GOVERNMENT OF
WESTERN AUSTRALIA

Understanding Water Quality on the Swan Coastal Plain

WHAT DO THE NUMBERS MEAN?

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This booklet is a
Swan-Canning Cleanup Program initiative

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1.1 Using this Booklet

Testing water quality is a complex task made up of different aspects. Determining whether the water you are monitoring is healthy or not can be confusing.

This booklet is directed at people who know how to measure some indicators of water quality, but need clarification on what their results actually mean. It is a general guide only. If you are interested in further details, please contact any of the people listed at the end of this publication.

1.2 Collecting the Data

If you are just starting out, remember it is necessary to get at least six readings, taken at regular monthly intervals, to characterise your waterway and establish what is ‘normal’there.

1.3 Parameters: Explaining the Results

Water quality is determined by a variety of parameters. Often these are interrelated, and many vary seasonally. Measurements for pH, temperature difference, conductivity, turbidity and phosphorus are important indicators of water quality. These are the parameters that catchment groups are encouraged to investigate. The next section briefly describes each of these parameters, and the significance of their values.

pH A Measure of Acidity

The acidity or alkalinity of waterways is measured by a pH scale from zero to 14. A pH less than seven indicates the water is acidic; seven is neutral, and above seven is alkaline or basic. For example, orange juice has a pH of about 4.4; distilled water is approximately 7; and household bleach is about 13.2.

The natural pH of waterways varies from one location to another. This is because the value depends heavily on the soil and rocks over which the water moves. Soils with a lot of limestone have a higher pH value, while those with no limestone and a lot of humus impart a lower pH.
Table 1 (page 4) shows classifications of results through limestone rich areas and limestone free areas. As a rough guide, drinking water should range from 6.8 to 8.5.

Temperature Difference

There are natural variations in temperature both seasonally and spatially across the river system. Thus, the important parameter to measure is temperature difference. Measuring temperature difference usually involves taking the water temperature upstream and downstream of a particular feature, possibly a pipe outlet. If there is a significant difference downstream in the measurements, there is likely to be an adverse influence from the feature. Long-term temperature difference can be calculated for a single location, but care must be taken to allow for seasonal variations.
Table 2 (page 5) classifies temperature difference results.

TABLE 1: pH CLASSIFICATIONS

Range		Status	Suggested Action	Example Situation
No Limestone	Limestone			
5.0 - 7.0	7.0 - 8.5	Normal	none	forested catchment
8.5 - 9.0 or 4.0 - 5.0		May be polluted	monitor carefully; research land uses in the catchment	urban catchment with moderate pollution
< 4 or > 9		Polluted	take action: contact relevant local and state bodies; take samples for laboratory analysis; search for sources of pollution	urban catchment with heavy pollution

Source: *Adapted from Ribbons of Blue Manual*

Table 2: Temperature Difference Classifications (°C) between test points within one site

Range (°C)	Status	Suggested Action	Example Situation
0 - 2	Clean	none	forested catchment
2 - 15	Moderate	monitor carefully; maintain regular data updates; research land uses in the catchment	downstream from discharge from the bottom of a large dam
> 15	High	take action; contact relevant local and state bodies; help to coordinate a reduction in pollution	downstream from factory cooling water outlet

Source: adapted from Ribbons of Blue Manual

Conductivity

Conductivity is a measure of dissolved salts. Common salt, sodium chloride, is the main cause of our water salinity problems. Since dissolved salts conduct a charge estimates of salinity can be derived directly from electrical conductivity.

Note that in an estuarine environment, the closer you get to the sea, the more likely it is that your water will be naturally influenced by sea water intrusion. It is important to find the natural salinity of your test area.

There are many units of measurement that express salinity. The international unit is milli Siemens per centimetre (mS/cm). Conversions between salinity units are displayed in Appendix One (page 13).

An explanation of abbreviations is placed in Appendix Two (page 14). Conductivity results can be classified according to Table 3 (page 7).

Turbidity

Suspended sediments in waterways may include silt and clay, organic and inorganic matter, and living or dead microscopic organisms. Suspended sediments can be measured as turbidity.

Turbidity is a measure of light passing through the waterbody, and is usually measured with a turbidity tube using NTUs (Nephelometric Turbidity Units). NTUs do not correlate exactly to sediment load, but a good rule of thumb is: 1 mg/L = 1.5 NTU of suspended sediments.

Aclassification of turbidity values is shown in Table 4 (page 8). Naturally occurring suspended sediments will be low in summer or extended dry periods. They will peak after storms or other events that affect runoff and stream flow velocity.

Table 3: Conductivity Classification (mS/cm) for Fresh Water

Range (mS/cm)	Status	Suggested Action	Example Situation
0 - 0.80	Fresh	none	forested catchment; eg. Canning River just below the dam
0.80 - 2.50	Brackish (moderate)	monitor carefully; maintain regular data updates	water discharge from the Darling Scarp; eg. Ellen Brook
2.50 - 5.00	Brackish (high)	take action; search for sources of pollution; discuss management possibilities with your community	stream water in agricultural/industrial catchments; eg. Wooroloo Brook
> 5.00	Salty	take urgent action; contact relevant local and State government bodies; take samples for laboratory analysis	water collected from a saline seep, or a stream in a severely affected agricultural area; eg. Avon River

Source: adapted from Ribbons of Blue Manual

Table 4: Turbidity Classifications (NTU)

Range (NTU)	Status	Suggested Action	Example Situation
> 15	Clean	none	stable banks and soils, and low flow conditions – intact waterway
15 - 25	Low	monitor carefully; maintain regular data updates	after a moderate disturbing event in a largely stable catchment
25 - 30	Moderate	take action; research land uses in the catchment; discuss management options with your community	after an intense rainfall in a largely stable catchment
30 - 45	High	take action; contact relevant local and state government bodies; trace sources of erosion	downstream from a degraded locality eg. a farm paddock or building site
> 45	Very high	take urgent action; take samples for laboratory analysis; help to coordinate reduction in erosion	eroding waterway banks within an eroding catchment

Source: Wes Eberhood, Stephen Wong (Swan River Trust) and Environmental Water Quality (AgWA)

PHOSPHORUS

Phosphorus is an essential element required by both plants and animals. Most waterways contain phosphorus in small concentrations of about 0.01 mg/Lto 0.05 mg/L.

Particulate and dissolved phosphates make up Total Phosphorus. Particulate phosphate is bound to soil particles travelling within the waterway.

Dissolved phosphate (or 'filterable reactive phosphate') is the fraction of total phosphorus that is free in water. If you have a Palin or La Motte Test Kit (from Ribbons of Blue), this is what you will be testing. Filterable reactive phosphate results are classified in Table 5 (page 10).

Note that the given concentrations apply to flowing water only. In still water, like dams and lakes, the concentrations producing equivalent nutrient enrichment may be approximately half of these values.

High levels of phosphorus in waterways may be associated with peak flows following rain events and "first flush" (the initial large flows of winter). The importance of first flush phosphorus readings is described in Catching the Slug, a booklet available from the Water and Rivers Commission.

Table 5: Filterable Reactive phosphate (dissolved phosphate) Classifications (mg/L)

Range (mg/L)	Status	Example Situations
< 0.01	Low	Jane Brook
0.01 - 0.2	Moderate	Blackadder Creek, Canning River above Kent St Weir
0.2 - 0.5	Elevated	Bannister Creek, Belmont Main Drain, Bennett Brook, Susannah Brook
0.5 - 1.0	High	Avon River, Bayswater Main Drain, Yule Brook, Claisebrook, Helena River
1.0 - 2.0	Very High	Mills Street Main Drain, Southern River
> 2.0	Extreme	Ellen Brook

Source: personal communication, K. Donohue, Water and Rivers Commission; Wes Horwood, Swan River Trust

1.4 Summary

Table 6 (fresh water only)

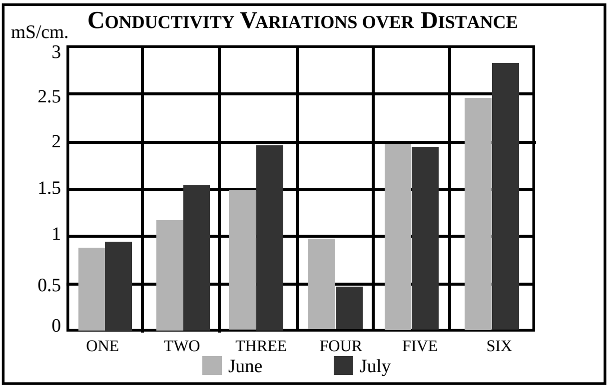
Parameter	Clean	Moderate	High	Critical variation
pH	5.0 - 8.5	8.5 - 9.0 or 4.0 - 5.0	< 4 or > 9	0.2pH units
Conductivity mS/cm	< 0.8	0.8 - 5.0	> 5.0	-
Turbidity NTU	< 10	10 ≤ 30	> 30	10% increase in mean conc.
Dissolved Phosphate mg/L	< 0.01	0.01 - 0.5	> 0.5	-
Temperature difference °c	0 - 2	2 - 15	> 15	2° increase

1.5 What to do with your Results

One of the most effective things to do with your data is to graph them. A graph can show changes in your results at a glance. Three factors can be incorporated into different graphs: time, space and the variable that was tested (for example, phosphorus).

Important combinations are:

- Space vs. variables: Graph the results for each parameter against distance along the river, or compare different sites according to any of the parameters.
- Time vs. variables: Graph last year's results for each measurement and compare with this year's results, or look for seasonal patterns over a single year.
- Variables vs. variable: Look for relationships between different measurements.



The graphs can have more than two axes, and can be as complex or as simple as you like. Other options include scatter graphs and pie graphs.

1.6 Conclusion

Remember that the best tools to use when testing water quality are your understanding and your common sense. You can end a session by asking yourself: "Do the results seem reasonable?" Genuine anomalies do occur, but if your results are illogical, it is wise to redo the test.

Salinity Units and Conversions

Salinity	Conversion Factor		Salinity	Conversion Factor		Salinity
electrical conductivity (mS/cm)	x550	=	total soluble salts (mg/L)	÷550	=	electrical conductivity (mS/cm)
electrical conductivity (mS/cm)	x38.5	=	total soluble salts (gr/gal)	÷38.5	=	electrical conductivity (mS/cm)
electrical conductivity (mS/cm)	x1000	=	electrical conductivity (µmhos/cm)	÷1000	=	electrical conductivity (mS/cm)
electrical conductivity (mS/cm)	x1000	=	electrical conductivity (µS/cm)	÷1000	=	electrical conductivity (mS/cm)
electrical conductivity (mS/cm)	x100	=	electrical conductivity (mS/m)	÷100	=	electrical conductivity (mS/cm)
total soluble salts (mg/L)	÷1	=	total soluble salts (ppm)	x1	=	total soluble salts (mg/L)
total soluble salts (mg/L)	÷100	=	total soluble salts (ppt)	x100	=	total soluble salts (mg/L)
total soluble salts (mg/L)	÷14.25	=	total soluble salts (gr/gal)	x14.25	=	total soluble salts (mg/L)

[illegible]

Appendix Two

Unit Abbreviation

mS/cm	milli Siemens per centimetre
µS/cm	micro Siemens per centimetre
mS/m	milli Siemens per metre
mg/L	milligrams per Litre
gr/gal	grains per gallon
µmhos/cm	micro mhos per centimetre
ppm	parts per million
ppt	parts per thousand

Further Reading

Australian Water Quality Guidelines for Fresh and Marine Waters.
Australian and New Zealand Environment and Conservation Council, 1992.

Catching the Slug.
Office of Catchment Management, 1992.

Environmental Awareness to Action.
Ribbons of Blue, 1994.

Environmental Water Quality.
Agriculture WA, 1996.

Estimates of Nutrients Streamload in the Swan-Canning Catchment.
Swan River Trust Report No. 20, 1994.

Rivercare Directory.
Swan River Trust, 1996.

Starting a Waterwatch Group.
Australian Nature Conservation Agency, 1994.

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