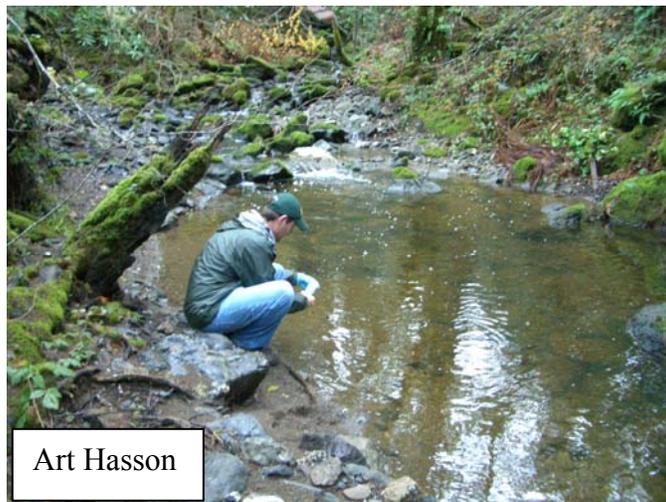




CCWI

**Citizen Monitoring
Handbook**

2011



Art Hasson

CCWI Citizen Monitoring Handbook

Community Clean Water Institute (CCWI) is dedicated to promoting and protecting clean water and public health by identifying water pollution, advocating for sound water policies, and providing information to the public.

Citizen monitoring involves monitoring of streams and water-bodies by community volunteers interested in watershed protection. By monitoring local creeks and rivers, citizen monitors learn about their watershed, help pinpoint pollution sources, and identify widespread problems. The data can provide the information needed to develop restoration projects or pollution prevention measures. CCWI works with existing citizen groups to develop and support citizen monitoring programs. To find out more about becoming a Citizen Monitor, contact the CCWI office, at (707) 824-4370, or info@ccwi.org.

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I. Water Quality Parameters

Conductivity

WHAT: Conductivity is the ability of water to conduct an electrical current through dissolved ions in the water. It can loosely be described as the concentration of salts, and is related to Total Dissolved Solids. It is measured in microSiemens per centimeter ($\mu\text{S}/\text{cm}$). In the literature one may find conductivity expressed as $\mu\text{mhos}/\text{cm}$. The $\mu\text{mhos}/\text{cm}$ are micromhos per centimeter where mho is the reverse spelling of ohm.

$$1 \mu\text{mhos}/\text{cm} = 1 \mu\text{S}/\text{cm}$$

CAUSES:

Natural factors:

- Material of surrounding rocks:
Granite bedrock: decreases conductivity (does not ionize easily)¹
Clay soils: increases conductivity (ionizes when washed into water)¹
- Evaporation: increases concentration of dissolved solids and salts, increasing conductivity.²

Human factors that increase conductivity:

- Failing sewage or septic increase chloride, phosphate, and nitrate¹
- Agricultural runoff with high levels of dissolved salts²

Human factors that are not detected by conductivity:

- Organic compounds like oil, phenol, alcohol, and sugar are not very conductive. (These compounds may get into the water through urban runoff)¹

CORRELATION:

- As temperature increases, conductivity increases.
- Nitrates and phosphates slightly increase conductivity.
- As conductivity increases, DO decreases.

LEVELS:

- Distilled water: 0.5 to 3.0 $\mu\text{S}/\text{cm}$,
- Drinkable water: 30 to 1500 $\mu\text{S}/\text{cm}$
- Ocean water: 53,000 $\mu\text{S}/\text{cm}$
- Streams with good mixed fisheries: 150 to 500 $\mu\text{S}/\text{cm}$.¹
- The State Water Board objective: 100 to 1300 $\mu\text{S}/\text{cm}$, depending on the water body.

Dissolved Oxygen (DO)

WHAT: “DO” is the amount of dissolved oxygen in milligrams per Liter (mg/L) water. Most aquatic organisms need oxygen to survive and grow. Bacteria consume DO and release CO₂ in the process of breaking down substances such as yard clippings, sewage, oil, and dead organic material.

CAUSES:

- Oxygen from air is dissolved in water at its surface, and through turbulence.
- Plants and algae produce oxygen as they photosynthesize.
- Low DO results from water temperature increases, still water and decaying organic matter.

CORRELATION:

- Temperature: As temperature increases, DO decreases.
- Altitude: Water holds less oxygen at higher altitudes.
- Salinity: As salinity increases, DO decreases.
- Mineral content: As the mineral content increases, dissolved oxygen decreases.

LEVELS:

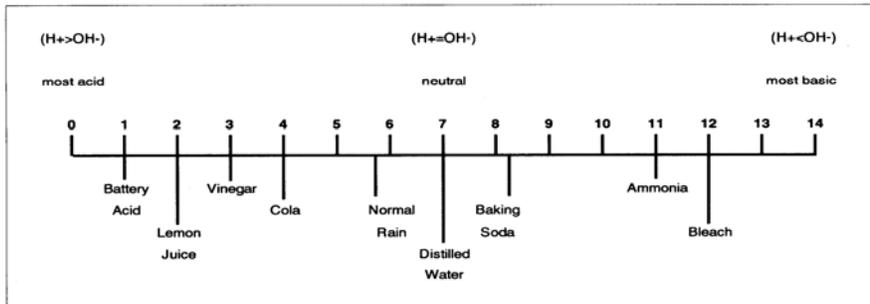
- For most life to survive: DO must be above 3 mg/l.
- To support fish: DO should be above 7 mg/L according to the SWRCB Basin Plan.

Dissolved Oxygen Requirements for Salmonids (general, differs between species)	
A. Embryo and larval stages	mg/L
No production impairment	11
Slight production impairment	9
Moderate production impairment	8
Severe production impairment	7
Limit to avoid acute mortality	6
B. Other life stages	
No production impairment	8
Slight production impairment	6
Moderate production impairment	5
Severe production impairment	4
Limit to avoid acute mortality	3

pH

WHAT:

- pH comes from the French: "puissance d'Hydrogène" meaning strength of the hydrogen.
- pH measures how acidic or basic the water is.
- The pH scale goes from 0 to 14 (7= neutral, <7 = acidic, >7=basic)



pH scale showing the values of some common substances. (Source: U.S. Fish and Wildlife Service.)

CAUSES:

Natural factors:

- Surrounding tree types or stream bottom material
 - Algae make the water more basic, increasing pH
 - Limestone (calcium carbonate) naturally raises the pH⁴
- Decomposing organic matter and root respiration decreases the pH (carbon dioxide forms a weak acid in water)⁵

Human factors:

- Acid rain (from autos or industries) reduces pH
- Acid mine drainage and sulfur fertilizers reduce pH⁵
- Excess nutrients cause algae growth, increasing pH (see phosphates effects - eutrophication)
- Global Warming: excess carbon dioxide reduces pH

CORRELATIONS: Increasing temperature decreases pH

LEVELS:

- Most natural environments: between 4 and 9.
- Seawater: between 7.5 and 8.4.
- Freshwater: between 6.5 and 8.5 is needed to protect most organisms and is the Basin Plan Objective in the North Coast area.

EFFECTS:

- Most aquatic life only survive within a narrow pH range
- May alter other substances to higher toxicity.

Temperature

WHAT: Temperature is a measure of the average energy (kinetic) of water molecules, in Celsius or Fahrenheit. Temperature affects water chemistry and the functions of aquatic organisms.

CAUSES:

Natural Factors

- Sunlight energy; summer and afternoons are naturally warmer
- Velocity of stream
- Depth of water
- Inflow temperature of groundwater and tributaries
- Color and turbidity (suspended sediment absorbs heat).

Human Factors

- Removal of shade canopy vegetation
- changes to stream flow
- Cooling water discharges from industries
- Discharge of cold bottom water from dams

LEVELS:

- North Coast California streams range from close to 0 °C to 30+ °C
- Generally optimum temperature ranges for salmonids range from 4 to 16 °C, depending on the lifecycle and species. Spawning and embryo life stages need cooler water than adult stages. The juvenile and adult upper lethal limit is somewhere around 24 °C, with stress beginning around 15 to 17 °C.
- Basin Plan water quality objective: To support salmon, water should be within 5°F of natural temperature.

EFFECTS:

- Rate of photosynthesis by aquatic plants.
- Metabolic rates of organisms.
- Sensitivity of organisms to toxic wastes, parasites and diseases.
- Timing of reproduction and migration of aquatic organisms.
- pH, DO, and conductivity levels (see quick reference charts).

Turbidity

WHAT: Turbidity is a measure of the amount of suspended particles such as algae, sediment, or organic matter. Turbidity is expressed in Nephelometric Turbidity Units (NTUs). Turbidity is directly proportional to the cloudiness of water. Larger values of NTU mean cloudier. The NTU units

are related to the former Jackson Turbidity Units (JTUs) as they both increase with increasing cloudiness however there is no conversion factor between NTUs and JTUs as the light scattering properties of water were measured in different ways.

What to Expect:

- Low (<5) levels naturally outside of rainy periods.
- Storm events can greatly increase turbidity, into the 100's NTU.
- Summer algae growth can increase turbidity.
- High flows, eroding soil, and heavy storms increase turbidity.

HUMAN FACTORS:

- Nutrient loading (↑ algae).
- Changes in stream patterns, increases in peak flow related to impervious surfaces, logging or conversion of forested lands to agriculture
- Erosion due to lack of vegetation, exposed or disturbed soils surface, erosion of dirt roads, human induced landslides.

LEVELS:

- Recreation: 5 NTU (Nephelometric Turbidity Units)
- Drinking: 0-5 NTU
- General Aquatic Life: under 25 NTU
- Trout (salmonid) waters: under 10 NTU.

EFFECTS:

Overall, excess turbidity reduces light, which decreases plant life. Reduced plant life leads to fewer invertebrates and therefore a fish population decline. The specific effects vary depending on type of particles: sediment, organic matter, or algae.

Suspended Sediment⁶

- Interferes with potable water treatment process.
- May harbor pathogenic bacteria, viruses, and protozoa.
- Clogs fish gills, smothers fish eggs, and clogs spawning gravels.
- Impairs fish navigation and predation.

Organic matter⁶

- Dissolved oxygen depletion
- Increases water temperature
- Imparts color to the water when biodegrading.
- May harbor pathogenic bacteria, viruses, and protozoa.

Stream Flow and Stage

WHAT: Stream flow, or discharge, is the amount of water that moves past a fixed point during a given period of time. Stage is the depth of the stream relative to a given point and often mathematically related to the flow or discharge. Flow is measured as cubic feet per second (cfs) (ft³/sec). It is important because of its impact on water quality, living organisms, and habitats in the stream. Large, swiftly flowing rivers can receive pollution discharges and be little affected, whereas small streams have less capacity to dilute and degrade wastes.

CAUSES:

Natural Factors

- The amount and timing of rainfall or snowfall
- Watershed size and topography (the steepness, location and orientation of sloping areas)
- Geology and soil characteristics
- Shape and size of stream channel and adjacent floodplains
- Level and movement of groundwater
- Logs (LWD) and other debris in the channel
- Vegetation: amount and type in the watershed
- Evaporation and evapotranspiration (water taken up by plants from the ground)

Human Factors

- Pumping of water into or out of the stream
- Impervious surfaces near the stream (roads, sidewalks,...)
- Logging or conversion of forested land to agriculture.
- Wells or groundwater pumping
- Dams, culverts, or other structures
- Litter and debris which clog pipes and culverts

EFFECTS:

- Determines the kinds of organisms living in the stream (some need fast-flowing areas; others need quiet pools)
- High flows (floods) affect the shape and pattern (morphology) of a stream (bars, pools, banks, ...)
- Affects the amount of silt and sediment carried by the stream. Sediment in slow-flowing streams settles more quickly to the bottom than in fast moving streams.

- High stream flow increases dissolved oxygen (DO) levels.
- Related to water temperature.

Nitrate

WHAT⁷:

- Nitrate is the form of nitrogen commonly found in soil and groundwater
- Essential Nutrient for plant and animal growth
- Nitrogen (N) cycles through the environment, moving from organic matter to ammonium (NH_4^+) to nitrite (NO_2^-) to nitrate (NO_3^-) as the nitrogen is oxidized (consuming oxygen). We measure nitrate (NO_3^-) directly and express the result as the amount of nitrogen (N) in nitrate (NO_3^-) or mg/L Nitrate Nitrogen ($\text{NO}_3\text{-N}$). Expressing results as “Nitrogen” makes doing the math in the nitrogen cycles easier.
- Most plants fix (use) nitrate, sometimes giving the water a low $\text{NO}_3\text{-N}$ reading even if there is a large source of nitrogen to the water.

CAUSES⁸:

- Naturally in the soil from decaying plants and animals
- Fertilizers: lawn, garden, crops, parks
- Sewage disposal systems (on-site septic systems and wastewater treatment plants)
- Livestock facilities (animal manure storage)
- Industrial discharges that contain corrosion inhibitors

LEVELS:

- Natural levels of nitrates in surface water are typically low (less than 1 mg/L)
- Maximum Contaminant Level (MCL) for drinking water is 45 mg/L NO_3 or 10 mg/L Nitrate Nitrogen ($\text{NO}_3\text{-N}$).
- For Nitrite Nitrogen ($\text{NO}_2\text{-N}$) the MCL is 1 mg/L.
- Wastewater treatment plants runoff: up to 30 mg/L $\text{NO}_3\text{-N}$ ¹

$$1 \text{ mg/L } \text{NO}_3\text{-N} = 4.4 \text{ mg/L } \text{NO}_3$$

EFFECTS:

- Excess nitrates cause low levels of DO
- Excess nitrates may be toxic to warm-blooded animals (especially pregnant females and infants under 6 months) at concentration of 10 mg/L $\text{NO}_3\text{-N}$ or higher.¹
- Eutrophication: (see phosphate effects)

Phosphate

WHAT⁸:

- Ortho Phosphate (PO_4) is the form of available phosphorus present in soil and groundwater. We measure ortho Phosphate (PO_4) directly and express the result as the amount of phosphorus in PO_4 or mg/L phosphate phosphorus ($\text{PO}_4\text{-P}$)
- Essential Nutrient for plant and animal growth
- Stimulates growth of plankton and aquatic plants, which provide food for larger organisms, including zooplankton, fish, and mammals.

Types of Phosphorous¹:

1. Ortho—produced by natural processes (i.e. Sewage)
 2. Poly—used in treating boiling water and in detergents
(In water they change to Ortho)
 3. Organic—produced in the break down of pesticides
- Amounts of $\text{PO}_4\text{-P}$ will be less than or equal to Total Phosphorus (TP) pending the relation of available to fixed phosphorus in the measured system.

CAUSES⁸:

- Natural decomposition of rocks and minerals
- Partially treated and untreated sewage
- Runoff from agricultural sites
- Application of some lawn fertilizers (which is carried into surface water during storms)
- Laundering and commercial cleaning fluids
- Erosion and sedimentation
- Permitted industrial discharges

LEVELS¹:

Thresholds:

- Not enough = sparse growth of bottom food chain, so little fish production
- Just right = enough plankton and plant growth to provide ample food for fish.
- Too much = growth chokes waterways, decreases DO, and causes eutrophication.

USEPA recommendations for Total Phosphate:

- Streams: under 0.1 mg/L
- Streams emptying into reservoirs: under 0.05 mg/L
- Reservoirs: under 0.025 mg/L

Toxicity:

- Not toxic to humans unless in extremely high concentrations
- Even very low concentrations such as 0.01 mg/L of phosphorus can have a dramatic impact on streams.

EFFECTS⁸:

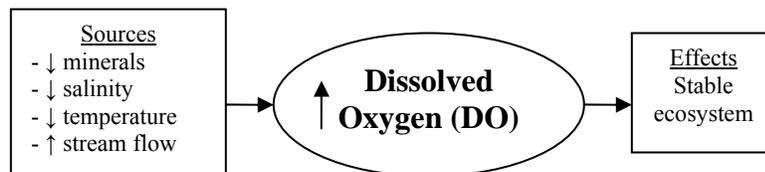
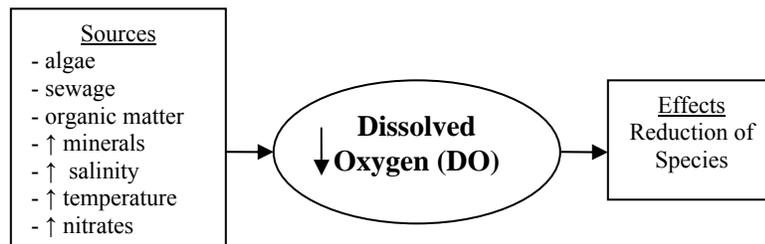
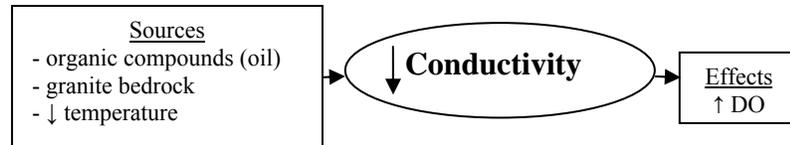
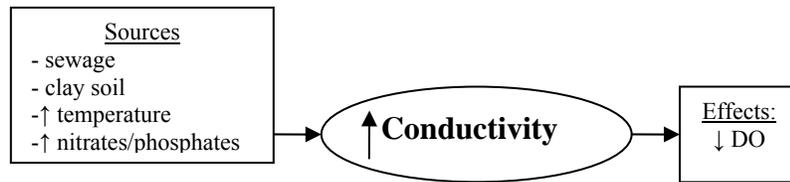
Eutrophication:

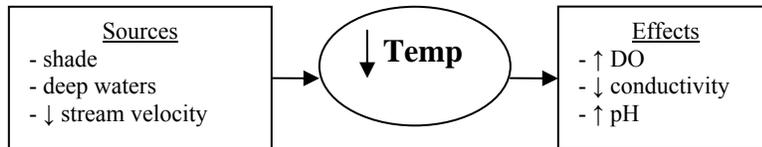
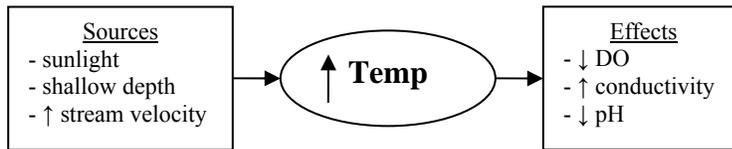
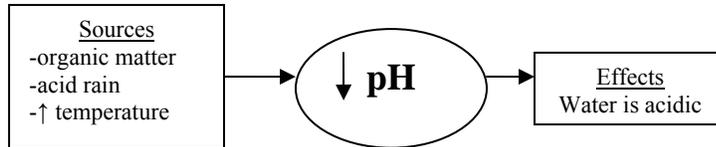
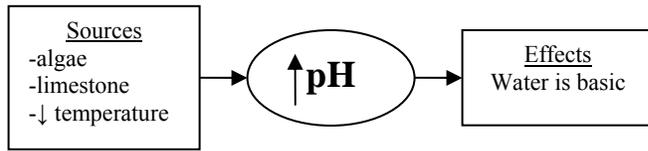
1. Excess nutrients such as nitrate, phosphate, and/or organic waste (usually caused by human activity and development)
 2. Imbalance in the "production versus consumption" of living material (biomass) in an ecosystem
 3. The system then reacts by producing more phytoplankton/vegetation than can be consumed by ecosystem
 4. This overproduction can lead to a variety of problems: decreased dissolved oxygen waters (through decomposition), toxic algal blooms, decreased diversity, reduced food supply, and habitat destruction.
- (Also see quick reference chart)

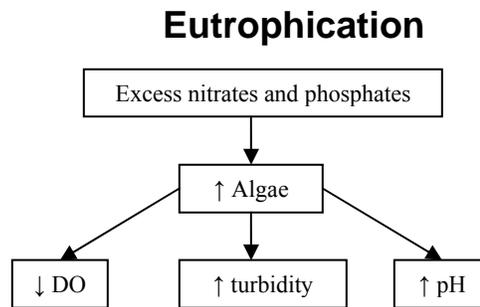
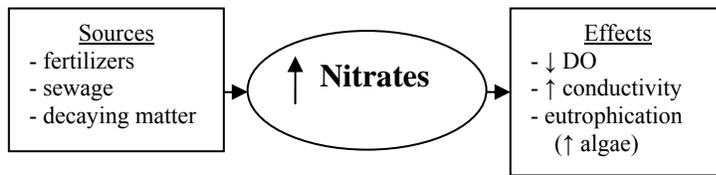
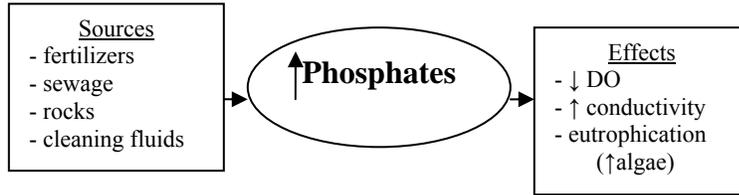
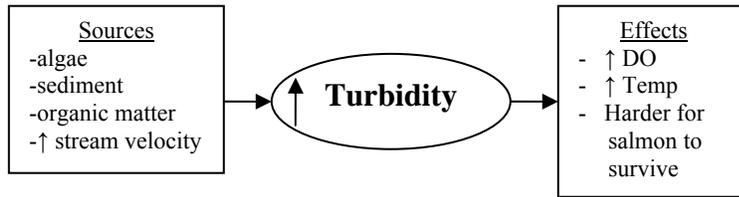


Sarah Shaeffer wading into the Russian River
for a dissolved oxygen reading.

II. Quick Reference Charts







III. How to Perform Testing¹

Collecting Grab Samples

Use the same location each time. In general, sample away from the riverbank in the main current. Never sample stagnant water or backwater eddies. Collection sites should be located in relatively straight channel reaches where the flow is uniform. Collecting samples directly in a ripple or from ponded or sluggish water should be avoided when possible. The outside curve of the stream is often a good place to sample, since the main current tends to hug this bank. In shallow stretches, carefully wade into the center current to collect the sample. Samples collected directly downstream from a bridge can be contaminated from the bridge structure or runoff from the road surface. If your goal is to find effects of structures and pollution, take an upstream and downstream sample at least 50 feet away from the disturbance, as well as one directly at the disturbance site. Should wading be unsafe, a pole sample collector should be used to grab the sample (see photo). Rinse the plastic cup at the end of the pole with the creek water three times before grabbing your final sample. Pour the sample from removable cup into a whirl-pak bag.

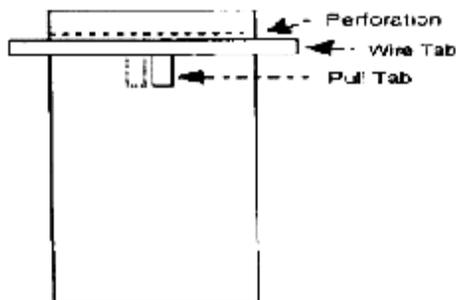


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How to Use Whirl-pak® Bags

John Pendergraft and Annie Mills using a pole sample collector near the confluence of Austin Creek and the Russian River

1. Label the bag with the stream name, site number, date, and time.



Tear off the top of the bag along the perforation above the wire tab just prior to sampling. Avoid touching the inside of the bag. If you accidentally touch the inside of the bag, use another one.

2. *Wading*. Try to disturb as little bottom sediment as possible. In any case, be careful not to collect water that contains bottom

- sediment. Stand facing upstream.
3. *Boat.* Carefully reach over the side and collect the water sample on the upstream side of the boat.
 4. Hold the two white pull tabs in each hand and lower the bag into the water on your upstream side with the opening facing upstream. Open the bag midway between the surface and the bottom by pulling the white pull tabs. The bag should begin to fill with water. You may need to "scoop" water into the bag by drawing it through the water upstream and away from you. Fill the bag no more than 3/4 full.
 5. Lift the bag out of the water. Pour out excess water. Pull on the wire tabs to close the bag. Continue holding the wire tabs and flip the bag over at least 4-5 times quickly to seal the bag. Don't try to squeeze the air out of the top of the bag. Fold the ends of the wire tabs together at the top of the bag, being careful not to puncture the bag. Twist them together, forming a loop.
 6. Fill in the bag number and/or site number on the appropriate field data sheet. It is the only way the lab coordinator knows which bag goes with which site.
 7. If samples are to be analyzed in a lab, place the sample in the cooler with ice or cold packs. Holding time for nutrients is 48 hours, so submit samples to CCWI office as soon as possible.

Measuring Conductivity

– Oakton ECTestr

1. Remove cap and press ON/OFF button.
2. Dip electrode in stream, making sure the sensor is fully covered. Do not submerge the fat end of the meter in the stream. This is where the batteries are housed and the meter can be ruined if water penetrates this end.
3. Wait for reading to stabilize, and record. To freeze display, press HOLD. Pressing HOLD again will release the value.
4. Press ON/OFF to turn off tester. It will automatically turn off after 8.5 minutes to conserve energy.

Trouble-shooting:

Low battery: indicator turns on, or reading display is faint.

Experiencing Drift: let the electrode fully dry.

Improve Performance: Clean electrode in an alcohol rinse for 10-15 minutes.

Measuring Dissolved Oxygen

Hach LDO HQ30d Portable Dissolved Oxygen Meter

Remember, the probe is waterproof, but the meter in the black box is not, so do not immerse it!

Note: Dissolved Oxygen (mg/L) will be the large number on the screen. On the right hand side you will see, from top to bottom, temperature (°C), dissolved oxygen (%), barometric pressure(hPa), the time and the date.

1. Place probe in water, and leave it there for a minute or two to allow temp adjustment..
2. Press the  power button. Gently stir the probe for accurate temperature readings.
3. Once the numbers, (temp and the D.O.), are stabilized you can record the readings.
4. Return a clean probe and meter to the carrying case

Sampling Considerations

Dissolved oxygen will increase in riffles and fast flowing water, and decrease in slow pools. Make sure to test in the main, well mixed part of the channel, either by wading or using an extension pole (this can be as simple as a piece of wood). Depth can also be a variable in oxygen levels, try to place the probe about half way between the surface and bottom of the stream.

NOTE: The meter temperature should be within around one degree of the temperature found on the bulb thermometer. Try leaving the probe in the water a little longer if there is a large discrepancy.

Trouble-shooting:

1. **Temperature:** The small silver button on the body of the probe under the shroud is the thermocouple. Make sure this portion of the probe is submerged when taking your reading. When testing, always check to see if the temperature seems accurate. You may want to check it against another thermometer. When left in the sun, the meter can get very hot, skewing your readings. Keep the meter

in the shade at all times, and wait for the temperature to come down if it has been in the sun. Gently stir the probe for better temperature accuracy. At very low temperatures, the meter takes longer to stabilize. Please be patient.

2. **Batteries:** The screen shows a battery life level in the upper right hand corner.
3. **Unbelievable results:** Water can become super saturated with oxygen. At low temperatures, turbulent water or with excessive algae and plant growth, the oxygen can (rarely) be as high as 16 or more. Anything past 20 mg/L is not possible in a surface stream. Slow, warm water can cause lower oxygen levels. With excess nutrients and decay eutrophication can drop oxygen to 0.0mg/L. If you believe the number you are getting is inaccurate, you can do an accuracy check by testing 100% saturated water. Put some tap water into a cup/bucket or other container. Pour the contents into another container, and then back again, transferring the water at least 10 times. Pour from a foot or so up, to allow lots of air contact and turbulence. Immediately test this water, it should be between 95% and 105% saturation. Always record in the notes section of the data sheet any concerns about the DO meter.

Measuring pH

- Oakton pHTestr 2 Double Junction

1. Remove cap from electrode and press ON/OFF button.
2. Dip electrode ½” to 1” into stream. Stir once and let reading stabilize. Do not submerge the fat end of the meter in the stream. This is where the batteries are housed and the meter can be ruined if water penetrates this end.
3. Note the pH or press HOLD/CON button to freeze the reading. To release the reading, press HOLD/CON again.
4. Press ON/OFF to turn off the tester. It will automatically turn off after 8.5 minutes to conserve energy.

Trouble-shooting:

Error Messages

- ER1: Weak batteries.
- ER2: Wrong or bad buffer value (calibration), or electrode is failing.
- OR: Over Range signal, or electrode is not in contact with water, or electrode is failing.



Mike Sandler testing pH at Monte Rio beach on the Russian River

Measuring Water Temperature

– Thermometer

1. Place the thermometer or meter probe in the water at least 4 inches below the surface or halfway to the bottom if in a shallow stream. Allow enough time for the thermometer to reach a stable temperature (about 3 minutes). If using a meter, allow the temperature reading to stabilize at a constant temperature reading.
2. If possible, try to read the temperature with the thermometer bulb beneath the water surface. If it is not possible, quickly remove the thermometer and read the temperature right away.
3. Record the temperature on the field data sheet.

Measuring Turbidity

– Hach 2100P Turbidimeter

1. Rinse the vial with the stream water three times.
2. Collect sample by inserting the vial upside down into the stream. Slowly turn the vial right-side up towards upstream. This collects a sample from the entire water column, rather than just surface water.
3. Use a lint-free cloth to wipe the outside of the vial. Be sure not to handle the vial below the line where the light will pass when it is placed in the meter. ***Do Not Scratch Tubes!***
4. Turn the meter on by pressing the POWER button.

5. Be sure that the SIG AVG and AUTO RNG functions are showing on the screen. If they are not, turn them on by pressing the respective button on the meter.
6. Shake the sample vigorously and wait until the bubbles have disappeared. You might want to tap the sides gently to accelerate the process.
7. Lift the lid and insert the vial into the space provided. Be sure that the white diamond is facing the screen on the front of the meter. There is a raised tab indicating the correct direction. Close the lid.
8. Press the READ button. A light bulb appears on the screen and the meter begins to take numerous readings, flashing as it goes.
9. Once the screen has stopped flashing and the light bulb disappears, record the final reading on your data sheet.



Beth Robinson teaching a student to use the Turbidimeter at Redwood Creek in Inverness

Measuring

Stream Flow

$$Flow = ALC / T$$

A = Average cross-sectional area of the stream (**stream width multiplied by average water depth**).

L = Length of the stream reach measured (**usually 20 ft.**)

C = A coefficient or correction factor (**0.8 for rocky-bottom streams or 0.9 for muddy-bottom streams**). This allows you to correct for the fact that water at the surface travels faster than near the stream bottom due to resistance from gravel, cobble, etc.

T = Time, in seconds, for the float to travel the length of L

Recommended equipment

- Measuring tape
- Rope and 4 stakes or ground staples
- A timer (stopwatch or digital watch)
- 2-3 floats: an orange or other natural material that sinks at least halfway into the water, is visible from shore, and is expendable and non-polluting--not ping-pong balls or plastic jugs.
- Pencils, paper or printed data sheets (waterproof preferred)
- Waders (for higher flows)
- Calculator (for field calculations to help identify errors on-site)

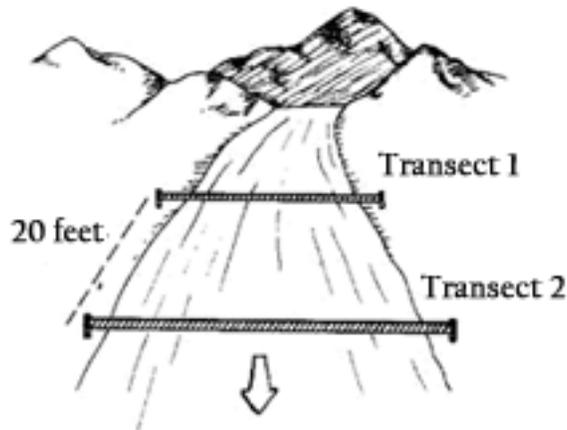
Where to measure

Pick a 20-foot long section of the stream of representative flow, with the following characteristics.

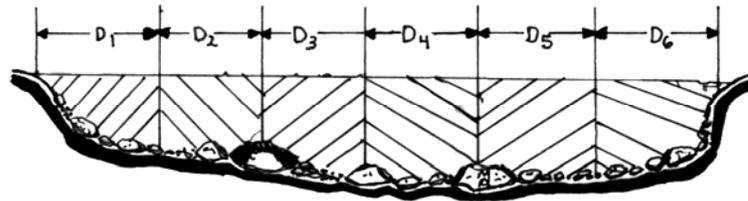
- The section is straight and of uniform width
- The water moves uniformly and smoothly. Backflowing areas or split streams should be avoided.
- The area should be free of scattered boulders, weeds and protruding obstructions, such as logs or bridge piers, that create turbulence.
- The section of the stream should be at least 6 inches deep, but shallow enough for you to safely wade across.

Normally, a good cross-section location is near the outlet of a pool where velocities don't vary drastically across the channel.

Procedures for determining cross-sectional area:



1. To measure the cross sectional area of a stream, place a stake at the wetted edge on each stream bank. Tie a level string line to both stakes running across the stream.
2. Use the tape measure to measure the width of the stream and record.
3. Have one person take the measuring rod to measure the depth of the water at regular intervals across the stream. Use the tape measure to establish these points. To achieve the most precision, take at least 4 depth measurements per cross-section. To determine the interval length, divide the total stream width by the number of measurements. A guideline is measure every 6 inches.
4. Continue to measure at regular intervals until you reach the edge of the water on the opposite side of the stream bank.
5. Add up the depths on the Stream Flow Data Sheet. Then divide



this sum by the total number of depth measurements taken. Next multiply the width of the stream and the average depth. This is the cross sectional area for that section of the stream. Note: Leave the string line attached to the stakes; you will use this as a marker for the velocity measurement.

6. Repeat steps 1-5, 20 feet downstream from where the first cross section was measured. This is where the finishing line for your stream flow velocity trials will take place. Compute the cross sectional area for this section and record. Add the two cross sectional area figures together and divide by two to get an average cross sectional area. Record this information on the Stream Flow Data Sheet.

Procedures for velocity float trial

1. Measure the length of the stream where the velocity float trials are to be conducted and record this information. This distance should ideally be 20 feet, from starting line to finish line.
2. The team member at the starting line drops an orange a little before the line, and starts a stop watch as it passes the line. When the orange passes the finish line the watch is stopped, the orange retrieved, and the time recorded.
3. Repeat this test three times moving from the left to the right side of the stream along the starting line. This will give you a more representative depiction of stream flow along that section of the stream. Record the results each time. Should the float get caught up on an object or take more than 3 minutes, discard the run and try again.
4. Add up the times for each of the velocity float trials and divide by the number of trials (3) to get an average velocity time. Record the results on the Stream Flow Data Sheet.
5. Use the Stream Flow Field Sheet to calculate surface velocity. Divide distance (20 feet) by average velocity time to get average surface velocity in feet per second. Next, multiply this result by the velocity correction factor. The velocity correction factor has been added to adjust for the fact that water velocity at the surface is faster than water velocity closer to the bottom of a stream.
6. Finally, calculate stream flow by multiplying average correction velocity by average cross sectional area. Your result will be in CFS (cubic feet per second). Record this number.

Bacteria Testing

Total coliforms and *E.coli* are two bacteria used as “indicators” of potentially dangerous bacterial water contamination. Coliforms are common in soil and water, and *E. coli* is more specifically associated with human and warm-blooded animal intestinal flora. A high number of indicator bacteria present in water indicates an increased probability of the presence for human or animal fecal waste. Fecal waste carries viruses and bacteria that can cause illness through recreational and municipal uses.

The IDEXX quantitray system is used at CCWI. A 100ml sample is sealed in a sterile plastic tray, and then incubated at 35°C for 24 hours. Most Probable Number (MPN) technique is used to estimate the number of coliform bacteria present, and an ultraviolet light is used to find *E. coli* colonies.

Safety Levels

CA Department of Health Services

Recreational water guidelines

E. coli: 235 MPN per 100ml

Total coliforms: 10,000 MPN per 100ml

Drinking water guidelines

E. coli/ total coliforms: 0 MPN per 100ml

Procedure for Bacteria Field Grab Sample

Use a 100ml sterile plastic vial provided by CCWI; however a whirl-pak may be used as a back up. Wear sterile lab gloves during the procedure. Write the time, date and site ID on the lid with a sharpie. A thumb pressed against the protruding triangular flap on the lid will open the vial. Do not touch the rim or inside lid of the vial. Take sample facing upstream, with vial upside down into the stream. Slowly turn the jar right-side up towards upstream, avoiding capture of the top surface layer.

The water level must be over the 100ml line found on the vial. Flip the lid closed, then push the square flap down until it snaps into place. Place the sample immediately in the cooler with ice packs. The holding time for bacteria samples is 8 hours, so make sure to arrange for samples to be back at the CCWI office within 6 hours to account for processing time.

*The Cycle of P (Phosphorous)*⁹

I put some P into the sea
the biomass did swell

But settling down soon overcame
and P went down toward Hell

From Purgatory soon released
it moved up to the land

To make a perfect rose for thee
to carry in thy hand

But roses wilt and die you know
then P falls on the ground

Gobbled up as ferric P
a nasty brown compound

The world is moral still you know
and Nature's wheels do grind

Put ferric P into the sea
and a rose someday you'll find

Sources

**Unless otherwise documented, the information is from State Water Board fact sheets*

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