Chapter 1

BIOLOGICAL MONITORING

- Biological Monitoring
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Biological monitoring involves identifying and counting macroinvertebrates. The purpose of biological monitoring is to quickly assess both **water quality and habitat**. The abundance and diversity of macroinvertebrates found is an indication of overall stream quality. Macroinvertebrates include aquatic insects, crustaceans, worms, and mollusks that live in various stream habitats and derive their oxygen from water. They are used as indicators of stream quality. These insects and crustaceans are impacted by all the stresses that occur in a stream environment, both man-made and naturally occurring.

Aquatic macroinvertebrates are good indicators of stream quality because:

- They are affected by the physical, chemical and biological conditions of the stream.
- They can't escape pollution and show effects of short- and long-term pollution events.
- They are relatively long lived – the life cycles of some sensitive macroinvertebrates range from one to several years.
- They are an important part of the food web, representing a broad range of trophic levels.
- They are abundant in most streams. Some 1st and 2nd order streams may lack fish, but they generally have macroinvertebrates.
- They are a food source for many recreationally and commercially important fish.
- They are relatively easy to collect and identify with inexpensive materials.

Macroinvertebrates are present during all kinds of stream conditions from drought to floods. Macroinvertebrates are adaptable to extremes of water flow. Some may burrow when it is raining and flow increases. However, heavy rain in areas with a high percentage of impervious surface (most urban areas) can cause flash floods and carry macroinvertebrates downstream.

Populations of macroinvertebrates may differ in North and South Georgia. For example, since the Adopt-A-Stream biological index is based on dissolved oxygen, the "sensitive" organisms that require a lot of oxygen, such as the stonefly, may not be found in warm, slow-moving streams in South Georgia. That does not mean that the stream has bad water quality or habitat, just that streams in North and South Georgia support different populations of macros. If you are monitoring in South or Coastal Georgia, it is important for you to conduct monitoring each season for several years. Doing this will help you recognize biological trends in your stream so that you can determine which changes are natural and which may be induced by human impact.

Populations of macroinvertebrates may vary from headwater streams to the river mouth. For more information, please review "The River Continuum Concept," Chapter 1, *Visual Stream Survey* manual.

Seasonal cycles can also affect the number and kinds of macroinvertebrates collected. Organisms such as immature stoneflies and mayflies will gain weight and size primarily during the fall and winter. During the spring and summer they may reach maturity and begin to metamorphose into their adult (non-aquatic) stage. Therefore, the presence of aquatic macroinvertebrates will tend to be more evident during winter and spring just before metamorphosis. After adults emerge, females lay eggs near or in the water. Soon after, the larvae and nymphs hatch and begin to grow, feeding on leaf litter, detritus and other organic matter that might be present. For more information on macroinvertebrates and their life cycles, please turn to "Some Background On Aquatic Insects" in Index A. If conditions are unsafe for any reason, including high water or slippery rocks, **DO NOT SAMPLE**.

Why Monitor for Macroinvertebrates

The basic principle behind the study of macroinvertebrates is that some species are more sensitive to pollution than others. Therefore, if a stream site is inhabited by organisms that can tolerate pollution, and the pollution-sensitive organisms are missing, a pollution problem is likely.

For example, stonefly nymphs, which are very sensitive to most pollutants, cannot survive if a stream's dissolved oxygen falls below a certain level. If a biosurvey shows that no stoneflies are present in a stream that used to support them, a hypothesis might be that dissolved oxygen has fallen to a point that keeps stoneflies from reproducing or has killed them outright.

This brings up both the advantage and disadvantage of the biosurvey. The advantage of the biosurvey is it tells us very clearly when the stream ecosystem is impaired, or "sick," due to pollution or habitat loss. It is not difficult to realize that a stream full of many kinds of crawling and swimming "critters" is healthier than one without much life. Different macros occupy different ecological niches within the aquatic environment, so diversity of species generally means a healthy, balanced ecosystem. The disadvantage of the biosurvey, on the other hand, is it cannot definitively tell us why certain types of creatures are present or absent.

In this case, the absence of stoneflies might indeed be due to low dissolved oxygen. But is the stream under-oxygenated because it flows too sluggishly, or because pollutants in the stream are damaging water quality by using up the oxygen? The absence of stoneflies might also be due to other pollutants discharged by factories or run off from farmland, water temperatures that are too high, habitat degradation such as excess sand or silt on the stream bottom has ruined stonefly sheltering areas, or other conditions. Thus a biosurvey should be accompanied by an assessment of *habitat and water quality* conditions in order to help explain biosurvey results.

Determining Stream Type and Sampling Location

Find a sampling location in your stream. This location should be within your stream reach, which you should have determined during your visual survey. Sample the same stretch of stream each time, to ensure consistency. Sample every three months, approximately once each season (spring, summer, fall and winter).

Macroinvertebrates can be found in many kinds of habitats—places like riffles (where shallow water flows quickly over rocks), packs of leaves, roots hanging into the water, old wood or logs, or the streambed. Based on the types of habitats that characterize your stream, determine if you have a **muddy bottom or rocky bottom stream.** Follow the directions that correspond with your stream type.

- **Rocky bottom streams** are generally found in North Georgia and the Piedmont Region. However, there are exceptions—some South Georgia streams possess rocky bottom characteristics. Rocky bottom streams are characterized by fast-moving water flowing over and between large rocks and boulders, interspersed with longer, smooth sections where the water forms pools.
- **Muddy bottom streams** include most South Georgia streams and many streams found in urban environments, which have been degraded by the introduction of sediment. In muddy bottom streams the pool/riffle system is replaced by slow moving water with little or no disturbances. The substrate is generally composed of fine silt, sand or coarse gravel.

Equipment List:
- Kick seine or D-frame net
- Sorting pans or white plastic tub
- Tweezers, forceps or plastic spoons
- Pencils and clipboard
- Hand lens
- Biological Count Form
- Adopt-A-Stream Macroinvertebrate Field Guide for Georgia's Streams
- Rubber waders or old tennis shoes
- Rubber gloves
- Trash bag to pick-up litter
- First aid kit

Optional:
- Preservation jars or baby food jars
- Rubbing alcohol, for preservation
- Bucket with screen bottom (for muddy bottom sampling)

**Page 44 provides a list of places to purchase equipment*

**Page 47 provides information on making a kick seine net*

Begin Sampling for: Rocky Bottom Streams

In the “rocky bottom” method, you will sample two different habitats—**riffles** and **leaf packs**. The rocky bottom method requires a minimum of two volunteers; one to hold the kick seine and one to “work” the sample area.

First, identify three different riffle areas. Collect macroinvertebrates in all three riffles with a kick seine, sampling a 2 x 2 foot area (the kick seines are usually 3 x 3 feet). Look for an area where the water is 3 to 12 inches deep. Place the kick seine downstream and firmly wedge the seine into the streambed, weighting the bottom edge with rocks. Gently rub any loose debris off rocks and sticks so that you catch everything in the seine. When you have "washed off" all the rocks in a 2 x 2 foot area, kick the streambed with your feet. Push rocks around; shuffle your feet so that you really kick up the streambed. Now gently lift the seine, being careful not to lose any of the macroinvertebrates you have caught. Take the seine to an area where you can look it over or wash the contents into a bucket.

Now look for decayed (old, dead) packs of leaves next to rocks, logs or on the streambed. Leaf packs may be found throughout your designated stream reach, in the riffle or pool systems. Add 4 handfuls of decayed leaves to your sample. The total area of stream you will sample is 16 square feet.

In summary, collect:

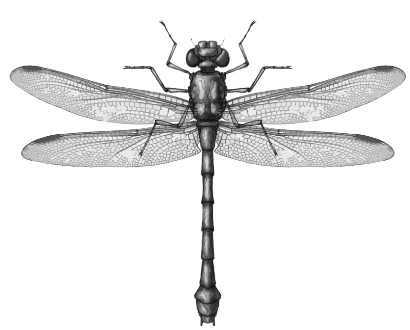
- 3 kick seine samples (4 square feet each) from the riffle area
- 4 handfuls (1 square foot each) of leaf packs

Riffles

Riffle areas constitute shallow areas of a stream or river with a fast-moving current bubbling over rocks. The water in riffle areas is highly oxygenated and provides excellent habitat, shelter, and food for a variety of macroinvertebrates.

Leaf packs

This includes decomposing vegetation (leaves and twigs) that is submerged in the water. Leaf packs serve as a food source for organisms and provide shelter from predators.



Dragon Fly Adult

Begin Sampling for: Muddy Bottom Streams

In this method you will sample three different habitats, using a D-frame (or dip) net. The habitats are **vegetated margins, woody debris with organic matter,** and **sand/rock/gravel streambed** (or substrate). Each scoop involves a quick forward motion of one foot, thus covering a sample area of one square foot. With this method you will sample the stream a total of 14 times or 14 square feet. To maintain consistency, collect the following numbers of scoops from each habitat each time you sample:

- 7 scoops from vegetated margins (1 square foot each)
- 4 scoops from woody debris with organic matter (1 square foot each)
- 3 scoops from sand/rock/gravel or coarsest area of the stream bed (1 square foot each)

Each time you sample you should sweep the mesh bottom of the D-Frame net back and forth through the water (not allowing water to run over the top of the net) to rinse fine silt from the net. This will prevent a large amount of sediment and silt from collecting in the pan and clouding your sample.

As you collect your scoops, place the contents of the net into a bucket. Separate the samples collected from the streambed and vegetated margin or woody debris samples. Keep water in the bucket to keep the organisms alive. Note descriptions below of each muddy bottom habitat and collection tips:

Vegetated margins
This habitat is the area along the bank and the edge of the waterbody consisting of overhanging bank vegetation, plants living along the shoreline, and submerged root mats. Vegetated margins may be home to a diverse assemblage of dragonflies, damselflies, and other organisms. Move the dip-net quickly in a bottom-to-surface motion (scooping towards the stream bank), jabbing at the bank to loosen organisms. Each scoop of the net should cover one foot of submerged (under water) area.

Woody debris with organic matter
Woody debris consists of dead or living trees, roots, limbs, sticks, leaf packs, cypress knees, and other submerged organic matter. It is a very important habitat in slow moving streams and rivers. The wood helps trap organic particles that serve as a food source for the organisms and provides shelter from predators such as fish.

To collect woody debris, approach the area from downstream and hold the net under the section of wood you wish to sample, such as a submerged log. Rub the surface of the log for a total surface area of one square foot. It is also good to dislodge some of the bark as organisms may be hiding underneath. You can also collect sticks, leaf litter, and rub roots attached to submerged logs. Be sure to thoroughly examine any small sticks you collect before discarding them. There may be caddisflies, stoneflies, and midges attached to the bark.

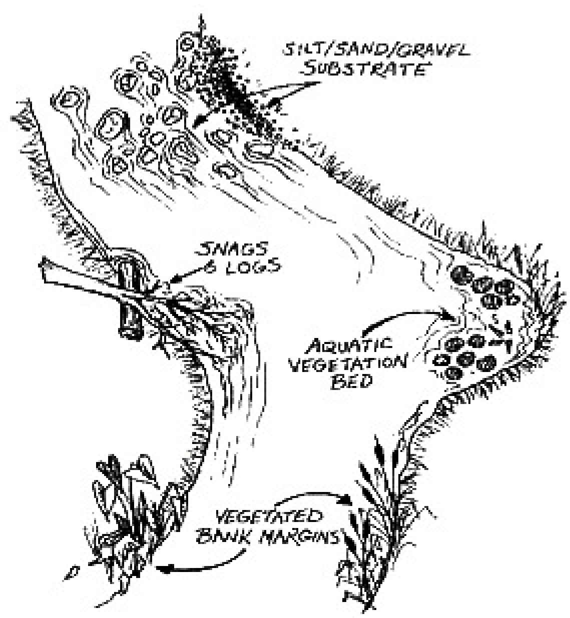
Sand/rock/gravel streambed

In slow moving streams, the substrate is generally composed of only sand or mud because the velocity of the water is not fast enough to transport large rocks. Sample the coarsest area of the streambed—gravel or sand may be all you can find. Sometimes, you may find a gravel bar located at a bend in the river. The streambed can be sampled by moving the net forward (upstream) with a jabbing motion to dislodge the first few inches of gravel, sand, or rocks. You may want to gently wash the gravel in your screen bottom bucket and then discard gravel in the water.

If you have large rocks (greater than two inches in diameter) you should also kick the substrate upstream of the net to dislodge any burrowing organisms. Remember to disturb only one square foot of upstream sample area.

Elutriation

Some substrate samples are composed almost entirely of fine silt and mud. To separate aquatic organisms, place the sample in a bucket with water and stir. Pour off water into the D-frame net and repeat 3 times. Any macroinvertebrates present will separate from the collected mud and be caught in the net. Before dumping remaining substrate, inspect bucket for snails or mollusks. This process is called elutriation.



Calculating Your Results

Place your macroinvertebrates in a white sorting pan or plastic tray. Separate creatures that look similar into groups. Use the Adopt-A-Stream's *Macroinvertebrate Field Guide For Georgia's Streams* (located at the end of the manual) to classify the types and numbers of each kind of insect. As you sort through your collection, remember each stream will have different types and numbers of macroinvertebrates. Calculate the score for your stream using the index on the Macroinvertebrate Count Form found in Chapter 3. Use the table below to interpret your results.

If you find:	**You may have:**
Variety of macroinvertebrates, lots of each kind	Healthy stream
Little variety, with many of each kind	Water enriched with organic matter
A variety of macroinvertebrates, but a few of each kind, or **NO** macroinvertebrates, but the stream appears clean	Toxic pollution
Few macroinvertebrates and the streambed is covered with sediment	Poor habitat from sedimentation

Chapter 2

PHYSICAL/CHEMICAL MONITORING

- Physical/Chemical Monitoring
- Why Are Physical/Chemical Tests Important?
- Temperature
- pH
- Dissolved Oxygen
- Conductivity
- Nutrients
- Nitrates
- Phosphorus
- Alkalinity
- Salinity
- Settleable Solids
- Secchi Disk

Physical/Chemical testing allows information to be gathered about **specific water quality characteristics**. A variety of water quality tests can be run on fresh water – including temperature, dissolved oxygen, pH, settleable solids, water clarity, phosphorus, nitrogen, chlorine, total dissolved solids, fecal coliform levels and many others. Adopt-A-Stream recommends that four core measurements be taken when doing physical/chemical testing – temperature, dissolved oxygen, pH, and conductivity. Phosphorus, nitrogen, and alkalinity may be added to your list as interest and equipment allows. On coastal waters, we suggest testing salinity.

If you choose to conduct chemical testing as an activity, plan on sampling regularly – at least once a month at the same time and the same location. Regular monitoring helps ensure your information can be compared over time. Water quality and environmental conditions can change throughout the day, so monitoring at approximately the same time of day is important. Also, chemical testing during or immediately after a rain may produce very different results than during dry conditions. Therefore, it is very important to record weather conditions. If conditions are unsafe for any reason, including high water or slippery rocks, **DO NOT SAMPLE**.

Equipment List:

- Water testing kit with dissolved oxygen, pH, temperature, and conductivity (may also include phosphate, nitrate, and alkalinity)
- Chemical kit instructions
- Physical/Chemical Data Form
- Safety glasses
- Rubber gloves
- Chemical waste container (old milk jug)
- Bucket with rope (if sampling off a bridge or in deep water)
- Rubber waders or old tennis shoes
- Trash bag to pick-up litter
- First aid kit

A list of places to purchase equipment is located on page 45.

Detailed instructions for each chemical test are found in Appendix A on page 39; however, a few recommendations are listed below.

1. Measure air and water temperature in the shade. Avoid direct sunlight.
2. Rinse glass tubes or containers twice with stream water before running a test.
3. Collect water for tests approximately midstream, one foot below surface. If water is less than one foot deep, collect approximately one-third of the way below surface. Collect samples at stream base flow.
4. Read values on plastic titrators (small syringe with green plunger) on the liquid side of the disc around the plunger tip. If you are using a glass syringes, read values at the plungers tip.
5. Always run two (2) tests for each parameter. If the tests are not within 10% of each other, run another test to ensure accuracy.

Safety Notes: Read all instructions before you begin and note all precautions. Keep all equipment and chemicals out of the reach of small children. In the event of an accident or suspected poisoning, immediately call the Poison Control Center (listed on the inside cover of most telephone books). Avoid contact between chemicals and skin, eyes, nose, or mouth. Wear safety goggles or glasses and rubber gloves when handling chemicals. After use, tightly close all chemical containers. Be careful not to switch caps.

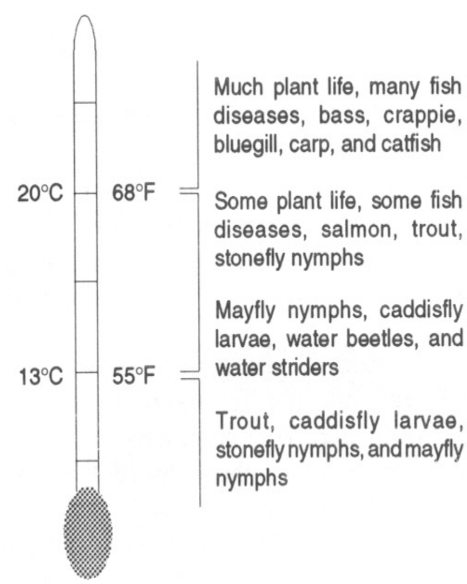
Why Are Physical/Chemical Tests Important?

This section describes some chemical and physical tests you can conduct and why they are important. Physical/Chemical testing should be conducted at least once a month because this type of testing measures the exact sample of water taken, which can vary weekly, daily or even hourly. A basic set of tests includes temperature, dissolved oxygen, pH, and conductivity. Test kits that measure these four parameters will cost approximately $190.00. Replacement chemicals are inexpensive and will be needed after one year. Advanced tests include total alkalinity, ortho-phosphate, conductivity, and nitrate. A test kit that includes both basic and advance tests costs approximately $300.00. Some groups may wish to work with a certified laboratory to sample for fecal coliform bacteria or chlorophyll A.

Further information for evaluating your test results can be found in the *Getting to Know Your Watershed* manual under “Causes and Sources of Water Resource Degradation.”

Temperature

Water temperature is one factor in determining which species may or may not be present in the system. Temperature affects feeding, reproduction, and the metabolism of aquatic animals. A week or two of high temperatures may make a stream unsuitable for sensitive aquatic organisms, even though temperatures are within tolerable levels throughout the rest of the year. Not only do different species have different requirements, optimum habitat temperatures may change for each stage of life. Fish larvae and eggs usually have narrower temperature requirements than adult fish.



Measuring Temperature

A thermometer protected by a plastic or metal case should be used to measure temperature in the field. Record air temperature by placing the dry thermometer in the shade until it stabilizes. Record the temperature of the air before measuring water temperature. To measure water temperature, submerge the thermometer in a sample of water large enough that it will not be affected by the temperature of the thermometer itself, or hold it directly in the stream.

Significant Levels

Temperature preferences among species vary widely, but all species can tolerate slow, seasonal changes better than rapid changes. Thermal stress and shock can occur when water temperatures change more than 1 to 2 degrees Celsius in 24 hours.

Many biological processes are affected by water temperature. Temperature differences between surface and bottom waters help produce the vertical water currents, which move nutrients and oxygen throughout the water column.

What Measured Levels May Indicate

Water temperature may be increased by discharges of water used for cooling purposes (by industrial or utility plants) or by runoff from heated surfaces such as roads, roofs and parking lots. Cold underground water sources, snow melt, and the shade provided by overhanging vegetation can lower water temperatures.

pH

The pH test is one of the most common analyses in water testing. An indication of the sample's acidity, pH is actually a measurement of the activity of hydrogen ions in the sample. pH measurements are on a scale from 0 to 14, with 7.0 considered neutral. Solutions with a pH below 7.0 are considered acids, and those above 7.0 considered bases.

The pH scale is logarithmic, so every one-unit change in pH actually represents a ten-fold change in acidity. In other words, pH 6 is ten times more acidic than pH 7; pH 5 is one hundred times more acidic than pH 7.

Significant Levels

A range of pH 6.5 to pH 8.2 is optimal for most aquatic organisms. Rapidly growing algae or submerged aquatic vegetation remove carbon dioxide (CO_2) from the water during photosynthesis. This can result in a significant increase in pH levels, so the water becomes more basic. Low or high pH can affect egg hatching, kill sources of food for fish and insects, or make water uninhabitable for any aquatic life. In Georgia, Mountain and Piedmont streams will have pH ranges of 6.0 to 8.0. Coastal black water streams will naturally have more acidic conditions, with pH values of 3.5 to 8.5. In other regions of the State, pH readings outside of the acceptable levels may be the result of mine drainage, atmospheric deposition or industrial point discharges.

pH values of some common substances:

pH	
0.5	battery acid
2.0	lemon juice
5.9	rainwater
7.0	distilled water
8.0	salt water
11.2	ammonia
12.9	bleach

Dissolved Oxygen (DO)

Like land organisms, aquatic animals need oxygen to live. Fish, invertebrates, plants, and aerobic bacteria all require oxygen for respiration.

Sources of Dissolved Oxygen
Oxygen dissolves readily into water from the atmosphere at the surface until the water is "saturated". Once dissolved in water, the oxygen diffuses very slowly, and distribution depends on the movement of aerated water by turbulence and currents caused by wind, water flow and thermal upwelling. Aquatic plants, algae and phytoplankton produce oxygen during photosynthesis.

Dissolved Oxygen Capacity of Water
The dissolved oxygen capacity of water is limited by the temperature and salinity of the water and by the atmospheric pressure, which corresponds with altitude. These factors determine the highest amount of oxygen that will dissolve in the water.

Temperature Effect
As water temperature changes, the highest potential dissolved oxygen level changes.

Lower temperature = Higher potential dissolved oxygen level
Higher temperature = Lower potential dissolved oxygen level

- At 0 degrees Celsius the saturation point for dissolved oxygen is 14.6 ppm
- At 32 degrees Celsius the saturation point for dissolved oxygen is 7.6 ppm

The temperature effect is compounded by the fact that living organisms increase their activity in warm water, requiring more oxygen to support their metabolism. Critically low oxygen levels often occur during the warmer summer months when capacity decreases and oxygen demand increases, this is often caused by respiring algae or decaying organic material.

Significant Levels
The amount of oxygen required by an aquatic organism varies according to species and stage of life. DO levels below 3 ppm are stressful to most aquatic organisms. DO levels below 2 or 1 ppm will not support fish; levels of 5 to 6 ppm are usually required for growth and activity. Fish and invertebrates that can move will leave areas with low dissolved oxygen and move to higher level areas.

What Measured Levels May Indicate
A low dissolved oxygen level indicates a demand on the oxygen in the system. Pollutants, including inadequately treated sewage or decaying natural organic material, can cause such a demand. Organic materials accumulate in bottom sediments and support microorganisms (including bacteria), which consume oxygen as they break down the materials. Some wastes and pollutants produce direct

chemical demands on any oxygen in the water. In ponds or impoundments, dense populations of active fish can deplete dissolved oxygen levels. In areas of dense algae, DO levels may drop at night or during cloudy weather due to the net consumption of dissolved oxygen by aquatic plant respiration.

High dissolved oxygen levels can be found where stream turbulence or choppy conditions increase natural aeration by increasing the water surface area and trapping air under cascading water. On sunny days, high dissolved oxygen levels occur in areas of dense algae or submerged aquatic vegetation due to photosynthesis. In these areas, the lowest DO levels occur just before sunrise each morning and highest levels just after noon.

Conductivity

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as conductivity at 25 degrees Celsius (25 C). Conductivity is measured in microsiemens per centimeter (µs/cm).

Conductivity in natural systems is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock such as in North Georgia tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water.

Significant Levels

Distilled water has conductivity in the range of 0.5 to 3 µs/cm. The conductivity of rivers in Georgia generally ranges from 0 to 1500 µs/cm. Studies of inland fresh waters indicate that streams supporting mixed fisheries have a range between 50 and 500 µs/cm. Some North Georgia streams may have natural background levels well below 50 µs/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates. Industrial waters can range as high as 10,000 µs/cm.

What Measured Levels May Indicate

Discharges to streams can change the conductivity depending on their make-up. A failing sewage system would raise the conductivity because of the presence of chloride, phosphate, and nitrate; an oil spill would lower the conductivity. Documented changes in conductivity readings warrant further investigation.

Nutrients

The addition of nitrogen, phosphorus and other nutrients to a body of water may lead to increased plant growth, ultimately resulting in algae blooms. Over time, living and dead plant material builds up and, combined with sediments, fills in lakes and reservoirs. This is a naturally occurring process called **eutrophication**. However, when excess nutrients and sediment are added as a result of human activity, the speed of this natural process is increased significantly.

Eutrophic – a body of water with excess nutrients, sediment and organic matter, which often causes water quality problems.

Plants, especially algae, are very efficient users of nitrogen and phosphorus. By the time an algae bloom is observed, the nutrients may no longer be measurable but may continue to impact the ecosystem. By sampling upstream from areas of algae blooms, the source of excess nutrients may be identified. Algae blooms will usually be found in lakes and reservoirs. If excessive algae are found in streams, the nutrient content is probably very high. The macroinvertebrate population will reflect a high input of nutrients, meaning you may find little variety of macroinvertebrates but many of one or two kinds.

High flow rates in streams may prevent the establishment of floating aquatic plants and algae despite the presence of high levels of nutrients. As the summer progresses and flow rates drop, once rapidly flowing streams can become choked with algae. Wide, slow moving and tidal areas downstream may exhibit algae blooms weeks earlier.

Sources of Nutrients
Nitrogen and phosphorus enter water from human and animal waste, decomposing organic matter and fertilizer runoff. Phosphates are also found in some industrial effluents, detergent wastewater from homes, and natural deposits.

Nitrates

Nitrogen occurs in natural waters as ammonia (NH_3), nitrite (NO_2), nitrate (NO_3), and organically bound nitrogen. Through a process called nitrification, bacteria convert ammonium to nitrites, which are quickly converted into nitrates. Ammonia test results are expressed as “ammonia as nitrogen”. Nitrate test results are expressed as "nitrate nitrogen" (NO_3-N), meaning "nitrogen that was in the form of nitrate." Some test kits and literature express levels only as nitrate (NO_3). Both expressions refer to the same chemical and concentrations, but use different units of measure:

Nitrate Nitrogen ppm x 4.4 = Nitrate ppm

Significant Levels
Unpolluted waters generally have a nitrate-nitrogen level below 1 ppm. Nitrate-nitrogen levels above 10 ppm (44 ppm nitrate) are considered unsafe for drinking water.

What Measured Levels May Indicate
Levels of nitrate-nitrogen above 1 ppm may indicate a sewage overflow. High levels may also indicate the presence of fertilizers and animal waste. High levels of ammonia nitrogen generally indicate a more immediate source of pollutants.

Phosphorus

Phosphorus occurs in natural waters in the form of phosphates, orthophosphates, polyphosphates and organically bound phosphates. Simple phosphate test kits measure reactive phosphorus (primarily orthophosphate), which is the form of phosphate applied as fertilizer to agricultural and residential lands.

Organically bound phosphates in water come from plant and animal matter and wastes. Organically bound phosphates and polyphosphates cannot be measured directly. They must first be broken down and then an orthophosphate test is performed to measure total phosphorus. Results are expressed as phosphate (PO_4).

Significant Levels
Total phosphorus levels higher than 0.03 ppm contribute to increased plant growth (eutrophic conditions), which will lead to oxygen depletion. Total phosphorus levels above 0.1 ppm may stimulate plant growth sufficiently to surpass natural eutrophication rates.

What Measured Levels May Indicate
Levels in excess of 0.1 ppm indicate a potential human source such as industrial soaps, sewage, fertilizers, disturbance of soil, animal waste, or industrial effluent.

Alkalinity

Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the bases found in a sample, including carbonate, bicarbonate, and hydroxide content. The alkalinity, and therefore buffering capacity, of natural waters will vary with local soils.

Significant Levels
The higher the alkalinity, the better the capacity to buffer the fluctuation of pH in water. To protect aquatic life it should be at least 20mg/L.

What Measured Levels May Indicate
Alkalinity levels should not fluctuate much unless a severe industrial problem has occurred upstream.

Salinity

Salinity refers to the concentration of dissolved salts in seawater. More specifically, salinity is the number of grams of dissolved salts in a kilogram of seawater, thus the units of salinity are parts per thousand. The salinity of average ocean water is 35 ppt. Salinity is most commonly determined by using a salinity refractometer, a hand held device that measures the refraction or bending of light passing through a solution to determine the strength or concentration of that solution.

Coastal Conditions
Coastal and inshore waters such as estuaries, tidal rivers and marsh creeks generally have lower salinity values. These inshore areas also have highly variable salinity conditions. As the tide comes in or rises, seawater is pushed further inshore or inland, and the salinity at a particular location might increase within hours. Similarly, as the tide goes out, the seawater moves seaward and thus the salinity might decrease.

Salinity is a very important feature and parameter of coastal aquatic habitats. Not only does salinity affect the biological community, but it also affects the density of the water itself. The resulting water density has an effect on, and may be the cause of water flow and transport (both speed and even direction). In fact, typical inshore water circulation includes less dense, less salty water moving downstream along the surface while denser, saltier water is actually moving inshore/upstream along the bottom.

In coastal aquatic habitats, it is thus very important to know and record the salinity at any monitoring site. Salinity is one of the most basic chemical parameters for characterizing a coastal aquatic habitat.

Estuary Monitoring
Estuaries are partially enclosed bodies of water where seawater and freshwater (e.g. from a river) mix. With variations in river inflow (due to rainfall, melting, freshwater removal for industries, agriculture, etc.) and the constant tidal action moving seawater in and out, estuaries are water bodies of temporally and spatially variable salinity. Organisms that live in estuaries must be able to withstand variable salinity conditions. Adaptations include: escaping/moving to more favorable conditions, closing up until more favorable conditions return, burrowing/digging into the bottom, using internal water balance metabolic processes such as producing more or less urine, drinking more or less water, or spending more energy to conserve or get rid of excess water and salts. Georgia estuarine animals such as oysters, blue crabs, shrimp, and mullet are capable of surviving in and dealing with the variable salinity conditions of coastal rivers, sounds, and salt marshes.

What Measures Measured Levels May Indicate
If high salinity readings are found in upstream rivers and estuaries, which traditionally have lower salinity readings, freshwater flow may be reduced. This in turn will impact the coastal aquatic habitat.

Settleable Solids

The settleable solids test is an easy, quantitative method to measure sediment and other particles found in surface water. An Imhoff cone (a plastic or glass 1 liter cone) is filled with one liter of sample water, stirred, and allowed to settle for 45 minutes. Solids will settle in the bottom of the cone and are then measured as a volume of the total, in millimeters per liter. This measurement is a reproducible analogue for turbidity.

A measurement of settleable solids is not the same as a turbidity reading. Turbidity levels are measured by taking into account all particles suspended in the water column, including small, colloidal sized particles, like clay. A settleable solids test only measures those particles large enough to settle out within a given period of time.

Excessive solids in water block sunlight and clog fish and macroinvertebrate gills. Sediment that settles on the streambed can smother habitat for fish and other aquatic life. Sediment can also carry harmful substances such as bacteria, metals, and excess nutrients.

What Measured Levels May Indicate
Land-disturbing activities contribute to elevated levels of settleable solids in Georgia's streams, rivers, lakes and wetlands. Possible sources include cropland, pasture, livestock operations, forestry activities, construction, roads, and mining operations. Sediment in streams functions much like sandpaper, scouring stream banks, leading to streambank failure, and ultimately causing further erosion.

Secchi Disk

The Secchi disk (pronounced sec'-key) is used to measure the clarity of the water. The disk is named after Pietro Angelo Secchi, a papal scientific adviser and head of the Roman Observatory in the 1860s. Secchi lowered a white plate on a rope into the Mediterranean to determine the depth at which he could no longer see it as a relative measure of water clarity.

Modern Secchi disks are weighted metal disks. The face of the disc is divided into quarters and painted black and white for contrast. The disk is lowered into the water to the point at which the disk can no longer be seen – this depth is then called the Secchi depth. Secchi depths can then be compared to track changes and compare differences in water clarity within and between bodies of water.