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Water Action Volunteers
Status and Trends Monitoring Manual[1,2]

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Project Contact

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[1] Adapted from Level 2 Manual, November 2018
[2] Updated April 2020

Project Background

Wisconsin Department of Natural Resources' (WDNR) biologists monitor streams on a regular basis for a variety of parameters including dissolved oxygen, air and water temperature, pH, and transparency. Your participation in the Status and Trends monitoring effort will provide valuable data to supplement monitoring already being conducted at other monitoring sites or in other streams around the state.



Volunteers participating in the Status and Trends program follow WDNR stream monitoring methodologies and use WDNR approved equipment to monitor streams around the state. Status and Trends Monitoring began in 2006 as Level 2 Monitoring.

Volunteer Monitor Responsibilities

Volunteers who are new participants of the program must:

- Attend a training session, which will have both field and classroom components, to learn the monitoring protocol.
- Collect dissolved oxygen, air and water temperature, (pH), and transparency data at least one time per month from May – October.
- Adhere to a predetermined monitoring schedule.
- Record data results in SWIMS

Volunteer Qualifications

To participate in the Status and Trends program, volunteers must meet the following qualifications:

- Must have one season of monitoring experience.
- Ability to walk along riverbanks and enter the water to access a monitoring site.
- Enjoyment of the outdoors.

No science background is needed, as training will be provided to those who are interested and able to meet the defined responsibilities.

Create a Sampling Plan

Wisconsin Department of Natural Resources methods dictate that Status and Trends monitoring are completed at consistent intervals. This type of monitoring places an emphasis on consistency. Therefore, we ask that you monitor on a regular, predetermined schedule.

Guidelines for scheduling monitoring events include:

- Plan to monitor at least once per month from May through October.
- Space monitoring dates apart by roughly 30 days.
    - For instance, plan to monitor on the second Tuesday of each month or on the 22nd of each month to stay consistent.
- Schedule a Primary date and a Safety date for each month.
    - Monitor on your Safety date only if either an electrical storm or flooding keep you from monitoring on your Primary date. Safety dates are also predetermined dates and are typically scheduled a couple of days or one full week after your Primary date.

    - If you are unable to monitor on your Primary or Safety date, then monitor when possible and record Other (O) on your datasheet.
- Try to schedule monitoring events in the morning to when stream's oxygen levels are at their lowest. This provides biologist with a 'worst case scenario'. If you are unable to monitor in the morning, please try to be consistent as to the time of day that you go out sampling as water quality parameters fluctuate diurnally.

All data must be entered into the SWIMS database at the end of each monitoring season so that a final quality assurance check can be done, and monitoring reports can be created. All volunteers must turn in their equipment at the end of each season, though considerations can be made if necessary.

Choose Monitoring Sites

You are free to choose stream sites that you or your group wishes to monitor. While this situation places no requirements on the location of your monitoring, we ask that you consider any monitoring site requests made by WDNR biologists, county staff, or other agency staff persons when selecting your sites. Sites should be monitored for 3-5 years at a minimum, as the goal of the Status and Trends program is to collect data pertaining to status and long-term trends in water quality.

Data collected at all locations are important. There are two ways to look at selecting monitoring sites. First, your data may very well be more useful to the WDNR and/or other agencies when considering the recommendations of natural resource managers. Second, your monitoring might be more valuable to you if you or your group has a good idea how you would like to use the data.

Safety

Safety precautions of a general nature should be recognized always. Your safety while monitoring should be your highest priority, so please remember to be careful and be mindful of changing stream and weather conditions! Stream monitoring in extremely hot and humid weather carries the risk of dehydration and heat stroke. Never sample during electrical storms or high wind events. For general safety consideration, a first aid kit should always be carried with you when in the field.

Be aware of stream velocity, water depth, and bottom conditions at your stream-monitoring site. Do not attempt to perform monitoring responsibilities if water velocity appears to be fast

enough to knock you down when you are working in the stream. If you are unsure of water depth across the width of the stream, be sure to proceed with caution as you move across the stream or choose an alternate point from which to monitor. If you are not comfortable with the stream conditions, do not monitor. Your safety is important!

Your Role in Ensuring Quality Data

The data are only as good as the care taken in collecting and recording them. It is of ultimate importance to follow standard procedures when monitoring and entering data into SWIMS.

What do you need to do to help with quality assurance and quality control?

1. *Calibrate Instruments*
   Each month that you monitor, please follow the instructions for calibrating both the dissolved oxygen (DO) and pH meters, step by step. This includes completely filling out the calibration logs for each meter every time you calibrate the meters. Good record keeping assures us that the meters are well maintained and functioning properly.

2. *Fill Out Calibration Logs and Your Data Recording Form Completely*
   Be sure to complete all entries on your calibration logs and monitoring datasheet and add any comments that may assist others in understanding your data. Make sure to return all monitoring datasheets and calibration logs to the program or local coordinator at the end of the season. Don't forget your thermistor log!

   Datasheets submitted to the WAV program coordinator without the monitor/monitoring group's name, date and time of the monitoring event, and the monitoring location (name and station ID#) will be omitted from review. This information is crucial for the WAV program coordinator to use when reviewing the data for quality assurance purposes.

3. *Address Abnormal Results*
   If a measurement is outside the expected range (as indicated on your datasheet), please repeat the measurement. If it's still outside the expected range, please recalibrate and then repeat the measurement. If you are finding an abnormally low or high value, then call your local coordinator or your local WDNR biologist as soon as possible.

4. *Review your Data*
   Check to make sure that you entered the data correctly. Also, when entering your data, please keep in mind that you should skip over all parameters that you did not monitor. SWIMS will recognize all '0' entries as data and they will be analyzed as such.

YSI Dissolved Oxygen (DO) Meter

YSI Model 550a Dissolved Oxygen Meter

The YSI 550a Dissolved Oxygen (DO) meter needs to be calibrated before being used in the field every time you monitor. Once calibrated, the meter must be left on until you/your team is done with monitoring activities for the day at all monitoring locations.

In order to avoid damaging the meter, do not let sponge inside the probe chamber dry. Maintaining a damp environment in the chamber will help to ensure that your meter has high quality performance throughout the field season. Keep sponge moist by re-wetting it, at least bi-weekly, if not more frequently. If the sensor membrane becomes damaged, you will need to replace it (contact the WAV program coordinator for assistance) and then wait at least 1 hour before calibrating and using the meter to monitor at your stream site.

Get to know your YSI 550A DO meter

Instrument display: displays temperature in either °C or °F and dissolved oxygen in either mg/L (milligrams per liter) or % air saturation.

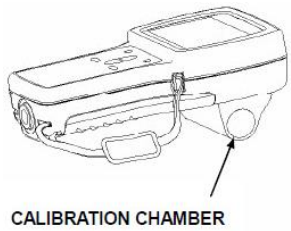
Power button: powers the unit on or off.

Backlight button: turns the display backlight on or off. The light will turn off automatically after two minutes of non-use.

Mode button: allows the user to select between % and mg/L during calibration process. When monitoring, pushing 'Mode' switches the instrument display between DO %, DO mg/L, and salinity calibration.

Arrow keys: increases or decreases the value during calibrations.

 : enter button



Probe: use to monitor water temp and dissolved oxygen content. Clean the probe with DI water after each monitoring event and store in the calibration chamber (image at the left) when not in use.

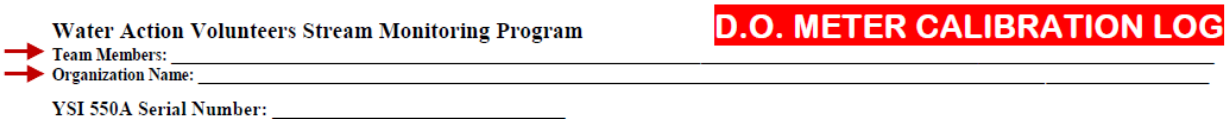
Maintaining your YSI 550A DO meter

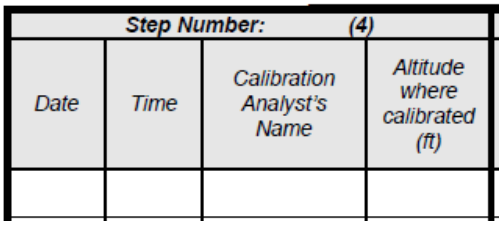
Verify that the sensor membrane is in good condition by removing the sensor from the storage chamber and check that the sponge is damp, if there are holes or tears in the membrane, and for air bubbles beneath the membrane. If air bubbles or damage to the membrane is evident, replace the membrane housing and solution. Ensure that membrane housing has been filled with KCl solution for at least 1 hour before calibration and first use. Training videos for how to calibrate the YSI 550A meter and monitor with it are available on the WAV website (http://watermonitoring.uwex.edu/wav/monitoring/video.html). Please contact your local coordinator or the WAV program coordinator if you have any questions!

Calibration Procedure

*Before calibrating your meter at the beginning of the field season, please fill out the top portion of the calibration log with the following information:

- Your name as well as that of any other team members
- Your organization name
- The serial number for your meter (located on the back of the meter)





**The numbers along the top of the calibration log correspond to the steps in the protocol.

1. Turn on the meter and allow at least 15 minutes of warm up time before calibration.
    - Be sure to note the time that you turned on the meter as this information will be important during the calibration process.

2. Verify that the sensor membrane is in good condition by removing the sensor from the calibration/storage chamber and doing the following:
    - Check that the sponge is damp (rewet if necessary).
    - Shake or blow off excess water on the sensor.
    - Check for holes or tears in the membrane.
    - Check for air bubbles beneath the membrane.

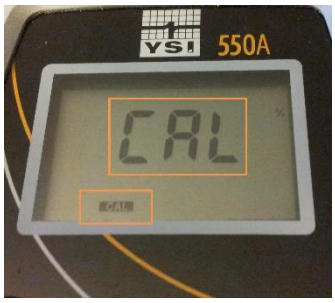
3. Reinsert the sensor into the calibration/storage chamber at the back of the meter.

4. On the calibration log, record the *date, time, name of analyst* (who is calibrating the meter), and the *altitude (in feet)* at which the calibration is taking place.

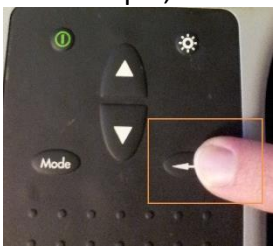
5. Record the number of minutes of *warm up time* on the DO calibration log.
6. Record the *stabilized probe temperature* (°C) on the DO calibration log (red box).
7. Record the *stabilized pre-calibration D.O.* (mg/L) on the DO calibration log (orange box).
    - Press the MODE button to change from % saturation to mg/L.

(5)	(6)	(8)
Warm Up Time (min)	Stabilized Probe Temp (°C)	Stabilized Pre-Calibration D.O. (mg/L)

8. Press and release both the UP ARROW and DOWN ARROW keys at the same time to enter the calibration menu.
    - The meter will say CAL on the screen in large letters and CAL in small letters in the lower left corner. The small CAL letters will stay on the screen until the calibration process is done.



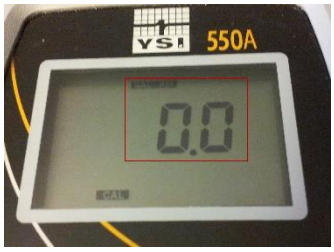
9. Press ENTER on the meter to show a value for altitude (x100) in feet.
    - For example, enter a 9 here indicates 900 ft and a 12 indicates 1200 ft.



10. Adjust the altitude with the up and down arrow buttons for the elevation where the calibration is taking place and press ENTER.
    - The % saturation value is now showing on the meter display.

11. Allow the % saturation value (red box) to stabilize on the screen
    - This may take a minute or two to happen

12. Press ENTER (orange box).
    - The salinity of the water samples is now on the screen.



13. Press ENTER again to accept 0 (the salinity of fresh water).
    - The calibrated % saturation value is now on the screen (red box) and the small CAL is no longer visible in the lower left corner.

14. Press the MODE key (orange box) to switch to mg/L. (This key is used to toggle between mg/L and % saturation.)

15. Record the *post-calibration D.O.* (mg/L) on the calibration log.
16. Look up the calibration chart D.O. value (mg/L) from the table (available on the next two pages of this manual and as a laminated sheet in the monitoring kit).
    - To read the table, find the probe temperature (y-axis) and the altitude (x-axis) and record the corresponding D.O. (mg/L) value as the *calibration chart D.O*. on the calibration log.
    - If the difference between the *post-calibration D.O.* and the *calibration chart D.O.* is greater than 0.3 (mg/L), re-calibrate the meter before using in the field.

(16)	(17)
Post-Calibration D.O. (mg/L)	*Calibration Chart D.O.* ☺

17. Record any comments about the calibration process in the *Comments* field on the log.

18. Conduct a post-calibration drift test to verify accuracy of your calibration
    - If unsuccessful, check on the condition of the probe tip and contact the WAV program coordinator for further instructions.

Post Calibration Drift

This quality control step must be performed to insure the collection of accurate data. After calibration, check the meter for drift. This is a check as to how well the meter is holding the calibration. Leave the meter where you calibrated it (this step is important to ensure a stabilized temperature) and walk away for 5 minutes. Upon returning, the DO percent saturation value should be within a couple of percent of the calibrated percent saturation value you recorded. If it has drifted more than a couple of percent, you must remove the cap membrane to check the condition of the probe. If necessary, refurbish the probe tip according to your instrument's manual, and change the solution and membrane (contact the WAV program coordinator for further instructions. Once the refurbishment process is completed, wait one hour before repeating the calibration procedures listed above (Steps 1-18).

19. After completing a successful calibration and post-calibration drift test, the <u>DO meter should be left on until the last reading of the day is completed.</u>

20. Once monitoring is complete, moisten the sponge in the calibration chamber and turn the meter off before storing it in the monitoring kit until the next field event.

Note: If you notice your meter is not calibrating properly, please check for bubbles or tears in the membrane and replace if necessary. If replacing the membrane does not work, try cleaning the probe by following instructions in the instrument's manual or contact the WAV program coordinator for further instructions.

Dissovled Oxygen Saturation (mg/L) Based on Elevation or Ambient Barometric Pressure (Station Pressure)

Temp		Elevation Feet Above Sea Level/Equivalent Un-Corrected[1] Barometric Pressure mm Hg																				
C	F	Elv:	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	900	800	700	600	500	400	300	200	100	0*	-200
		Press:	706.5	709.1	711.8	714.5	717.1	719.8	722.5	725.1	727.8	730.5	733.1	735.8	738.5	741.1	743.8	746.5	749.1	751.8	754.5	757.1	760	765.1
20	68.0		8.5	8.5	8.5	8.5	8.6	8.6	8.6	8.7	8.7	8.7	8.8	8.8	8.8	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.09	9.2
21	69.8		8.3	8.3	8.3	8.4	8.4	8.4	8.5	8.5	8.5	8.6	8.6	8.6	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.9	8.91	9.0
22	71.6		8.1	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.4	8.4	8.4	8.5	8.5	8.5	8.6	8.6	8.6	8.6	8.7	8.7	8.74	8.8
23	73.4		8.0	8.0	8.0	8.1	8.1	8.1	8.2	8.2	8.2	8.2	8.3	8.3	8.3	8.4	8.4	8.4	8.5	8.5	8.5	8.5	8.58	8.6
24	75.2		7.8	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.1	8.1	8.1	8.1	8.2	8.2	8.2	8.3	8.3	8.3	8.4	8.4	8.42	8.5
25	77.0		7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.1	8.1	8.1	8.1	8.2	8.2	8.2	8.26	8.3
26	78.8		7.5	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9	7.9	8.0	8.0	8.0	8.1	8.1	8.11	8.2
27	80.6		7.4	7.4	7.5	7.5	7.5	7.5	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.8	7.8	7.8	7.9	7.9	7.9	7.9	7.97	8.0
28	82.4		7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.5	7.5	7.5	7.6	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.8	7.8	7.83	7.9
29	84.2		7.1	7.2	7.2	7.2	7.3	7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.5	7.5	7.5	7.6	7.6	7.6	7.6	7.7	7.69	7.7
30	86.0		7.0	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.2	7.3	7.3	7.3	7.3	7.4	7.4	7.4	7.5	7.5	7.5	7.5	7.56	7.6
31	87.8		6.9	6.9	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.2	7.3	7.3	7.3	7.3	7.4	7.4	7.43	7.5
32	89.6		6.8	6.8	6.8	6.9	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.3	7.3	7.30	7.4
33	91.4		6.7	6.7	6.7	6.8	6.8	6.8	6.8	6.9	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.1	7.1	7.1	7.1	7.2	7.18	7.2
34	93.2		6.6	6.6	6.6	6.6	6.7	6.7	6.7	6.7	6.8	6.8	6.8	6.8	6.9	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.06	7.1
35	95.0		6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.7	6.7	6.7	6.7	6.8	6.8	6.8	6.8	6.8	6.9	6.9	6.9	6.95	7.0

*Dissolved oxygen saturation at 760 mm Hg derived from the tables of Benson & Kuause (1980), from C.M. Mortimer 1981. The oxygen content of air-saturated fresh waters over ranges of temperature and atmospheric pressure of limnological interest. Mitt. Int. Ver. Limnol. No. 22. Stuttgart, Germany.

[1]Dissolved oxygen saturation values based on elevation due not account for TRUE station pressure. For more accurate dissolved oxygen saturation values use un-corrected pressure measurements. Uncorrected barometric pressure values = National Weather Service Barometric Pressure in mm Hg x (Equivalent elevation pressure/760)

Source: J. Sullivan, WDNR-LaCrosse, March 2006

Dissovled Oxygen Saturation (mg/L) Based on Elevation or Ambient Barometric Pressure (Station Pressure)

Temp		Elevation Feet Above Sea Level/Equivalent Un-Corrected[1] Barometric Pressure mm Hg																					
C	F	Elv:	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	900	800	700	600	500	400	300	200	100	0*	-200
		Press:	706.5	709.1	711.8	714.5	717.1	719.8	722.5	725.1	727.8	730.5	733.1	735.8	738.5	741.1	743.8	746.5	749.1	751.8	754.5	757.1	760	765.1
0	32.0		13.6	13.6	13.7	13.7	13.8	13.8	13.9	14.0	14.0	14.1	14.1	14.2	14.2	14.3	14.3	14.4	14.4	14.5	14.5	14.6	14.62	14.7
1	33.8		13.2	13.3	13.3	13.4	13.4	13.5	13.5	13.6	13.6	13.7	13.7	13.8	13.8	13.9	13.9	14.0	14.0	14.1	14.1	14.2	14.22	14.3
2	35.6		12.9	12.9	13.0	13.0	13.0	13.1	13.1	13.2	13.2	13.3	13.3	13.4	13.4	13.5	13.5	13.6	13.6	13.7	13.7	13.8	13.83	13.9
3	37.4		12.5	12.6	12.6	12.7	12.7	12.7	12.8	12.8	12.9	12.9	13.0	13.0	13.1	13.1	13.2	13.2	13.3	13.3	13.4	13.4	13.46	13.6
4	39.2		12.2	12.2	12.3	12.3	12.4	12.4	12.5	12.5	12.6	12.6	12.6	12.7	12.7	12.8	12.8	12.9	12.9	13.0	13.0	13.4	13.11	13.2
5	41.0		11.9	11.9	12.0	12.0	12.0	12.1	12.1	12.2	12.2	12.3	12.3	12.4	12.4	12.5	12.5	12.5	12.6	12.6	12.7	12.7	12.77	12.9
6	42.8		11.6	11.6	11.7	11.7	11.7	11.8	11.8	11.9	11.9	12.0	12.0	12.1	12.1	12.1	12.2	12.2	12.3	12.3	12.4	12.4	12.45	12.5
7	44.6		11.3	11.3	11.4	11.4	11.5	11.5	11.5	11.6	11.6	11.7	11.7	11.8	11.8	11.8	11.9	11.9	12.0	12.0	12.1	12.1	12.14	12.2
8	46.4		11.0	11.0	11.1	11.1	11.2	11.2	11.3	11.3	11.3	11.4	11.4	11.5	11.5	11.5	11.6	11.6	11.7	11.7	11.8	11.8	11.84	11.9
9	48.2		10.7	10.8	10.8	10.9	10.9	10.9	11.0	11.0	11.1	11.1	11.2	11.2	11.2	11.3	11.3	11.4	11.4	11.4	11.5	11.5	11.56	11.6
10	50.0		10.5	10.5	10.6	10.6	10.7	10.7	10.7	10.8	10.8	10.8	10.9	10.9	11.0	11.0	11.0	11.1	11.1	11.2	11.2	11.2	11.29	11.4
11	51.8		10.3	10.3	10.3	10.4	10.4	10.4	10.5	10.5	10.6	10.6	10.6	10.7	10.7	10.8	10.8	10.8	10.9	10.9	10.9	11.0	11.03	11.1
12	53.6		10.0	10.1	10.1	10.1	10.2	10.2	10.2	10.3	10.3	10.4	10.4	10.4	10.5	10.5	10.5	10.6	10.6	10.7	10.7	10.7	10.78	10.8
13	55.4		9.8	9.8	9.9	9.9	9.9	10.0	10.0	10.1	10.1	10.1	10.2	10.2	10.2	10.3	10.3	10.3	10.4	10.4	10.5	10.5	10.54	10.6
14	57.2		6.6	9.6	9.7	9.7	9.7	9.8	9.8	9.8	9.9	9.9	9.9	10	10.0	10.0	10.1	10.1	10.2	10.2	10.2	10.3	10.31	10.4
15	59.0		9.4	9.4	9.4	9.5	9.5	9.6	9.6	9.6	9.7	9.7	9.7	9.8	9.8	9.8	9.9	9.9	9.9	10.0	10.0	10.0	10.08	10.2
16	60.8		9.2	9.2	9.2	9.3	9.3	9.3	9.4	9.4	9.5	9.5	9.5	9.6	9.6	9.6	9.7	9.7	9.7	9.8	9.8	9.8	9.87	9.9
17	62.6		9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.3	9.3	9.3	9.4	9.4	9.4	9.5	9.5	9.5	9.6	9.6	9.6	9.66	9.7
18	64.4		8.8	8.8	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.3	9.3	9.3	9.4	9.4	9.4	9.47	9.5
19	66.2		8.6	8.7	8.7	8.7	8.8	8.8	8.8	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.2	9.28	9.3
20	68.0		8.5	8.5	8.5	8.5	8.6	8.6	8.6	8.7	8.7	8.7	8.8	8.8	8.8	8.9	8.9	8.9	9.0	9.0	9.0	9.1	9.09	9.2

Monitoring Procedure

It important that you indicate what type of equipment was used to monitor for dissolved oxygen. In this case, you will circle the 'YSI 550A Meter' option on your datasheet.

Dissolved Oxygen (D.O.) Sampling Method	**Circle one:**	Hach Kit	LaMotte Kit	YSI 550A Meter	Other: _____	-
D.O. mg/L	No. of Titration Drops: _____		No. of Plastic Measuring Tubes: _____		Dissolved Oxygen Content: _____	mg/L
D.O. % Saturation						%

To measure dissolved oxygen (DO) in the stream:

1. With the DO meter in hand, enter the stream downstream from your monitoring location as to not disturb the bottom sediment as you move towards the site. You can also monitor dissolved oxygen from a bridge overpass as to not disturb the bottom sediment.
2. Remove the probe from its chamber and insert it into the water to be measured. Continuously stir or move the probe through the water (especially when monitoring in very still water) while taking the measurement.
3. Allow the temperature and dissolved oxygen readings to stabilize. This should take anywhere from 2 to 5 minutes.
4. Observe and record the water temp and the DO values on the monitoring datasheet.

Water Temperature						˚C
Dissolved Oxygen (D.O.) Sampling Method	**Circle one:**	Hach Kit	LaMotte Kit	YSI 550A Meter	Other: _____	-
D.O. mg/L	No. of Titration Drops: _____		No. of Plastic Measuring Tubes: _____		Dissolved Oxygen Content: _____	mg/L
D.O. % Saturation						%

5. Press the MODE button to change the instrument display.
6. Observe and record the % saturation value on the monitoring datasheet.

D.O. mg/L	No. of Titration Drops: _____		No. of Plastic Measuring Tubes: _____		Dissolved Oxygen Content: _____	mg/L
D.O. % Saturation						%

7. Rinse the probe with distilled water after each use and return it to the storage chamber.
8. Before storing the meter in the carrying case, moisten the probe sponge by soaking with distilled water.
9. Press the green button on the meter to turn if off at the conclusion of the day's monitoring effort.

YSI Model Pro20i Dissolved Oxygen Meter

The YSI Pro20i Dissolved Oxygen (DO) meter needs to be calibrated before being used in the field every time you monitor. Once calibrated, the meter must be left on until you/your team is done with monitoring activities for the day at all monitoring locations.

In order to avoid damaging the meter, do not let sponge inside the probe sleeve dry. Maintaining a damp environment in the chamber will help to ensure that your meter has high quality performance throughout the field season. Keep sponge moist by re-wetting it, at least bi-weekly, if not more frequently. If the sensor membrane becomes damaged, you will need to replace it (contact the WAV program coordinator for assistance) and then wait at least 1 hour before calibrating and using the meter to monitor at your stream site.

Get to know your YSI Pro20i DO meter

Instrument display: displays temperature in either °C or °F, barometric pressure, and dissolved oxygen in either mg/L (milligrams per liter) or % air saturation. This display will also flash a battery symbol when one hour of battery life remains.

Power button: powers the unit on or off.

Backlight button: turns the display backlight on or off. The light will turn off automatically after two minutes of non-use.

Enter button

Arrow keys: increases or decreases the value during calibrations and toggle between screen options.

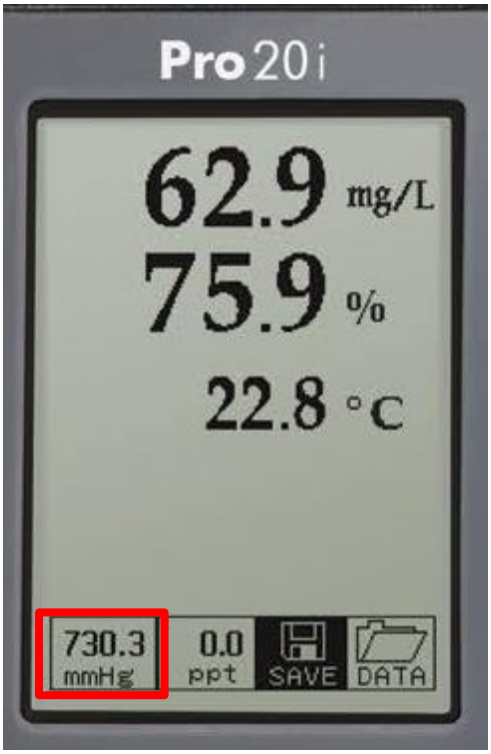
Cal button: enters calibration screen or begins One-Step Calibration process.

Menu button: accesses the System Setup menu.

Probe: use to monitor water temp and dissolved oxygen content. Clean the probe with DI water after each monitoring event and store in the probe sleeve.

Maintaining your YSI Pro20i DO meter

Verify that the sensor membrane is in good condition by removing the sensor from the storage sleeve and check that the sponge is damp, if there are holes or tears in the membrane, and for air bubbles beneath the membrane. If air bubbles or damage to the membrane is evident, replace the membrane housing and solution. Ensure that membrane housing has been filled with KCl solution for at least 1 hour before calibration and first use. Please contact your local coordinator or the WAV program coordinator if you have any questions!



Calibration Procedure

Pro20i DO meters can be easily calibrated using the One Touch Cal program.

1. Turn on the meter and let it warm up for 15-20 minutes before beginning the calibration process. Ensure the sponge in the probe sleeve is damp. A dry sponge may indicate damage to the probe membrane.

2. Begin the calibration of your Pro20i meter by setting the barometer. Use the up and down arrows to navigate to the barometer box (red box) on the home screen.

3. Press the enter key to select the barometer reading. Use the up and down arrows to adjust the barometer reading to the local, true, (not corrected to sea level), barometric pressure.

4. Press enter to confirm and save the barometric pressure.

5. Use the Menu button (orange box) to enter the System Setup menu. Use the arrow buttons to scroll down to One Touch Cal. Use the enter key to select One Touch Cal. Use the arrow keys to navigate to the ESC option to exit the menu screen.

6. Ensure that the barometric pressure is correct, then press and hold the Cal button (red box) for 3 seconds. The display will indicate **Calibrating %DO** and automatically calibrate the meter. This can take up to 2 minutes. **Calibration Successful** will display briefly when the process is complete. Leave the meter on until the last reading of the day is completed.

Note: If you notice your meter is not calibrating properly, please check for bubbles or tears in the membrane and replace if necessary. If replacing the membrane does not work, try cleaning the probe by following instructions in the instrument's manual or contact the WAV program coordinator for further instructions.

Monitoring Procedure

It important that you indicate what type of equipment was used to monitor for dissolved oxygen. In this case, you will circle the 'Other' option on your datasheet. In the comments section, fill in the name of the device used, YSI Pro20i meter.

Dissolved Oxygen (D.O.) Sampling Method	**Circle One:**	Hach Kit	LaMotte Kit	YSI 550A Meter	Other:_____	-
D.O. mg/L	No. of Titration Drops: _____		No. of Plastic Measuring Tubes: _____		Dissolved Oxygen Content: _____	mg/L
D.O. % Saturation						%

To measure dissolved oxygen (DO) in the stream:

1. With the DO meter in hand, enter the stream downstream from your monitoring location as to not disturb the bottom sediment as you move towards the site. You can also monitor dissolved oxygen from a bridge overpass as to not disturb the bottom sediment.
2. Remove the probe from its sleeve and insert it into the water to be measured. Continuously stir or move the probe through the water (especially when monitoring in very still water) while taking the measurement. If the water is flowing quickly, try to place the sensor perpendicular to the flow as opposed to facing directly into the flow.
3. Allow the temperature and dissolved oxygen readings to stabilize. This could take anywhere from 2 to 5 minutes.
4. Observe and record the water temp and the DO values on the monitoring datasheet.

Water Temperature						˚C
Dissolved Oxygen (D.O.) Sampling Method	**Circle One:**	Hach Kit	LaMotte Kit	YSI 550A Meter	Other:_____	-
D.O. mg/L	No. of Titration Drops: _____		No. of Plastic Measuring Tubes: _____		Dissolved Oxygen Content: _____	mg/L
D.O. % Saturation						%

5. Rinse the probe with distilled water after each use, and return it to the storage chamber.
6. Before storing the meter, moisten the probe sponge with tap water.
7. Turn the meter off at the conclusion of the day's monitoring effort.

Oakton Acorn pH 5 and 5+ Meter

WAV volunteers currently use one of three different pH meters:

1. pH 5 (original software and original outside casing)
2. pH 5 (updated software, but original outside casing)
3. pH 5+ (updated software and updated outside casing)

pH 5 meter

pH 5+ meter

Which pH meter do I have?

Before calibrating your pH meter, you will first need to ascertain which meter version you are using. This information is important to know because the calibration protocol is varies slightly between the different software versions.

The only way to tell if you have meter version #1 or #2 is by going through the calibration process and seeing what happens between the calibration with the pH 7 buffer solution calibration and the calibration with the pH 10 buffer solution. The original software tells the meter to exit calibration mode and return to measurement mode upon completion of the first calibration point. This means that you will complete two 'one point' calibrations as you have to re-enter calibration mode in order to complete the pH 10 calibration. The software update on the newer meters keeps the meter in calibration mode throughout the calibration process (the values on the screen will continue to blink). This means that you will complete a 'two point' calibration when calibrating the meter.

For all meters used by WAV volunteers…

Both the Oakton Acorn pH 5 and the 5+ meters need to be calibrated before being used in the field every time you monitor throughout the field season. Once calibrated, the pH meter can be turned on and off between monitoring events if you monitor at multiple locations in one day (unlike the DO meter).

When calibrating your meter, please use both the pH 7 and pH 10 buffer solutions (NIST) provided to calibrate the meter. Do not reuse the buffer solutions following the calibration as contaminants in the solution can impact the accuracy of the calibration and the field measurements.

To avoid damaging the meter, be sure to keep the pH electrode (specifically the bulb at the end of the probe) wet when not in use. Store the electrode in the electrode soaker bottle and keep it filled with electrode storage solution. Refresher storage solution can be found in your monitoring kit. Contact the WAV program coordinator if you need more solution.

If you notice your meter is not calibrating properly, try cleaning the probe by following the instructions in the instrument's manual (located in the pocket of your meter case) or contact the WAV program coordinator for directions.

*Before calibrating your meter at the beginning of the field season, please fill out the top portion of the calibration log with the following information:

- Your name, as well as that of any other team members
- The name of your organization
- The serial number for your meter (located on the back of the meter)
- The type of meter that you are using
    - This can be recorded after the first calibration is completed

Water Action Volunteers Stream Monitoring Program **pH METER CALIBRATION LOG**

Team Members: _____

Organization Name: _____

Oakton Acorn pH Meter Serial Number: _____ **Meter Type:** ❑ **ph 5** ❑ **ph 5+**

Calibration Procedure: pH 5 meter with original software and original outside case

This calibration process will be completed by conducting two one-point calibrations. This means that the meter will complete a single point calibration and then exit calibration mode each time. You will have to restart the calibration process when using the pH 10 buffer solution by pressing the CAL button.

1. Connect pH and temperature probes to meter. Ensure that the pH probe connecter snaps into place.
2. Turn the meter on by pushing the On/Off button on the face of the meter.
3. Record the *date*, *time*, and the *name of analyst* performing the calibration on the calibration log.

Date	Time	Calibration Analyst's Name

4. Remove the pH electrode from the electrode soaker bottle.
5. Rinse the pH electrode with distilled water and shake the excess water off the electrode.
6. Click the MODE button to find the *temperature* reading and record value on the calibration log.
7. Click the MODE button again to return to the pH screen on the meter.
8. Press the CAL button on the meter to start the calibration process.
9. Place the electrode and temperature sensors into the pH buffer solution and submerge the glass bulb completely in the solution.
10. Wait for the reading to stabilize and record the *Stabilized pH* on the calibration log.
11. Press the ENTER key once and record the *Calibrated pH* value (the meter is now out the calibration mode and in measuring mode).

Stabilized pH	pH Std	Calibrated pH ☺
	7	

12. Check that the *Calibrated pH* value is within 0.2 of the pH buffer standard (7 or 10). If the value is more than 0.2 higher or lower than its pH buffer value (compare the two values in the grey columns, outlines in blue), recalibrate the meter. Record the new results on the next line of the pH meter calibration log.

pH 7 standard				pH 10 standard			
Temp. (C)	Stabilized pH	pH Std	Calibrated pH ☺	Temp. (C)	Stabilized pH	pH Std	Calibrated pH ☺
		7				10	

13. Remove the electrode from the buffer solution, rinse with distilled water and shake off the excess water from the electrode.
14. **To finish the calibration, repeat steps 6 through 12 for the pH 10 buffer solution.**
15. Replace the pH probe in the electrode soaker bottle, turn the meter off, and head out to the field to complete your monitoring activities.

Calibration Procedure: pH 5 meter with updated software and original outside case

The updated software version in the pH 5 allows for you to complete a two-point calibration without ever leaving the calibration mode. After you press ENTER following the first calibration, the value on the screen will continue to blink, indicating that it is still in calibration mode (unlike the old version that stopped blinking after you hit ENTER and went into measuring mode).

1. Connect the pH and temperature probes to meter. Ensure that the pH probe connecter snaps into place.
2. Turn the meter on by pushing the On/Off button.
3. Record the *date*, *time*, and the *name of analyst* performing the calibration on the calibration log.

Date	*Time*	*Calibration Analyst's Name*

4. Remove the pH electrode from the electrode soaker bottle.
5. Rinse the pH electrode with distilled water and shake the excess water off of the electrode.
6. Click the MODE button to find the *temperature* reading and record value on the calibration log.
7. Click the MODE button again to return to the pH screen on the meter.
8. Press the CAL button on the meter in order to start the calibration process.
9. Place the electrode and temperature sensors into the pH 7 buffer solution and submerge the glass bulb completely in the solution.
10. Wait for the reading to stabilize and record the *Stabilized pH* on the calibration log.
11. Press the ENTER key once and record the *Calibrated pH* value (the value on the screen will continue to blink after you push ENTER as the meter is still in calibration mode).
12. Check that the *Calibrated pH* value is within 0.2 of the pH 7 buffer standard. If the value is more than 0.2 higher or lower than its pH buffer value (compare the two values in the grey columns, outlines in blue), recalibrate the meter. Record the new results on the next line of the pH meter calibration log.

Stabilized pH	*pH Std*	*Calibrated pH ☺*
	7	

13. Remove the electrode from the pH 7 buffer solution, rinse with distilled water and shake off the excess water from the electrode.
14. Place the electrode and temperature sensors directly into the pH 10 buffer solution and submerge the glass bulb completely in the solution
15. Wait for the reading to stabilize and record the *Stabilized pH* on the calibration log.

16. Press the ENTER key once and record the *Calibrated pH* value (the value on the screen will stop blinking as the meter should have exited calibration mode and entered measurement mode).
17. Check that the *Calibrated pH* value is within 0.2 of the pH 10 buffer standard. If the value is more than 0.2 higher or lower than its pH buffer value (compare the two values in the grey columns, outlines in blue), recalibrate the meter. Record the new results on the next line of the pH meter calibration log.]

pH 7 standard				pH 10 standard			
Temp. (C)	Stabilized pH	pH Std	Calibrated pH ☺	Temp. (C)	Stabilized pH	pH Std	Calibrated pH ☺
		7				10	

18. Remove the electrode from the pH 10 buffer solution, rinse with distilled water and shake off the excess water from the electrode.
19. Replace the pH probe in the electrode soaker bottle, turn the meter off, and head out to the field to complete your monitoring activities.

Calibration Procedure: pH 5+ meter with updated software and new outside case

For the pH 5+ meter, the updated software version from the pH 5 is all wrapped up in a brand new package! The updated version allows for you to complete a two-point calibration without ever leaving the calibration mode. After you press ENTER following the first calibration, the value on the screen will continue to blink, indicating that it is still in calibration mode (unlike the old version that stopped blinking after you hit ENTER and went into measuring mode).

1. Connect the pH and temperature probes to meter. Ensure that the pH probe connecter snaps into place.
2. Turn the meter on by pushing the On/Off button.
3. Record the *date*, *time*, and the *name of analyst* performing the calibration on the calibration log.

Date	Time	Calibration Analyst's Name

4. Remove the pH electrode from the electrode soaker bottle.
5. Rinse the pH electrode with distilled water and shake the excess water off the electrode.
6. Click the MODE button to find the *temperature* reading and record value on the calibration log.
7. Click the MODE button again to return to the pH screen on the meter.
8. Press the CAL button on the meter in order to start the calibration process.
9. Place the electrode and temperature sensors into the pH 7 buffer solution and submerge the glass bulb completely in the solution.
10. Wait for the reading to stabilize and record the *Stabilized pH* on the calibration log.

11. Press the ENTER key once and record the *Calibrated pH* value (the value on the screen will continue to blink after you push ENTER as the meter is still in calibration mode).
12. Check that the *Calibrated pH* value is within 0.2 of the pH 7 buffer standard.
    a. If the value is more than 0.2 higher or lower than its pH buffer value (compare the two values in the grey columns, outlines in blue), recalibrate the meter. Record the new results on the next line of the pH meter calibration log.
13. Remove the electrode from the pH 7 buffer solution, rinse with distilled water and shake off the excess water from the electrode.
14. Place the electrode and temperature sensors directly into the pH 10 buffer solution and submerge the glass bulb completely in the solution
15. Wait for the reading to stabilize and record the *Stabilized pH* on the calibration log.
16. Press the ENTER key once and record the *Calibrated pH* value (the value on the screen will stop blinking as the meter should have exited calibration mode and entered measurement mode).

Stabilized pH	*pH Std*	*Calibrated pH ☺*
	7	

17. Check that the *Calibrated pH* value is within 0.2 of the pH 10 buffer standard. If the value is more than 0.2 higher or lower than its pH buffer value (compare the two values in the grey columns, outlines in blue), recalibrate the meter. Record the new results on the next line of the pH meter calibration log.

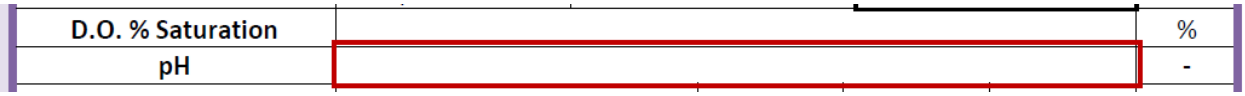
pH 7 standard				*pH 10 standard*			
Temp. (C)	*Stabilized pH*	*pH Std*	*Calibrated pH ☺*	*Temp. (C)*	*Stabilized pH*	*pH Std*	*Calibrated pH ☺*
		7				10	

18. Remove the electrode from the pH 10 buffer solution, rinse with distilled water and shake off the excess water from the electrode.
19. Replace the pH probe in the electrode soaker bottle, turn the meter off, and head out to the field to complete your monitoring activities.

Oakton Acorn pH Meter Monitoring Procedure

To measure pH in the stream:

1. Connect any electrodes to the pH meter and turn the meter on by pushing the On/Off button on the face of the meter. The meter does not have to be left on following the calibration process.
2. Remove the electrode from the electrode soaker bottle. Place the bottle to the side.
3. Rinse off the electrode with distilled water and shake off any excess water.
4. Wade into the middle of the stream, walking upstream from an access point downstream of monitoring location as to not disturb the bottom substrate.
5. Place pH and temperature probes into the stream and gently stir the probes.
6. Wait 2-3 minutes for pH reading to stabilize.
7. Record the pH reading on the monitoring datasheet.



8. Rinse the electrode with distilled water and shake off the excess water.
9. Place the electrode back in the electrode soaker bottle.
    a. Refresh storage solution if necessary.
10. Turn the meter off using the On/Off button on the face of the meter.
11. Disconnect the electrodes from the meter and store the meter in the carrying case.

A refresher video for how to monitor pH with the Oakton Acorn pH meter is available on the WAV website (http://watermonitoring.uwex.edu/wav/monitoring/video.html). Please contact your local coordinator or the WAV program coordinator if you have any questions!

Continuous Temperature Monitoring Procedure

**Revised for WAV from Wisconsin DNR April 2010 Standard Operating Procedures

Temperature has an important influence on pH, density, specific conductance, the rate of chemical reactions, and solubility of constituents in water. The biological activity and species composition of a water body is largely determined by water temperature as well.

Thermistor Use Background Information

Thermistors (continuous temperature monitoring devices) will be deployed in May and collected in October. Thermistors will be launched by the WAV program coordinator and distributed to volunteers to be deployed at stream monitoring locations across the state. Thermistors will be set to record temperature at one-hour intervals to assess thermal extremes and to determine if a stream should be classified as cold, cool, or warm. Volunteers should check thermistors at least once a month to ensure that they are in place and submerged in the stream (not covered by silt or vegetation). At the end of the monitoring season, volunteers will retrieve the thermistors and return them to the WAV program coordinator for data retrieval.

Collecting continuous water temperature data on all sizes and types of streams – small, medium, and large; warm, cool and cold; and across the range of stream classifications - is incredibly useful when making management decisions. Your continuous temperature data can be used to:

- Document baseline water temperatures.
- Determine a stream's temperature category - cold, cool, or warm water.
- Aid in documenting and determining the effects of thermal discharges on aquatic biota.
- Aid in location of groundwater influence to streams.
- Document point source and nonpoint source storm-water effects on streams.
- Document thermal impacts of structural dams and beaver dams to cold water streams.
- Distinguish brown trout streams from potential native brook trout streams.
- Document changes in stream temperatures after installation of agricultural and urban best management practices.
- Aid in development of a model using landscape factors to predict stream temperatures.
- Assess the impact of climate change.

Temperature ranges for cold, cool and warm water stream (as per John Lyons, WDNR research scientist):

- Cold = maximum summer daily mean temperature <22 C (<72 F)
- Cool = maximum summer daily mean temperature 22 to 25 C (72 to 77 F)
- Warm = maximum summer daily mean temperature >25 C (>77 F)

Deploying you Thermistor in the Stream

Attempt to deploy/place the thermistor in an area pf the stream that is well mixed, free of sedimentation, and where the thermistor will stay submerged during the period of deployment. If the thermistor gets buried by sediment or vegetation it may not be exposed to the true water temperature and may not sense changes in temperature as quickly. A riffle or run is preferred to a pool. Seek shade to minimize any radiant heat from the sun, but a deep run or riffle in the sun would be acceptable. Be sure to consider the safety of others using the stream and try your best to pound rebar stakes in where it is unlikely people will run into them.

What type of thermistor do I have?

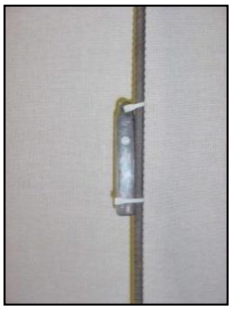
The WAV program distributes three types of thermistors to volunteers. Each device performs the same action. However, because margins of errors differ between devices, it is important to note your device type on your thermistor log. Different devices also have different means of being protected in the stream.

	Tidbit V2	**HOBO U22-001**	**MX Temp 400**
What does this device look like?			
How do I know if it is working?	A small red light will be flashing in the top left of the device.	A small red light will be flashing in the circular underside of the device	A small green light will flash in the check mark icon.
How can I protect this device in the stream?	This device should be deployed zip tied in a PVC tube as shown on the following page.	This device can either be zip tied in a PVC tube as shown on the following page or encased in a custom rubber protector.	This device is already enclosed in a protective case. Make sure the button bridge is not being depressed by the deployment mechanism.

When deploying the thermistor, check to see if the light is blinking (you may need to shield the device to see it if the light is faint). If your device is not blinking it may not be logging data. Contact WAV program coordinator before deploying if this is the case.

When deploying your thermistor, please remember that the main goals are to:

a. Keep the thermistor submerged for the whole season
b. Avoid having the thermistor get buried by sediment or debris
c. Secure it well enough so that it will not be lost during the monitoring season (keep in mind the flow of your stream can increase drastically after heavy rain events). Connect the thermistor to rebar or railroad plate with zip ties as described below.



Connect to re-bar with zip-ties and pound rebar into the stream bed.

Connect to PVC tube with zip ties and attach to railroad plate or rebar. Wedge plate or pound rebar into streambed.

We recommend using two zip ties, or one zip tie and some wire, in case one of the zip ties fails. A zip tie around the rebar above the thermistor can also help the thermistor from sliding off the end of the rebar. Alternatively, you can weld something to the top of the rebar or bend the top of the rebar 90 degrees. Pound the rebar into the streambed with a sledge type hammer and angle the rebar with the flow of the water to help keep it clear of debris. Make sure the thermistor is a few inches above the stream bottom. If you are using a railroad plate, wedge the plate into the stream bottom. To avoid someone pulling up your thermistor keep the rebar below water level. Undercut banks work great to keep the rebar out of the way of stream users and protect it from getting washed away. The stream type and size may determine which deployment method is most likely to keep the thermistor submerged and free of sediment during the deployment period. Many people have developed their own solution for their stream. Ask other volunteers in your area for advice. Every year we do lose some, but thermistors cost over $100 each, so please try to do what you can to make sure they do not get lost.

Take an accurate GPS reading or make detailed notes about where you place the thermistor in the stream (so you can find it again). Record this information, along with the device serial number, date, and time you placed the thermistor in the stream on your Thermistor Log. Thermistor data turned into the WAV program coordinator at the end of the season without a thermistor log (or a completed log) will not be entered into SWIMS.

During the Season

Check the thermistors each month and note the dates of your checks on the Thermistor Log. Check that the thermistor is not covered by sediment or vegetation and that it is still under the water. If possible, check that your thermistors are secure before any anticipated high-water events during which the thermistors could become dislodged.

Retrieving your Thermistor in the Fall (October)

At the end of the monitoring season, pull up the rebar or railroad plate to which the thermistor is attached. Note the date and time that the thermistor came out of the water on your Thermistor Log. This is important since the thermistor will continue to log data even after it is out of the stream, however we don't want the temperature of your car and house to be included in the final data set that is uploaded to SWIMS. WAV Program owned thermistors should be returned to the WAV program coordinator for data downloading at the conclusion of the monitoring season. The WAV program coordinator will also upload the processed data into SWIMS. Groups that own their thermistors and software can download the data themselves and send the raw files via email to the WAV program coordinator in order to have the data uploaded into SWIMS.

Rebar and railroad plates do not need to be returned each winter. If able and willing, please store them for next year. If you will not be placing thermistors at a stream site next year, please contact the WAV program coordinator to see if someone else in your area can use them.

Thermistor Logs

Once launched, the thermistors begin to constantly log temperature data at one-hour intervals. When the data are downloaded, we need to delete all readings from when the thermistor was not in the water (pre and post deployment, as well as any low water events that left the thermistor suspended above the water). Carefully and completely filled out Thermistor Logs are essential for determining what data to cut out. Thank you for taking the time to fill them out throughout the season and return them with your thermistor at the end of the monitoring season!