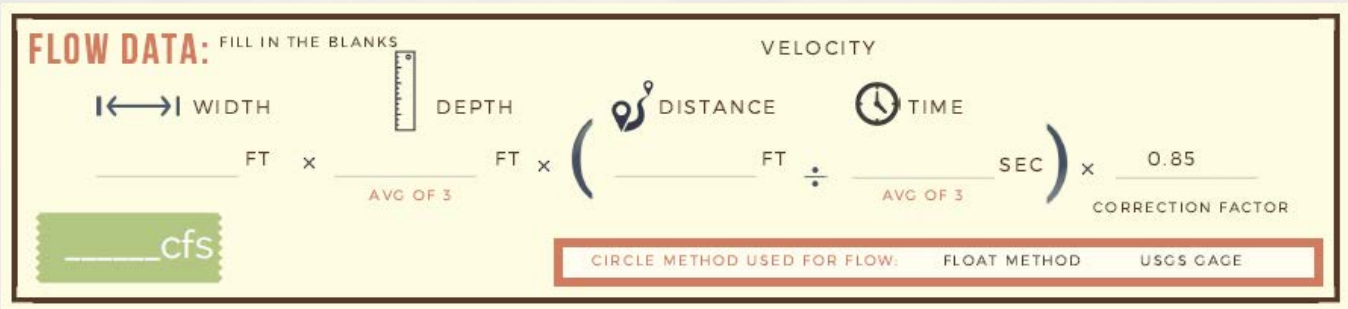
1. It is recommended that a dilution factor (DF) of 10 be used for the turbidity calculation. The DF is the multiplier for the meter reading. For example, if the operator were to dispense 9 mL of deionized water into a 10 mL graduated cylinder and 1 mL of sample water, for a total of 10 mL, the DF is 10 (a ratio of 9:1); therefore, the turbidity value is the meter reading times 10.
2. For samples that are extremely turbid, it may be necessary to make more than one dilution to obtain a meter reading less than 1,000. For multiple dilutions, the procedure is the same as described above; however, for the second dilution, the 9:1 diluted sample becomes the sample to be diluted. If this is the case, and a 9:1 dilution is performed a second time, the DF is 100 (DF of 10 for the first dilution and DF of 10 for the second dilution). The turbidity value is simply the meter reading times 100.

FLOW DATA

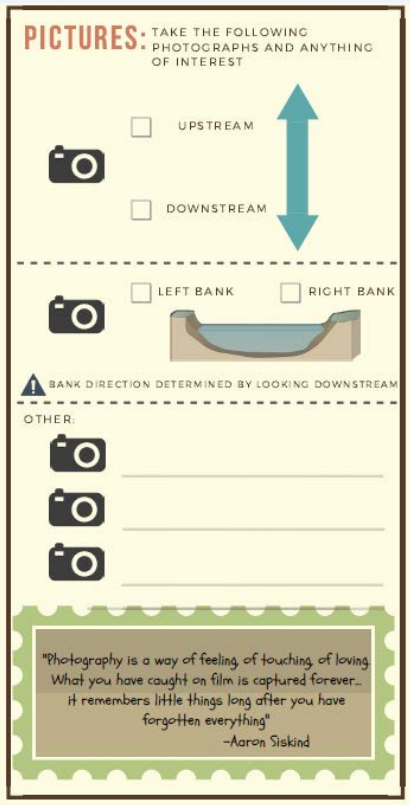
Measuring flow is important to understand how much water is at a certain point at a certain time. Flow meters are expensive, but flow can be calculated using the float method with a measuring tape, small plastic bottle, and a timer. Float is best measured in a run, where water is flowing.

Float Method Procedure

1. Determine the float reach (distance) by measuring and marking two points along the length of the channel. Try and get a length of at least 10 feet. Record this value on the field form under distance.
2. Measure three depths across at the channel cross-section. Average the 3 depths and record the value on the field form under depth.
3. Measure a representative width of the stream and record that value on the field form under width.
4. Partially fill the float bottle with water.
5. Two observers are best when calculating the velocity of the stream. One observer stands at the top of the reach and the second observer stands at the bottom of the reach with the times. The observer at the top of the reach gently tosses the float bottle into the channel above the marker and calls out "start" when it crosses the upstream point. The other observe stands at the bottom of the reach and presses start on the timer when observer one calls out "start" and waits for the float bottle to cross the second point. Make note of the time (in seconds) that it took to travel the reach.
6. Repeat the toss three times and average the three times together. Place this value on the field form under time.
7. Determine the flow, in cubic feet per second, by multiplying the width (ft) x average depth (ft) x ((distance (ft)/average time (seconds)) x 0.85. A correction factor of 0.85 is commonly used because surface flow is faster than flow in the water column.
8. Record the CFS on the field data sheet.



PICTURES

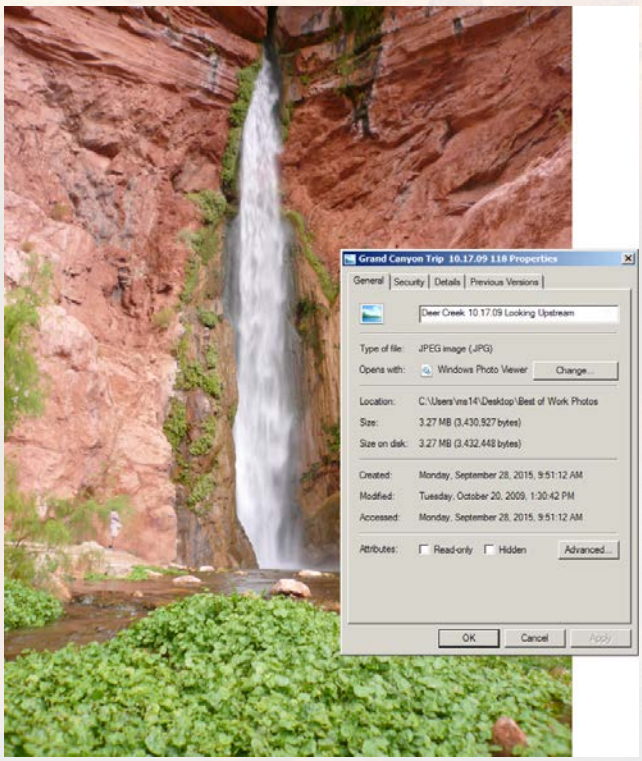


Field Picture Procedure

1. Using a cell phone or a digital camera stand in the middle of the stream and face upstream and take a landscape picture.
2. From the middle of the steam, turn and take a picture facing downstream.
3. From the middle of the reach turn and take a picture of the right bank (bank direction is determined by facing downstream).
4. From the middle of the reach turn and take a picture of the left bank (bank direction is determined by facing downstream).
5. Walk the area and take pictures of anything of importance that might change or alter the quality of the stream. Things like bank sluffing, large trash items, wildlife, channel substrate, algae, etc…
6. Check the boxes on the field form when the pictures have been collected.
7. When downloading the photos be sure to edit the properties to include site information on the image name. Include site name, date sampled, and what the image is of. For example: VRFOS011.88 5.10.17 looking downstream.

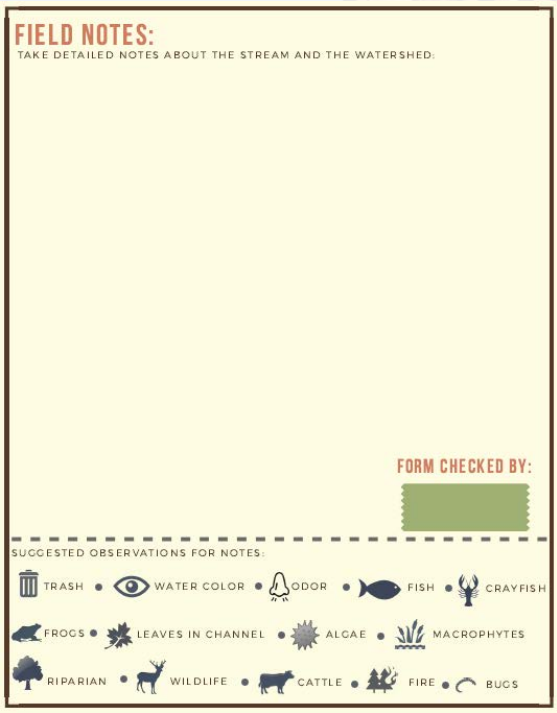
How to Edit an Image Name

1. Open the photo.
2. Right click on the image and scroll down to properties.
3. Click on the general tab.
4. Add the site name, date sampled (Month. Day.Year), and a brief description of the photo (looking upstream, looking downstream, right bank, erosion on left bank, trash in stream, etc.). See the example to the right.
5. Press OK.
6. Send to Arizona Water Watch Coordintor monthly with scanned field forms.



FIELD NOTES

The field note section is the perfect place to identify all things observed that are of importance to the water body. The note section is a great way to share what you observed, with others who were not there. Hand written notes can be added to this section or circling and identifying presence and quality of specific observations can occur below.


FIELD NOTES:

TAKE DETAILED NOTES ABOUT THE STREAM AND THE WATERSHED:

FORM CHECKED BY:

SUGGESTED OBSERVATIONS FOR NOTES:

TRASH • WATER COLOR • ODOR • FISH • CRAYFISH

FROGS • LEAVES IN CHANNEL • ALGAE • MACROPHYTES

RIPARIAN • WILDLIFE • CATTLE • FIRE • BUGS

Potential Observations

- Trash- Describe the quantity and type of trash in the stream and on the banks.
- Water Color- Clear, milky, light brown, dark brown, oily sheen?
- Odor- Sewage, chlorine, fishy, rotten eggs?
- Fish- Present? How many? Are they abundant?
- Crayfish- Present? How many? Are they abundant?
- Frogs- Present? How many? Are they abundant?
- Leaves in channel- Absent? Rare? Common?
- Algae- Estimate the percentage covering the stream bed 10 meters above water sampling site.
- Macrophytes- Estimate the percentage covering the stream bed 10 meters above water sampling site.
- Riparian- Describe types and health of riparian vegetation.
- Wildlife- Describe observations: feces, tracks, grazed vegetation, etc.
- Cattle- Describe observations: feces, tracks, grazed vegetation, etc.
- Fire- Describe observations: exposed soil, burnt vegetation, etc.
- Bugs- Describe observations: aquatic bugs (flip over rocks), terrestrial bugs, etc.
- Other- Any details that would help gain a better understanding of the sampling site and details of the day.
    - Equipment issues
    - Low flow conditions
    - Dry stream
    - Fish kill
    - Flooding or signs of flooding (debris)
    - Any changes in protocol/techniques

Datasheet Sign Off

Have a colleague read over the field form to ensure that all necessary items were collected. Look to make sure that all blank lines and check boxes have been filled in and marked. Ensure that photos were collected. Ask questions to the note taker if something wasn't clear in the notes. Once the team agrees that everything is complete, sign your initials in the form checked by box under the field note section. This is common practice with field forms and it's proven to be a useful tool!

CITIZEN SCIENCE TIMESHEET

Keeping track of volunteer hours helps us identify how much time certain projects require and helps us assess the need for supplies. Thank you for being awesome and volunteering your time! ADEQ staff is unable to be at all places at once, but with the help of Arizona Water Watch members we can certainly get an increase in coverage around the state! Please submit time sheets to the program coordinator monthly: Meghan Smart ms14@azdeq.gov .

ADEQ CITIZEN SCIENCE TIMESHEET

Thanks for being AWESOME!

"NEVER DOUBT THAT A SMALL GROUP OF THOUGHTFUL COMMITTED CITIZENS CAN CHANGE THE WORLD. INDEED IT'S THE ONLY THING THAT EVER HAS" -MARGARET MEAD

VOLUNTEER YEAR AND MONTH: CIRCLE APPLICABLE YEAR AND MONTH

YEAR: 2017 2018 2019 2020

MONTH: Jan Feb March April May June July Aug Sep Oct Nov Dec

CITIZEN SCIENTIST HOURS: ADD VOLUNTEER NAME AND HOURS WORKED. ONE MEDAL PER VOLUNTEER PER MONTH. SUBMIT TIME SHEET MONTHLY TO CITIZEN SCIENCE COORDINATOR MEGHAN SMART BY SCANNING /TAKING A PICTURE AND EMAIL PICTURE TO ms14@azdeq.gov

PAPER TIMESHEET

Download the ADEQ Citizen Science Timesheet from the Arizona Water Watch page. Mark with a pen. Take a picture and email to coordinator.

- Year- Circle the applicable sampling year.
- Month- Circle the applicable
- Ribbon- Add name of the volunteer and hours worked during the month. One ribbon per volunteer.

EXCEL TIMESHEET

An excel version can be made available. Email the program coordinator at ms14@azdeq.gov to request the template. Fill in and return timesheets monthly with datasheets and photos.

- Watershed Group- Add name of watershed group.
- Volunteer Name- Add volunteer name.
- Date- Add month and year when sampling occurred.
- Hours- Add the total hours of volunteer time for the project.

Watershed Group Name:	Verde River Institute		
Volunteer Name	Date (Month/Year)	Monthly Hours Volunteered	
Sue Johnson	May-17	12	Example
Mack Davidson	May-17	4	Example

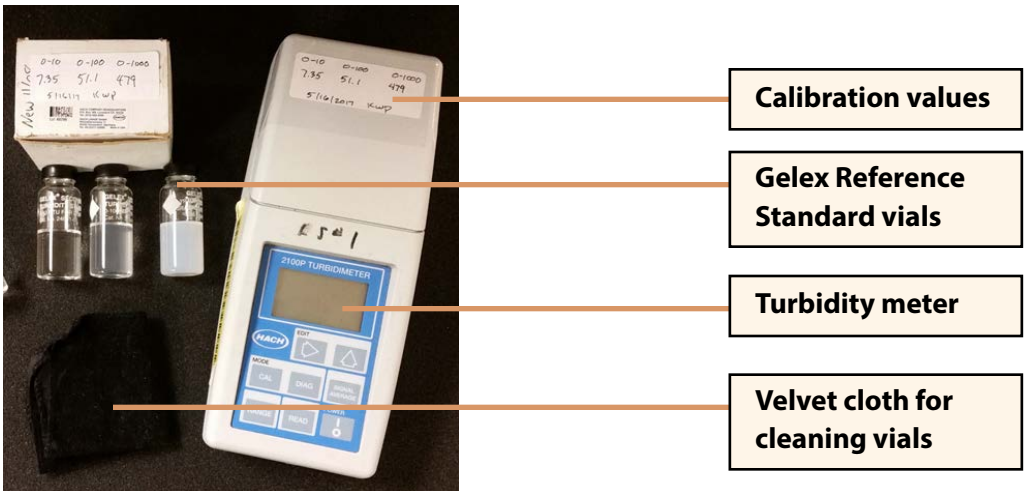
Table 10.2
Example of a timesheet in Excel

SUMMARY

You now have the tools, equipment, training, and sample plan to collect high quality credible water quality data! Once again, we at ADEQ would like to thank you for your time and commitment to keeping Arizona's waterbodies beautiful!

APPENDIX A: HACH TURBIDITY METER CALIBRATION AND MEASUREMENT

SETUP



CALIBRATION

1. Place turbidity meter on a flat surface.
2. Choose a Gelex Secondary Reference Standard that has a turbidity value close to that of the stream or lake.
3. Record which Standard is being used on the data sheet in the Field Calibrations section.
4. Clean the outer surface of the vial with the velvet cloth.
5. Power on the instrument (Figure 1).
6. Insert the vial into the instrument cell compartment with the white diamond on the vial aligned to the raised orientation mark on the instrument (Figure 2) and close the lid.
7. Press Read (Figure 3).
8. The displayed value should be within 5% of the calibration value located on the label.
   a. If the difference between the measurement and the calibration value on the label is greater than 5%, re-clean and re-oil the vial, and take another measurement (Press Read).
9. The equipment is now calibrated.
10. Record the Standard reading on the data sheet in the Field Calibrations section.

Figure 1: Power on

Figure 2: Insert vial

Figure 3: Read sample

TURBIDITY MEASUREMENT

1. Rinse an empty stream sample vial three times with stream water.
2. Fill vial with stream water, replace cap, and wipe outside surface clean.
3. Insert stream sample vial with the white triangle aligned to the raised orientation mark on the instrument (Figure 2) and close the lid.
4. Press Read (Figure 3).
5. Record value on data sheet in the Field Data section.

Congratulations you have now measured the turbidity of the stream!

APPENDIX B: HYDROLAB SURVEYOR AND MINISONDE 4A CALIBRATION

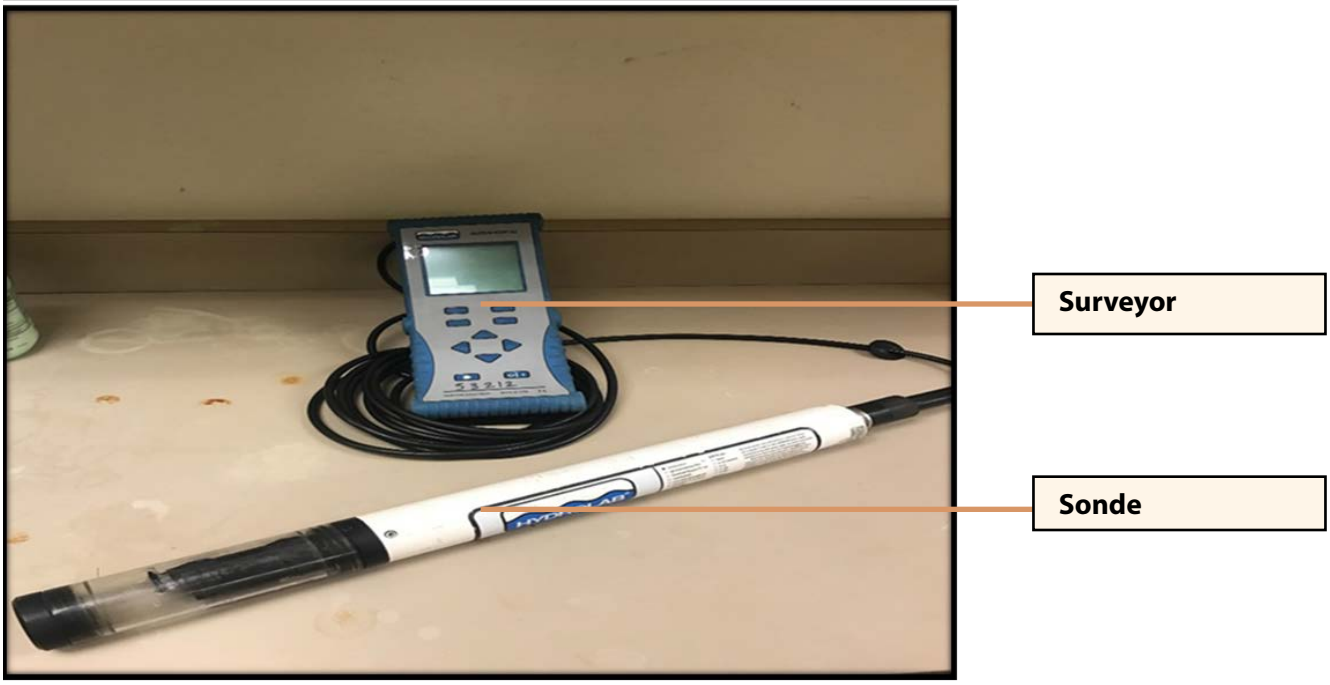
SETUP

Connect plug to Surveyor unit.

Connect plug into MiniSonde.

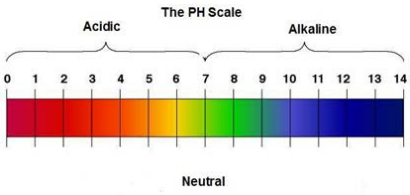
Turn Surveyor unit ON using the on and off button on the bottom right.

Completed Setup: Surveyor Connected to Sonde



pH CALIBRATION

1. Remove calibration cup (Figure 1).
2. Clean probe and storage cup with DI water.
3. Rinse sensor with small amount of pH 7 buffer.
4. Remove cap of calibration cup to pour in buffer.
5. Fill calibration cup up to line with pH 7 buffer solution (Figure 1).
6. Allow 2-3 minutes for readings to stabilize.
7. Press Calibration/Setup; Calibrate; Sonde buttons on Surveyor (Figure 2-4).
8. Choose "pH : Units" Press Select (Figure 5).
9. When prompted to enter pH; enter (7) using prompted number line. Press Done (Figure 6).
10. A message "Calibration Succesful" should appear.
11. Rinse probe/calibration cup with DI water and pH 10 buffer.
12. Fill calibration cup with pH 10 buffer solution (Figure 1).
13. Allow 2-3 minutes for readings to stabilize.
14. Press Calibration/Setup; Calibrate; Sonde buttons on Surveyor (Figure 2-4).
15. Choose "pH : Units" Press Select (Figure 5).
16. When prompted to enter pH of buffer enter (10). Press Done (Figure 6).
17. A message "Calibration Successful" should appear.



The equipment is now calibrated for pH.

SPECIFIC CONDUCTIVITY CALIBRATION

1. Remove calibration cup.
2. Clean probe and storage cup with DI water.
3. Rinse sensor with small amount of Specific Conductivity
4. standard.
5. Remove cap of calibration cup to pour in buffer
6. Fill calibration cup up to line with Specific Conductivity standard (Figure 1). (Avoid introducing bubbles while pouring)
7. Allow 2-3 minutes for readings to stabilize.
8. Press Calibration/Setup; Calibrate; Sonde buttons on Surveyor (Figure 2-4).
9. Choose "SpCOND : us/cm" press Select (Figure 5).
10. When prompted to enter value; enter (1413 or value of provided buffer solution) using prompted number line. Press Done (Figure 6).
11. A message "Calibration Successful" should appear.

The equipment is now calibrated for Specific Conductivity.

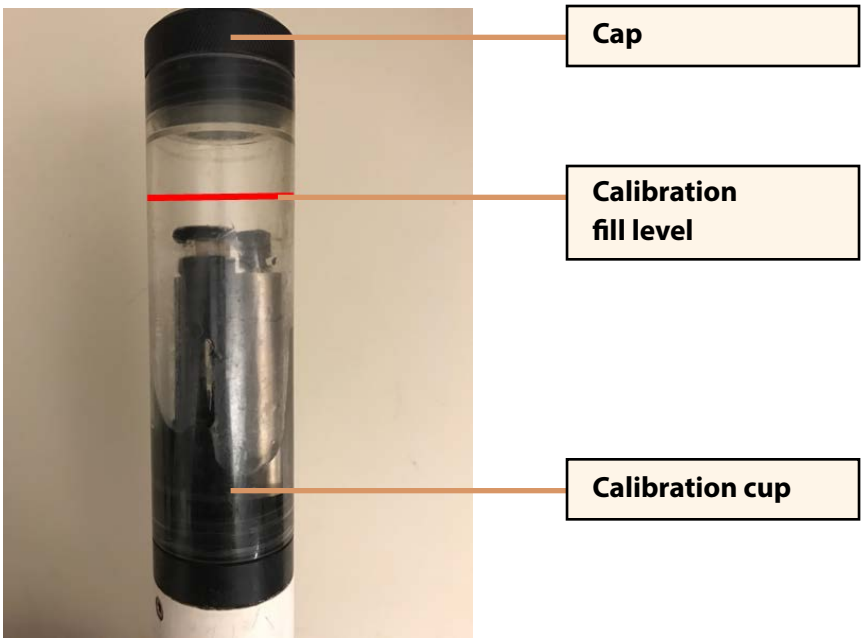


Figure 1: Calibration

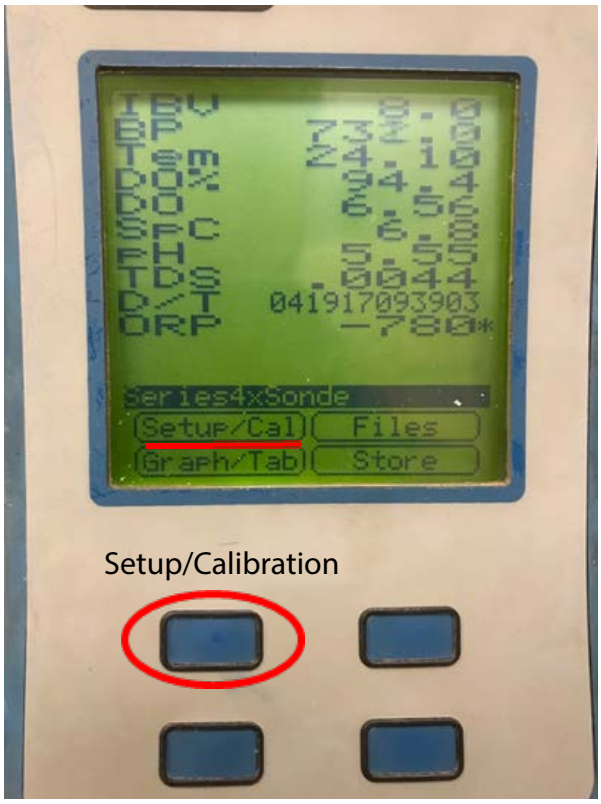


Figure 2: Menu

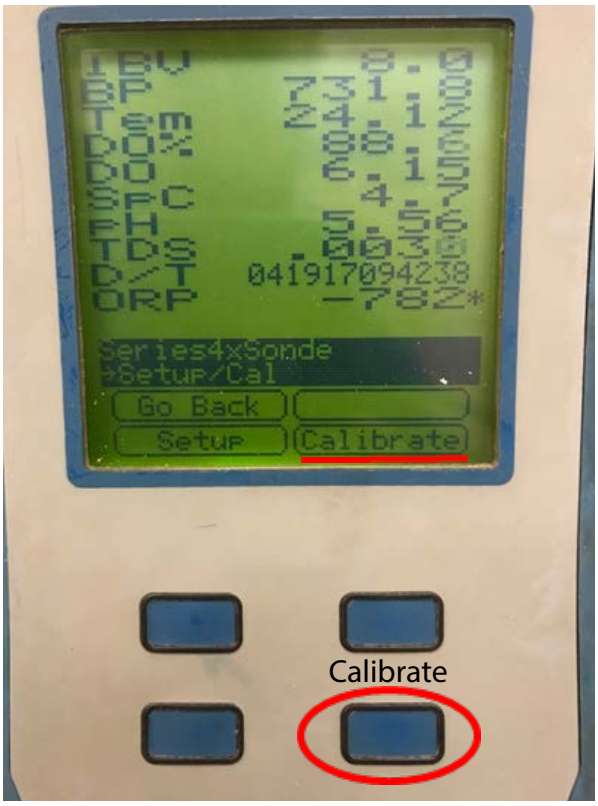


Figure 3: Calibrate

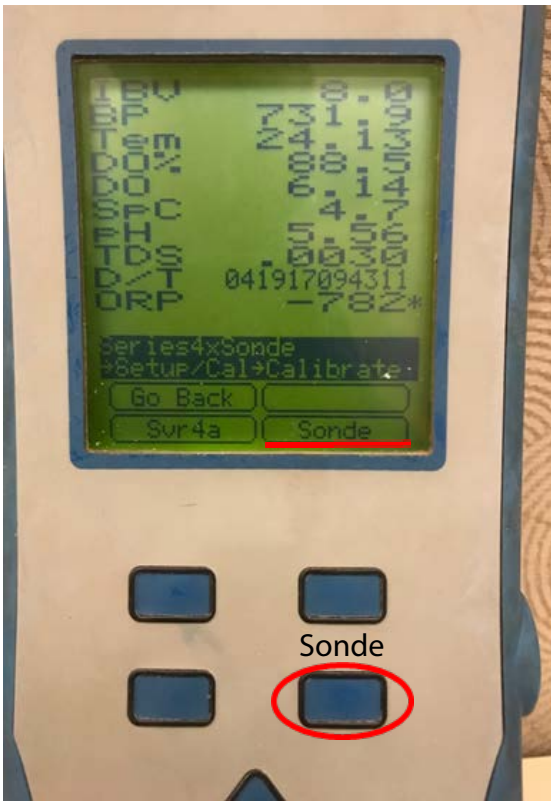


Figure 4: Sonde

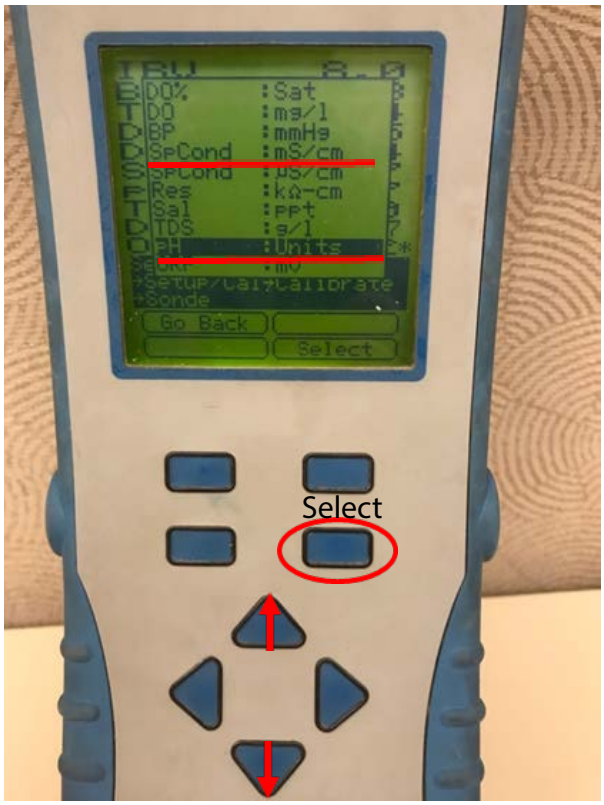


Figure 5: Select

Figure 6: Done

Calibration Successful!

STORAGE

1. Rinse the probes and storage cup with DI water.
2. Fill the storage cup ¼ the way up with DI water and place back onto probes.
3. Remove electrical plugs from both surveyor and minisonde.
4. Place caps on end of plugs for protection.
5. Place the equipment back into its case for storage.

Link to manual: http://web.mit.edu/1.75/www/FieldTrips/Series_4a_Manual.pdf

APPENDIX C: INSITU SMARTROLL CALIBRATION GUIDE

PREPARATION

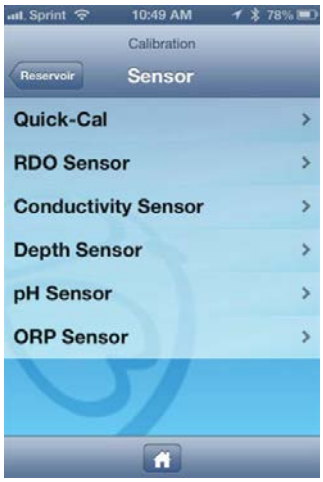
1. Remove Stainless Steel Restrictor.
2. Take the orange pH port plug out of the sonde unit.
3. Locate the pH probe in the sensor storage bottle and remove.
4. Insert probe into unit.
5. Reattach Stainless Steel Restrictor.
6. Store sensor storage bottle in safe location.
7. Put batteries into battery pack.
8. Attach cable to battery pack and sonde.
9. Turn on Battery Pack and Ipod.

Battery Pack Opening

PREPARATION

Tap the Calibration icon in the inSitu App to access a list of sensors that are available for calibration:

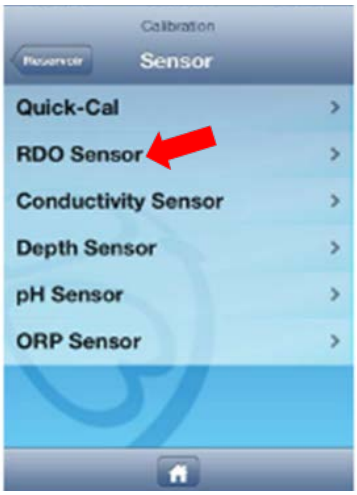
Quick-Cal will automatically select conductivity, pH, and ORP sensors. The RDO sensor will have to be selected separately.



DISSOLVED OXYGEN

Use the vented cup for calibration

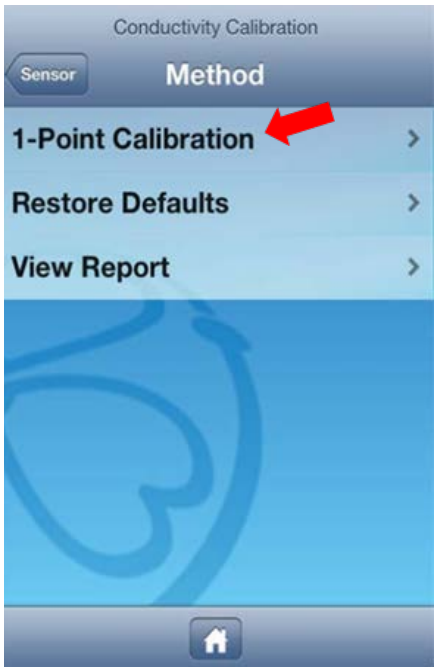
1. Tap the Calibration icon.
2. Tap RDO Sensor.
3. Select 100% Saturation.
4. Place a water-saturated sponge in the bottom of the calibration cup. Place the instrument into the calibration cup, and tap Start.
5. When the calibration is stable, tap the Accept button.
6. To view the calibration report, tap View Report.
7. Rinse the sensors thoroughly with DI water.

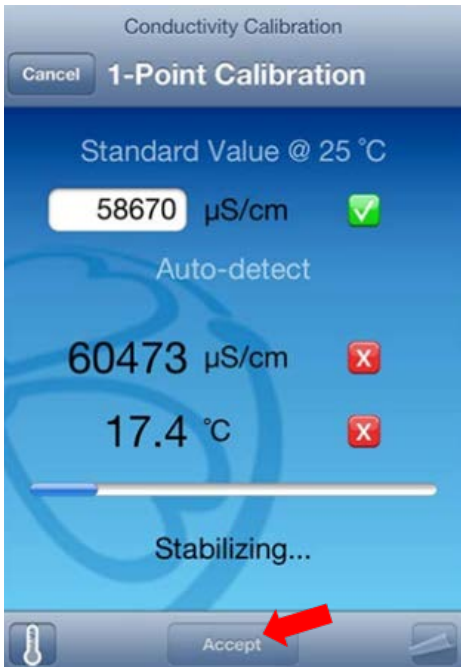


CONDUCTIVITY SENSOR

1. Tap the Calibration icon to access a list of sensors that are available for calibration.
2. Tap Conductivity Sensor.
3. Tap 1-Point Calibration.
4. Make sure the vented cap is installed on the calibration cup. Fill the cup to the fill line with calibration standard. Place the instrument into the calibration cup, and tap Start.
5. inSitu automatically detects the calibration standard. If not, tap the white box and type in true value of standard.
6. Once the calibration is stable, tap the Accept button.
7. To view the calibration report, tap View Report.
8. Rinse the sensors with DI water.

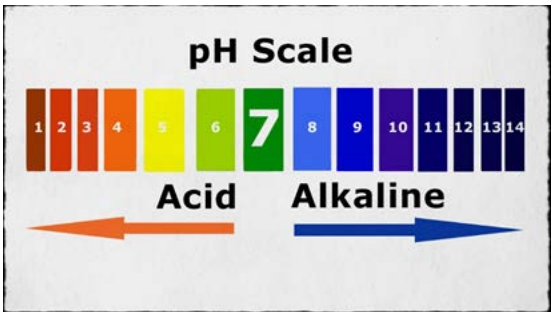
If your calibration standard references 20° C, tap the thermometer icon and change the reference temperature.

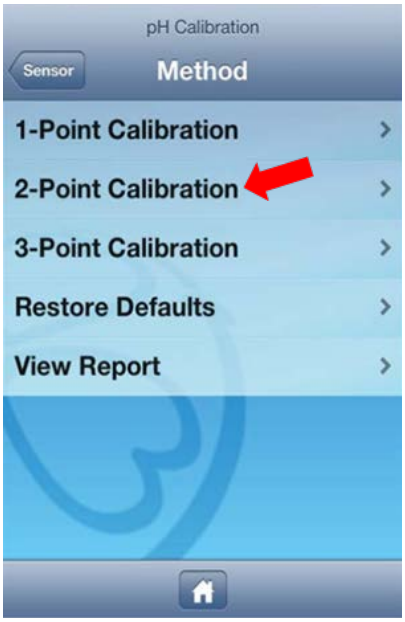


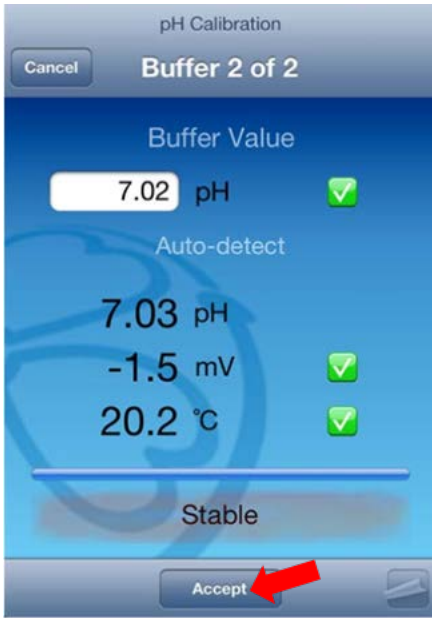


pH SENSOR

1. Tap the Calibration icon to access a list of sensors that are available for calibration.
2. Tap pH Sensor.
3. Tap 2-Point Calibration.
4. Make sure the vented cap is installed on the calibration cup. Fill the cup to the fill line with the pH 7 calibration buffer. Place the instrument into the calibration cup, and tap Start.
5. When the calibration is stable, tap the Accept button.
6. Rinse the sensors with DI water.
7. Fill the cup to the fill line with the pH 10 calibration buffer. Place the instrument into the calibration cup, and tap Start.
8. When the calibration is stable, tap the Accept button.
9. To view the calibration report, tap View Report. Document the stabilization of the pH 7 and check Live Reading screen for pH 10 and record value.







HOW TO STORE

1. Take pH probe out of unit and insert orange pH port plug into unit.
2. Take pH probe and put on o-ring and cap. Store probe in sensor storage bottle with appropriate solution (pH storage solution or pH 4 buffer).
3. Take batteries out of bluetooth.

Online manual: https://in-situ.com/wp-content/uploads/2014/11/smarTROLL-MP_Manual.pdf