

1.1 WATER QUALITY SAMPLING – IMPORTANCE OF PROPER SAMPLE COLLECTION TO ACHIEVE RESULTS

When gathering ambient water quality samples, it is crucial that samples be collected in a consistent and proper manner with the appropriate equipment, so the analytical results or field measurements will reflect the environmental conditions at the time of sampling.

There is the potential during any sampling effort, to inadvertently generate sampling errors. They may be themselves minute in nature. However, several errors can combine into one significant error from any one sample collection. This can lead to poor samples collected, money wasted to test the poor samples, erroneous results generated, and lead to poor conclusions derived.

Inter-relationships of Different Variables

When testing water quality in an ambient sample, there is a wide array of potential assays from which to choose, and many provide the same information. In other situations, in order to fully understand the significance of one variable, it may be necessary to test a variety of variables this can maximize the interpretation of the data. This section will describe several of these variables.

Parameters measured in-situ

Specific variables should be tested in the field, this can be completed by using a hand-held meter or any other additional field technology. Specific variables can also be tested in a laboratory environment with the correct equipment. The purpose of the apparent duplication is that there is potential for the sample to change state during transport from the field to the laboratory.

The *sample temperature* should be collected immediately from a standalone sample, no other variables should be tested from this sample. *Dissolved oxygen* concentrations may be tested by either an appropriate DO meter or by using the laboratory process, the Winkler titration. *pH* and *specific conductivity* should be measured in the field to capture any sample change during transportation to the laboratory. *Turbidity* is frequently measured in the field; this can be achieved through a continuous process throughout the sampling period.

Parameters measured in laboratories

Laboratories can provide additional testing methods for samples. This allows several types of parameters to be analyzed in a sample. Generally, the analysis includes what are deemed as conventional parameters (pH, specific conductivity, hardness, and turbidity), solids (total, suspended, dissolved, inorganic, and organic), nutrients (such as different forms of nitrogen, phosphorus, and carbon), metals (measured as total, dissolved, or extractable), pesticides, and more complex organic compounds such as PCBs, PAHs, dioxins and furans, and many others. For a detailed description of standard analytical methods for these parameters see Eaton *et al.* (2005).

Variable (s)	Second Variable (s)	Relationship
Specific Conductivity (SC)	Dissolved Solids (TDS)	SC and TDS are usually related for each water body. TDS is the sum of constituents such as chloride, sulphate, etc.
Turbidity	Suspended Solids (TSS)	Turbidity can be related to the amount of solids in suspension
Temperature	Dissolved Oxygen	The amount of oxygen in water increases with cooler temperatures.
pH and Temperature	Ammonia	The toxicity of ammonia in water increases with higher pH and temperatures
Secchi Disc Reading	Turbidity, colour, algae	Measures light penetration in a lake that is reduced by these three factors
Chloride	Nitrite	The toxicity of nitrite in water decreases with increased chloride
Hardness	Alkalinity	Alkalinity and hardness often have similar concentrations in water
Hardness, Dissolved Organic Carbon (DOC)	Metals	The toxicity of some metals (e.g., copper, zinc) decreases with increasing hardness and DOC

Table 1 – Summary of inter-relationships of some key variables

As mentioned, variables such as *pH*, *specific conductivity*, and *turbidity* should be measured in the field and again upon receipt in the laboratory, this will determine whether the sample has changed during transport. It is usual for the laboratory to measure the *temperature of a sample upon arrival*. Temperature is an excellent indicator to identify if the samples have been shipped correctly (i.e. with enough ice for ambient air conditions). Samples collected during the winter months will naturally be at a lower temperature to start and generally will not require the same amount of packaging as samples collected during summer months. Care should be taken when packaging samples in winter months in ensuring that the sample containers do not freeze and rupture, in turn destroying the integrity of the sample. In cases where temperatures are expected to be below freezing, collapsible jugs of warm water should be added to the packaging in order to prevent samples from freezing and possibly breaking in transport. This is particularly important when samples are shipped as cargo by bus or plane.

Sample hold times

Each parameter has a specific hold time that ensures the results generated are accurate. If this maximum time frame (i.e. hours or days) has passed, the data generated through sample analysis should not be used since its accuracy cannot be confirmed. Some variables must be analyzed within 48 or 72 hours from the time of collection (referred to as holding time) It is essential that samples be shipped to the laboratory as soon as possible. It is important to avoid a lengthy time

delay before laboratory analysis. It may be necessary to ship the sample on the same day as collection to preserve the variables. It is the responsibility of the sampler to determine which variables are time sensitive and ensure the hold times are met. When shipping samples, aim to maintain the shipment temperature between 10°C and 4°C, temperature ranges may require adjustment with specific sample parameters. Temperature control for shipping during warmer months can be through ice packs placed in the coolers. During winter months care (i.e. heat packs) should be taken to prevent freezing of the samples.

Description of key variables

It should be noted that *specific conductivity* is often used as a surrogate measurement for *dissolved solids*. The actual relationship between these two variables will be site specific and based on the water body. Both specific conductivity and dissolved solids provide a measure of the contribution of different salts that may be present in the sample; this may include *potassium*, *sodium*, *chloride*, *sulphate* and others.

Turbidity is a measure of the light penetration in the sample. The turbidity of the sample depends on the size and distribution of the suspended solids in a sample. Turbidity and specific conductivity can provide estimates of the amounts of suspended or dissolved solids that may be present, however they can not be used as absolute replacement measurements for the more specific test. For sites with sufficient enough data, it is possible to identify a significant site specific relationship between turbidity and total suspended solids. The relationship should be reviewed overtime as the water body changes. Understanding the connection between turbidity and total suspended solids is important. If turbidity is a known variable and TSS is unknown, one can calculate the existence of the TSS using the turbidity levels.

Other tests require accompanying measures of other variables. When *metals* are measured, interpreting the results sometimes requires knowledge of the *hardness* and/or the *organic carbon* concentration in the sample. The toxicity of some metals is reduced with increasing hardness or organic carbon concentrations.

To interpret the impact that *ammonia* might have in a water body, knowledge of the *pH* and *temperature* is also necessary. The toxicity of ammonia decreases at lower temperatures and pH values, therefore these variables must be measured and recorded. Similarly, the impact of *nitrite* is ameliorated at higher concentrations of *chloride*.