Intermittently Open Estuaries

Physical and Chemical Monitoring

1. Physical and Chemical Parameters

Why do we monitor temperature, salinity, electro-conductivity and dissolved oxygen?

Estuaries are dynamic systems. The ratio of freshwater to saltwater is dependent on tide, freshwater flows, season and how recently the mouth of the estuary has opened. These factors determine how the physical and chemical parameters of an estuary change with depth, known as the depth profile. The depth profile of an estuary can change dramatically from its upper reaches to where it meets the sea.

At up to six representative monitoring sites within the estuary (as outlined in your relevant monitoring plan), four water quality parameters are measured at multiple depths within the estuary: temperature, salinity, electro-conductivity and dissolved oxygen. Two water quality parameters are also recorded at the top and bottom depths within the estuary: pH and turbidity.

By regularly monitoring the physical and chemical components of the water within the estuary, EstuaryWatch monitors can develop a dataset that indicates what processes may be occurring in a particular estuary at different times of year. Conducting regular physical-chemical monitoring will also help us to understand the natural variations that take place over time in and around an estuary. Once natural variations are understood, changes in water quality due to human impacts can easily be detected. Capturing the physical and chemical changes in an estuary will tell us what kind of environment the estuary provides for the animals that visit it. It will also go some way to explaining the habitat types found within the estuary. More information on specific parameters is included in the following sections.

Temperature

The temperature of a waterbody directly affects many physical, biological and chemical characteristics. Temperature changes can occur naturally as part of normal daily and seasonal cycles, or as a consequence of human activities. For example, loss of riparian vegetation can lead to temperature increases in streams and estuaries.

Accurate measurement of temperature is important for:

- determining the range of temperatures that estuarine plants and animals experience
- understanding hydrodynamic processes of an estuary
- accurately recording salinity and dissolved oxygen.

The temperature of an estuary can vary depending on air temperature, time of day, water depth and the relative influences of fresh and salt water in any given time or place.

Expected Results

Temperature is measured in degrees Celsius. There are currently no guidelines for acceptable temperature levels in estuaries as there is insufficient data to establish a guideline. By gathering temperature information through EstuaryWatch we will be able to build up some reference data. This will enable us to develop an understanding of temperature fluctuations within estuaries.

Electrical Conductivity and Salinity

Electrical conductivity (EC) is a measurement of a water sample's ability to pass an electrical current. Conductivity is greatly influenced by the presence of dissolved salts and hence it is commonly converted into a measurement of salinity. Patterns of salinity distribution are a crucial part of estuaries, which are defined as places where fresh and salt water mix.

Salinity is very important to aquatic plants and animals, which are adapted to live in particular ranges of salinity. Salinity patterns in estuaries depend on factors such as the size and shape of an estuary, how much fresh and salt water is entering and leaving an estuary and wind. Salinity is measured as the amount of dissolved salts that are in a water sample. It is measured in parts per thousand (ppt). EC is most commonly measured in microSiemens per centimetre (μS/cm) or milliSiemens per centimetre (mS/cm). 1mS/cm is equal to 1000μS/cm.

In estuaries, salinity largely depends on the interaction between marine and freshwater inflows. Thus, the salinity range may vary greatly between 35ppt when the tide is high to less than 5ppt when the tides is low and there is minimal freshwater inflow. Salinity is normally highest at the mouth and decreases gradually as the water moves upstream to the freshwater reaches. However, in some estuaries when freshwater flows are low, or non-existent, evaporation in the mid reaches of an estuary can cause water to become even more saline than seawater (hypersaline) by as much as 60%. It can also be common for a layer of fresh water to be 'floating' on top of a layer of salt water. This is termed 'stratification'. The boundary between the two layers (known as the halocline) may be sharp, occurring over a small depth range, or may be blurry, over a larger depth range. At times, waters in the estuaries may also mix, leading to an essentially homogeneous water body. The occurrence and timing of these patterns determines what plants and animals are able to use the estuary.

The meters used for EstuaryWatch do not directly measure salinity. They measure the electrical conductivity of the water sample. The electrical conductivity is automatically temperature-corrected by the meter to result in a number that compares electrical conductivity of the sample to an international standard 'seawater' sample to determine the salinity. An increase in salts and/or temperature in turn increases the electrical conductivity. The meter then converts this EC measure to salinity in parts per thousand (ppt).

Expected Results

Each estuary has a relatively consistent range of electrical conductivity and salinity values, which once known can act as baseline data against which to compare regular measurements of these variables (see Table 1).

Table 1. Expected electrical conductivity and salinity results

Parameter	Units Measured	Expected Range	Results to note
Salinity	Parts Per Thousand (ppt)	5 to 38	<5 freshwater >38 the estuary is hypersaline.
Electro-conductivity (EC)	MilliSiemens per centimetre (mS/cm)	0 to ~54	Freshwater 0 -1.99 >54 the estuary is hypersaline

Dissolved Oxygen

Dissolved oxygen is essential for a healthy and diverse water body. It enters estuarine waters by mixing in from air at the surface and from estuarine plants photosynthesizing during the day.

Dissolved oxygen is used by animals and most microbes and by plants during the night. Without enough dissolved oxygen, estuarine animals will die or move elsewhere. Examples of this have been seen in fish death events throughout western Victoria. At times it is possible for the fresh water layer in a stratified estuary to 'blanket' the salt water layer. If this occurs for long enough animals and microbes living in the lower waters and sediments can use all the oxygen in the bottom layer. At such times there is a particularly high risk of a fish death event after the sudden draining of the surface layer, such as after an artificial mouth opening. During algal blooms it is common to observe very high levels of dissolved oxygen during the day, followed by low levels through the night.

Dissolved oxygen can be recorded in two ways. The first, mg/L represents the number of milligrams of oxygen per litre of water. Most animals and plants can grow and reproduce unimpaired when dissolved oxygen levels exceed 5mg/L. When levels drop to 3-5mg/L living organisms become stressed.

The second way of recording dissolved oxygen is as percent saturation and is more biologically relevant than mg/L. Percent saturation refers to the highest dissolved oxygen concentration possible in a water sample under the limits of temperature, salinity and atmospheric pressure. As salinity increases, the amount of oxygen that water can hold decreases substantially. For example, at 20°C, 100% dissolved oxygen saturation for freshwater is 9.09mg/L. At the same temperature, 100% saturation for sea water is 7.34mg/L.

Measurements of percent saturation of dissolved oxygen will typically range from 0% to 100%, but can exceed 100% at times when large amounts of oxygen are being produced by plants and algae. When levels greatly exceed 100% saturation this can indicate an unhealthy imbalance in the estuarine system and potentially an algal bloom. Most animals and plants can grow and reproduce unimpaired when dissolved oxygen levels exceed 80%. When levels drop to less than 80% living organisms can become stressed.

Percentage saturation values should be used for estuaries because the solubility of oxygen is affected by both the temperature and the salinity of the water.

Table 2. Expected dissolved oxygen results

Parameter	Units Measured	Expected Range	Results to note
Dissolved Oxygen	% saturation	70 -110% (surface sample) and 15 -110% (bottom sample)*	<80% not optimal >110% not optimal
Dissolved Oxygen	mg/L	5mg/L and greater	5mg/L not optimal

* Environment Protection Authority Victoria 2011

pH

pH measures how acidic or alkaline a sample is. pH has been identified as an important parameter in estuaries, particularly for those with acidic freshwater inflows. Monitoring of pH along with depth profiling will provide information to help assess the potential influences of pH.

In estuarine systems the pH can range from around 8.2 in seawater and 6.5-8.0 in freshwater. The pH can also vary with the time of day due to photosynthetic activity of plants affecting the levels of carbon dioxide (CO_2) in an estuarine system (CO_2 forms a weak acid in water called carbonic acid). High rainfall events will tend to reduce the pH as the pH of fresh rainwater is around 5.5 and there is also an increased likelihood of runoff from acid sulphate soils in sensitive systems.

Changes in pH have direct and indirect effects on aquatic organisms and bacterial processes. For example, extremes of pH can cause damage to the gills, skin and eyes of fish along with increased vulnerability to infections (e.g. red spot disease). A low pH level can also increase the biological availability of metals and their toxicity (e.g. aluminium).

Expected Results

pH values can vary significantly depending on acidic influences on the estuary as outlined above. Regular sampling of an estuary will help determine what is an expected consistent range of pH for a particular estuary (see Table 3).

Table 3. Expected pH results

Parameter	Units Measured	Surface Sample	Bottom Sample
pH	pH Units	7 - 8	7 - 8

(Environment Protection Authority Victoria 2011)

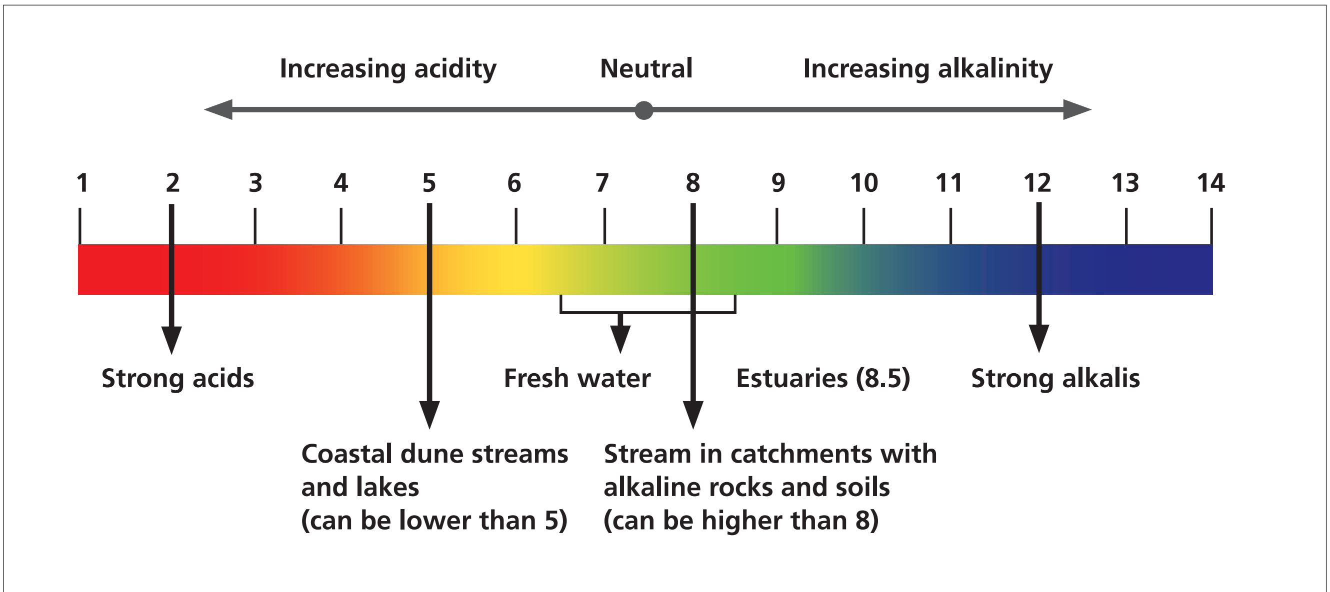

Figure 1. pH scale Source: Department of Environment and Resources, Waterwatch Queensland, 2007 (amended).

Turbidity

Turbidity is an indirect measure of the suspended solids in the water. As the amount of suspended solids in the water increases, the turbidity increases, i.e. the depth that light can penetrate is reduced.

The suspended solids may consist of sediments or of plankton, including both algae (phytoplankton) and tiny animals (zooplankton). Turbidity is affected by numerous factors including rainfall and catchment run-off, soil erosion, riparian vegetation, salinity, tidal flow, stormwater and algal growth. Most of the sediment in estuaries comes from catchment, river, stream-bed and bank erosion. Sediment entering upstream waterways is a natural process, but human land use can result in excessive quantities entering these waterways. Agriculture, forestry activities and housing developments can all lead to extensive soil disturbance, erosion and sediment runoff to estuaries. Unsealed roads can also contribute substantial quantities of sediment. Carp, an introduced pest fish species, can increase the mobilisation of sediment in the catchment due to its habit of digging around in stream sediments and dislodging macrophytes, resulting in unstable stream beds.

Unnaturally high turbidity can be an indication that the amount of light reaching plants on the bottom of the estuary is limited. It can also be a sign of high sediment loads that can stress filter-feeding animals like pipis and other shellfish.

Apart from making the water look muddy, unnaturally high levels of turbidity can have other negative effects. The reduced light reaching the estuary floor can affect plant growth, and has been recorded as reducing the extent and range depth of seagrass beds. Fine particles can clog the gills of fish, or hinder their ability to spot prey. Nutrients, heavy metals and other pollutants can attach themselves to the fine particles, resulting in increased nutrient and pollutant levels.

Large variations in estuary turbidity levels can occur depending on chemical, physical and biological factors. Therefore interpreting turbidity readings requires measurements to be made over a long period of time to determine the natural turbidity in your estuary.

Table 4. Expected turbidity results

Parameter	Units Measured	Surface Sample	Bottom Sample
Turbidity	Nephelometric Turbidity Units (NTUs)	5	7

(Environment Protection Authority Victoria 2011)

2. Methods

Every time you undertake physical-chemical monitoring you must record what estuary you are monitoring at and the following details:

Sampled by

This is where you record the names of all the people undertaking monitoring.

Site

- There are set physical/chemical monitoring sites within the estuary that are representative of the entire estuary. Refer to the monitoring plan for your estuary (found at Appendix A) of study to ascertain which monitoring site you are taking your recordings at. Testing is to take place at each of these sites.
- If possible, data recordings are to be taken in the deepest part of the estuary at each monitoring site.

Maximum Depth

To measure the maximum depth of the water, lower the nylon rope with dive weight attached found in your EstuaryWatch Field Monitoring Kit. Coloured electrical tape marks every 50cm interval on the nylon rope. Be sure to measure the depth from the surface of the water, not from the bridge or boat you are on. If you will be using an extension pole/remote sampler to take depth profiling measurements (see the Depth profiling section) you should also use the extension pole/remote sampler to extend the nylon rope out from the bank of an estuary or from a jetty over the water. This will enable you to sample deeper water away from the bank. This does not always have to be used if safety is compromised.

Date and time

This is where you record the date and the time when you started monitoring at the physical-chemical site.

EstuaryWatch Physico-chemical Data Sheet - YSI
Sampled by:

CORANGAMITE CMA HEALTHY CATCHMENTS · HEALTHY WATERWAYS
EstuaryWatch

Estuary: **Site:** **Max Depth:** **Date:** **Time:**

Last membrane replacement: (please indicate the meter, date and time recorded on your membrane replacement record sheet in the space below).
Meter: Date: Time:

Calibrations required: (i.e. for DO or Salinity) **Yes / No**

- **If you selected yes in the above section please indicate Which calibrations you performed (please circle): DO / Salinity**

Calibrations recorded on calibration record sheet: Yes / No / N/A

Data Entered:	Yes / No
Date of Entry:	/ /
Data Entered By:	
Observation Id on database:	
Approved by Team leader:	Yes / No
Approved by Coordinator:	Yes / No

Depth Profiling

Depth (m)	Temp (^oC)	D.O. (% sat)	D.O. (mg/L)	EC (mS/cm)	Salinity (ppt)	Notes
0.10						
0.50						
1.00						
1.50						
2.00						
2.50						
3.00						
3.50						
4.00						
*						

* - sample at 10cm above bottom

Freshwater inflow (circle most appropriate)	**Dry**	**Pool**	**Slow**	**Med**	**Fast**

Top and Bottom Sample (indicate bottom depth if different to max depth)

Top Turbidity (10cm): **Bottom Turbidity:**
Top pH (10cm): **Bottom pH:** **www.estuarywatch.com.au**

Figure 2. An EstuaryWatch Physico-chemical Data Sheet (a copy can be found at Appendix C).

Notes

This is where you record anything general which may be of interest in relation to estuarine health. General observations should be recorded in the Notes section of the datasheet as part of each estuary mouth condition assessment and during each physico-chemical monitoring session. These general observations are recorded to provide clues about how an estuary is functioning and can assist managers in better understanding local estuary processes.

General observations are indeed, just that - generally anything relevant to estuary monitoring. Some examples of the types of information you may record in the notes section are listed below, but anything you believe is relevant can be recorded.

If you have nothing of interest to record you may leave the notes section blank.

Table 5. Examples of information to the included in the Notes Section.

Fauna & Flora	Dead fish/birdlife, whale sightings, unusually high mosquito count, presence and colour of algae
Equipment	Unusual equipment behaviour, damage or testing equipment in short supply
Vegetation	Changes to vegetation type or extent
Stratification	Visible stratification of salt/fresh water layers
Odour	Unusual odour presence or possible sources
Litter	Presence, quantity and type
Safety	Observe any new OH&S risks, incidents, near misses.

Physical and Chemical Monitoring

Depth Profiling

Dissolved oxygen, temperature, electrical conductivity and salinity are all physical and chemical components of estuarine water quality. EstuaryWatch records these parameters through depth profiling. Depth profiling refers to obtaining information on the variation of water quality with depth below the surface.

1. Methods

Location and Timing

Equipment

- multi-parameter meter (Hach, YSI Model 85 or YSI Pro2030). This meter measures for temperature, EC, salinity and dissolved oxygen. The handheld meter is attached to a cable/s on the end of which is a probe. The cables/s range from 5 to 15 metres in length which allows the probe/s to be lowered to a certain depth at which measurements can be taken. Intervals of 0.5m are marked with electrical tape on each of the cables
- distilled water to rinse the probe after measurements have been taken
- extension pole. This is to be used to extend the meter probe out from the bank of an estuary or from a jetty over the water. This will enable you to sample deeper water away from the bank (see Figure 1). This does not always have to be used if safety is compromised
- clipboard and EstuaryWatch physico-chemical data sheet.

Procedure

- Measure oxygen, electrical conductivity, salinity and temperature at depths outlined on the physico-chemical data sheet.
- Record details on data sheet.

Figure 1. Using the remote sampler to extend the YSI Model 85 meter cable and probe out over the estuary to reach deeper water when sampling

Techniques used

1. Calibrate multi-parameter meter if required. See the mulit-parameter meter set-up and calibration section for calibration methods.
2. Travel to monitoring site as outlined in your monitoring plan.
3. Lower the probe/s of the multi-parameter meter into the water to a selected depth. Take your first measurement at the surface of the water (ensuring the probe is immersed) and record in the corresponding 0.10m depth line on the EstuaryWatch data sheet, then take readings at 0.50m, 1.00m, then 1.50m and so on in 50cm intervals. For the last reading at the bottom, to ensure you do not touch the probe on the bottom of the estuary, keep the probe raised 10cm above the bottom (using the maximum depth recording to calculate this) and record the depth in the last row on the datasheet.

4. If a Van Dorn Remote Sampler is being used for top and bottom sampling (see Top Bottom Sampling Section for more information), the bottom depth readings are to be taken with the probe attached to the Van Dorn. This can only be done with YSI brand meters, not the Hach HQ40d. Before the Van Dorn Sampler is set, attach the probe of the multi-parameter meter to the clamp on the side of the Van Dorn Sampler. Take the bottom physico-chemical readings once the Van Dorn has been lowered to the bottom of the estuary and before the Van Dorn has been activated to collect water.
5. Allow appropriate time for readings to stabilize at each depth. Try not to disturb sediments on the bottom of the estuary.
6. When you have finished measuring rinse the meter in distilled water and store meter appropriately.

2. Taking data measurements

Depending on the multi-parameter meter you are using, you will need to use different techniques to take data measurements. Techniques specific to each type of multi-parameter meter used for EstuaryWatch are outlined below.

Figure 2. The YSI Model 85, YSI Pro2030 and Hach HQ40d meters being used for sampling physico/chemical water quality parameters in estuarine waters.

YSI Model 85 meter

There are three parameters measured by the YSI Model 85 meter. Temperature is always shown on the bottom right hand corner of the screen. Press the 'mode' button and the YSI scrolls through a series of: dissolved oxygen (%sat), dissolved oxygen (mg/L), actual conductivity (ms or µS), specific conductance (ms or µS) (conductivity temperature corrected to that at 25°C) and salinity (ppt) (see p. 17 of the YSI manual).

For each depth (0.1m, 0.5m,1.0m,1.5m, 2.0m etc.), scroll slowly through all 5 parameters that are required to complete the green physico-chemical data sheet, ensuring that each value has stabilised before recording it. If a recording does not stabilise, but fluctuates by a few decimal places (or by ~3%), record the average reading.

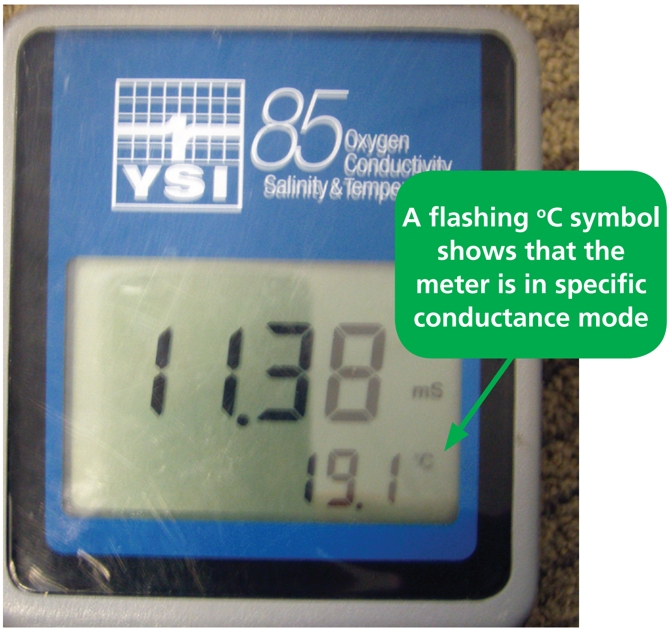

Figure 3. The YSI Model 85 Meter display screen. Note that when the °C is flashing this shows that the meter is in specific conductance mode.

Dissolved oxygen measurement

The YSI Dissolved Oxygen probe is an electrochemical probe that consumes the oxygen as it measures it. If the probe is kept still in the water column the oxygen levels will start to drop as oxygen is consumed. This happens within a few seconds. To get an accurate reading, water must be flowing past the probe. Therefore gently 'bouncing' the probe in the water at about once or twice a second is required to get a stable reading. The 'bouncing' should continue until the reading has been taken. This method will usually achieve a stable reading within about 10 seconds.

Electrical conductivity measurement

When taking electrical conductivity (EC) readings with the YSI meter you must ensure that the mode you select is "specific conductance", not the actual conductance. To do this, ensure that the °C symbol next to the temperature reading is flashing. This indicates that the meter is in "specific conductance" mode. An easy way to remember this is that if the °C is NOT flashing then it's NOT the setting to use. We use specific conductance (conductivity temperature corrected to that at 25°C) as this enables us to more easily make comparisons between the conductivity of different monitoring events independent of what temperature the water was on that day. When measuring surface samples, ensure the probe is completely submerged with the two holes near the top of the probe under water.

YSI Pro2030 meter

In order to take measurements with the YSI Pro2030 the probe must be removed from the calibration/travel sleeve and you should also ensure that the sensor guard is on.

Once the meter is turned on, a monitoring display automatically comes up on the screen. This display lists all the parameters you will need to record for each site. The units of measure are displayed beside each number helping you to determine which parameter is which.

For each depth (0.1m, 0.5m,1.0m,1.5m, 2.0m etc.) wait approximately 10 seconds for the readings to stabilise. Record all five parameters that are required to complete the green physico-chemical data sheet, ensuring that each value has stabilised before recording it. If a recording does not stabilise, but fluctuates by a few decimal places (or by ~3%), record the average reading.

Dissolved oxygen measurement

The dissolved oxygen sensor in the YSI Pro2030 Probe is dependent on water movement past the sensor for accurate measurements. This required movement can be achieved by the combination of the natural movement of water in the estuary and by always moving the probe through the water by gently 'bouncing' the probe at about once or twice a second. Once the 'DO mg/L' and 'DO %' values displayed on the screen stabilise you should record the values. The 'bouncing' should continue until the reading has been taken.

Electrical conductivity measurement

When measuring surface samples, ensure the probe is completely submerged with the two holes near the top of the probe under water, these are the sensors used for EC measurements. The 'spc' next to ms/cm on the monitoring display screen refers to specific conductance which is what EstuaryWatch uses to measure electrical conductivity (conductivity temperature corrected to that at 25°C). We use specific conductance (conductivity temperature corrected to that at 25°C) as this enables us to more easily make comparisons between the conductivity of different monitoring events independent of what temperature the water was on that day.

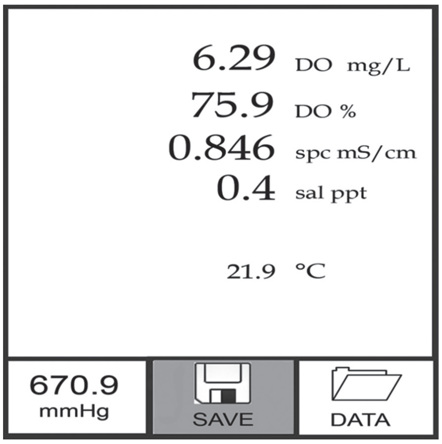

Figure 4. An example YSI Pro2030 monitoring screen display. Source: YSI Pro2030 Manual, 2010.

Hach HQ40d meter

When you are using the dissolved oxygen probe (called the LDO probe) and the conductivity probe, the Hach HQ40d meter provides you with 4 water quality parameter readings: temperature, dissolved oxygen (%sat), dissolved oxygen (mg/L) and specific conductance (*m*s or µS) (conductivity temperature corrected to that at 25°C). Ensure the meter is in dual screen display mode by pressing the up or down arrow.

For each depth, press the green button denoted 'read' and wait for the lock symbol to appear next to dissolved oxygen (mg/l) and specific conductivity readings (*m*s or µS) to show that all the values have stabilised before recording them on the data sheet. If a recording does not stabilise, but fluctuates by a few decimal places (or by ~3%) after a few minutes, record the average reading. You'll find that each probe will provide a temperature reading. Average these two values and record it on your physico-chemical data sheet.

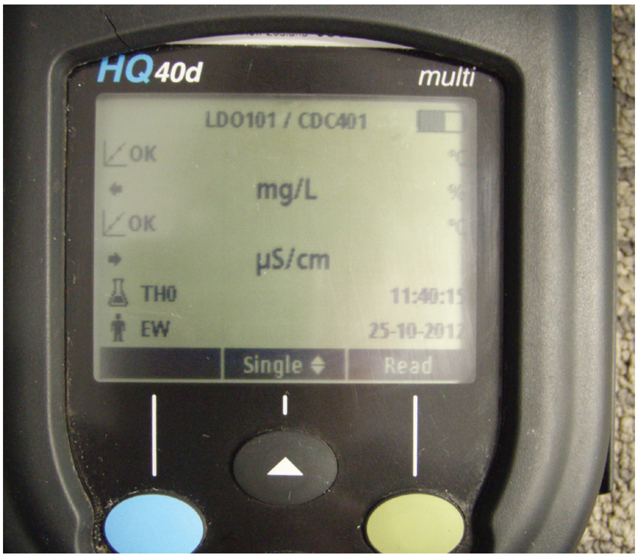

Figure 5. Hach HQ40d in dual screen mode for taking measurements.

Top-Bottom Sampling

Two further measures of water quality are part of the physical-chemical core monitoring program: pH and turbidity. These parameters are measured in water samples taken from the top and bottom of the water body at each monitoring site. The top sample is taken 10cm below the water surface and the bottom sample is taken approximately 10cm above the bottom.

Sample Collection Techniques

EstuaryWatch Top-Bottom sampling is done through collection of a water sample which is brought to the surface and then measurements are taken. This is different to depth profiling where measurements are taken in-situ. There are two methods of collecting the water samples. Dependant on the monitoring site, estuary conditions and your particular skills, you can either use a remote sampling pole or a Van Dorn sampler for Top-Bottom Sampling. Your EstuaryWatch Coordinator will provide guidance on what sampler is to be used.

Using a remote sampling pole to collect a water sample:

1. Place the water sampling bottle in the holder located at the end of the remote sampler pole.
2. Place the remote sampler into the water with the open end of the bottle facing down, at the required depth below the surface rotate the bottle to the side, bubbles of air will appear at the surface.
3. Once the bubbles finish appearing, turn the bottle to ensure the open end is facing up. Wait a few moments to allow the bottle to completely fill and then raise it to the surface with the open end facing up.
4. Pour the water sample collected into the plastic jug and take pH and turbidity measurements as outlined in Methods.

Figure 1. Remote Sampler being lowered down to collect a bottom sample

Using the Van Dorn Bottle to collect a water sample

1. Attach the YSI multi-parameter meter probe to the clamp on the side of the Van Dorn. (This cannot be done with the Hach meter).
2. Open each end of the Van Dorn Bottle and secure the release cables to the central trigger mechanism.
3. Ensure that sufficient rope has been unwound and is untangled. Ensure that the 'messenger' weight is secure at the opposite end of the rope.
4. Lower the Van Dorn Bottle to the required depth below the water's surface, either 10cm above the bottom or 10cm below the surface.
5. Record readings from the YSI meter as outlined in the Depth profiling section. Ensure you bounce the probe cable for oxygen measurements.
6. If it is a bottom sample, wait approximately 1 minute to ensure that any disturbed sediments have time to settle.
7. Ensure the rope is tight and close to directly above the bottle, then cast the 'messenger' weight down the rope. The delivery is successful if bubbles rise to the surface.
8. Once the end caps are closed and the bubbles have ceased to rise bring the bottle to the surface.
9. Open one of the end caps and pour the sample water collected into the plastic jug. If it is a bottom sample, let the water settle in the jug. This will help exclude any bottom sediment accidentally collected compromising measurements.
10. Take pH and turbidity readings as outlined in Methods on pages 3 & 4.

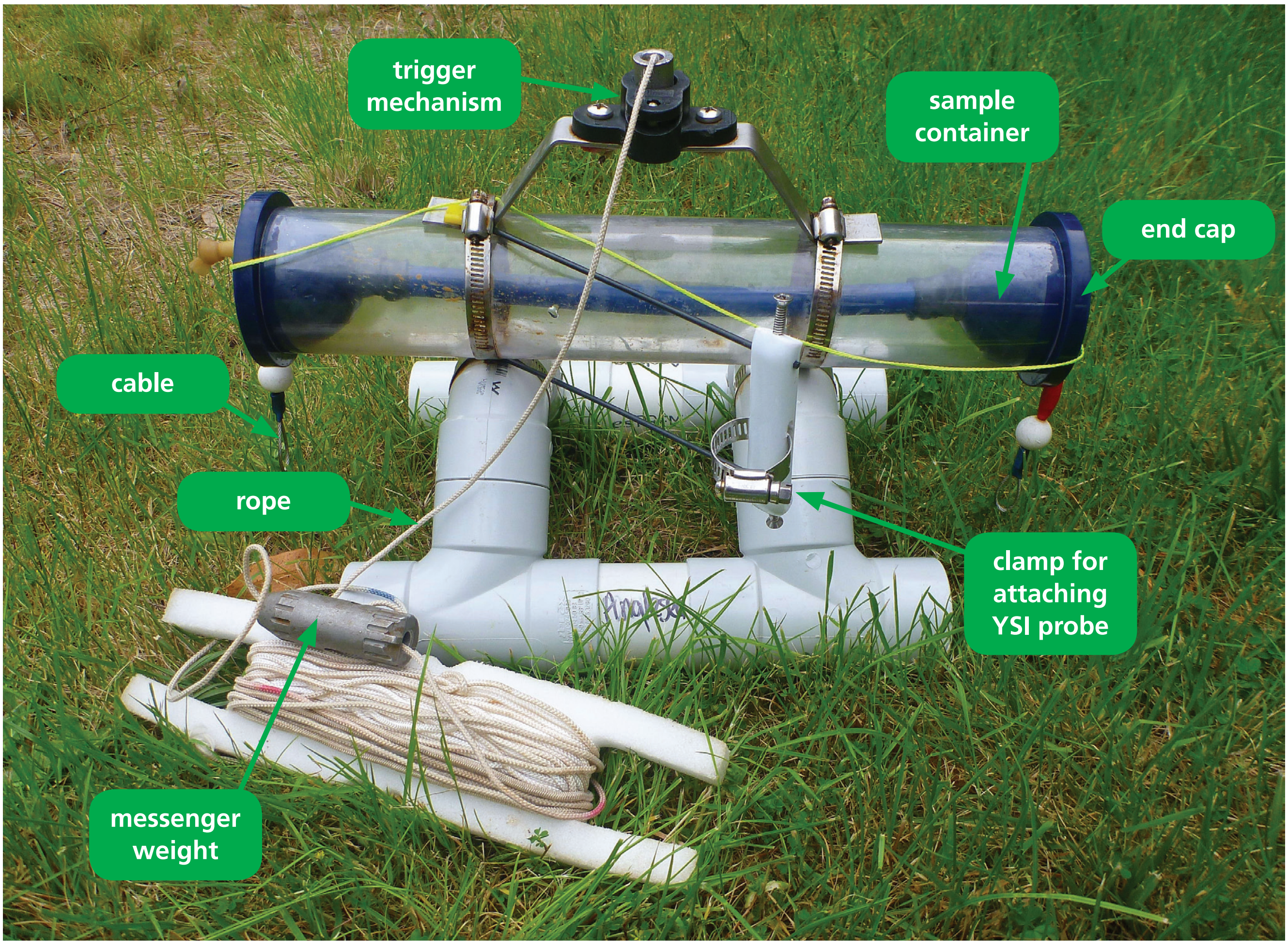

Figure 2. A Van Dorn Water Sampler.

Figure 3. Lowering a Van Dorn sampler off a bridge on the Anglesea Estuary.

Top-Bottom parameters: pH & Turbidity

Methods

Location and Timing

At set monitoring sites within the estuary as outlined in the monitoring plan for your estuary.

Equipment

- EstuaryWatch Physico-chemical data sheet and clip board
- PCS Testr35 pH Meter
- turbidity tube
- remote sampler pole and bottle or Van Dorn Bottle;
- one Litre jug
- distilled water
- tissues.

Procedure

1. Calibrate pH meter if required. See multi-parameter meter set-up and calibration section for more details.
2. Collect a sample of water from 10 cm below the surface using methods outlined above. Pour the sample into the 1L jug.
3. Place the sensor end of the pH meter into the jug of water. Take pH measurement as outlined below and then rinse pH meter with distilled water, shake off excess water and then pat dry with tissues.
4. Fill the turbidity tube to the top with water from the jug and take reading as outlined below.
5. Collect a sample from 10 cm above the bottom, pour into jug and take pH measurement.
6. Rinse the pH probe in distilled or tap water, shake off excess water, pat dry with tissues and store with sensor cap on.
7. Pour water from jug into turbidity tube and take turbidity reading as outlined below.
8. If necessary, rinse turbidity tube in tap water before storing.

Taking pH measurements

The PCS Testr35 pH Meter provides measurements for electrical conductivity and pH. EstuaryWatch only uses this meter for the pH recordings.

When taking measurements, simply place the sensor electrode in the water sample to be tested (do not submerge the rest of the meter including the display) and ensure the meter is in ‘Meas’ mode which will be displayed at the top of the screen and that the primary value has pH displayed next to it. While it takes a short while for the pH reading to stabilize, the meter will reach 95% response in around a second. You do not need to press any buttons, simply view the reading on the screen.

Do not touch the glass bulb with your fingers as any electrostatic charges may affect the response. Rinse electrodes with distilled water before and after measuring a sample. You should never wipe the electrode to remove excess water - wiping can create static charges that interfere with correct pH measurement. Instead, give the meter a quick shake to remove any excess distilled water.

Figure 4. Taking a reading with the PCS Testr35 pH meter. Note only the sensor electrode section of the meter is immersed in the water.

Figure 5. Taking a reading from a turbidity tube. Note sun at the monitor's back.

Taking turbidity measurements

1. Assemble the two parts of the turbidity tube together.
2. Fill the turbidity tube to the top with water from the jug.
3. Stand with your back to the sun and the turbidity tube at arm's length and at right angles to the ground (vertically). This ensures the light reaching the tube is even. Look down through the tube to see whether the three wiggly lines at the bottom of the tube are visible and distinct from each other;.
4. Gradually pour water out of the turbidity tube stopping regularly to look down through the tube. Stop pouring water out when the wiggly black lines become barely visible.
5. Note the N.T.U. reading on the tube. The turbidity tube has a logarithmic scale running down the outside of the tube, therefore, you will need to estimate based on this scale. If you fill the tube to the top and the lines are still visible, the reading is taken as <10.

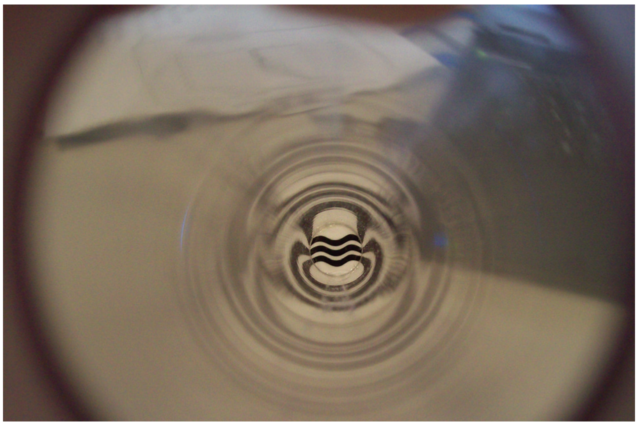

Figure 6. View looking down a turbidity tube to see the three wiggly lines at the bottom. Source: Unidentified.