Howqua River

WATER MONITORING REPORT 1995 -2007

A monitoring program is important as:

- An educational tool that introduces water quality issues to the general community;
- A means of gathering base datasets to allow useful discussion of issues and provide some direction for future works;
- A method of assessing the value of works completed.

This project is funded by the Australian Government through the National Action Plan for Salinity & Water Quality and the Community Stream Sampling Project

Front Page: **Howqua River upstream of Running Creek Campground – looking downstream 17th January 2007**

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Introduction

Waterwatch is a community water quality monitoring program that assists the community in monitoring their local waterway. The Program aims to:

- Increase community awareness and understanding of water quality issues;
- Increase community involvement in water management decisions; and,
- Generate useful data for community and agency use which complements that collected by Agency monitoring networks.

Monitoring networks across the Goulburn Broken Catchment have been formed to study water quality in their local areas. The networks are able to test a local stream for a range of parameters using equipment supplied by the Waterwatch Program. The parameters selected for testing in each area depend upon the water quality issues identified by the monitoring network. Monitors also record the date, time and rainfall to assist in the interpretation of the data.

The Howqua River has been monitored regularly since 1994. More intensive monitoring was initiated in 2001 after some community concern over the water quality in the lower Howqua River. Interest from Parks Victoria has resulted in a monitoring program in the Upper Howqua River since 2002. Additional monitoring has occurred over the 2007 year to monitor the water quality since the fires that swept through the area in early 2007.

A total of ten sites are now regularly tested for a range of chemical and biological parameters.

This report contains the following information:

1. A Monitoring Plan of the network
2. Information about water quality parameters
3. Graphical representation of the overall medians of each parameter along the length of the waterway
4. A tabular summary of data collected at all sites year by year. This table includes historical data collected by Waterwatch dating back to 1995
5. Comparisons of local water quality data with State Environment Protection Policy (SEPP) guidelines
6. Macro-invertebrate sampling conducted over the period of water monitoring
7. Raw data from 2006 to 2007.

There are many reasons why people are prepared to become involved in a water monitoring program. **In fact, there are as many different reasons as there are people participating in a program!**

The challenge for Waterwatch as a community monitoring program is to help monitoring networks gather the information that **they** want. In the process, the data collected can be extremely valuable to waterway management agencies that are committed to improving the condition of our rivers and streams.

Definitions	
Median	Middle number in a series
Mean	Average calculated by adding all data points and dividing by the number of data points

Data Representation

Water quality data in this report is represented and interpreted using a number of methods of presentation:

1. Individual data points (see Appendix C).
   Individual monitoring results are arranged in tabular form according to site and date.

2. Overall median where the median is calculated using all data collected at the site during the monitoring project.
   This gives an overall indication of water quality at that site during the monitoring program. The overall median is compared to a Waterwatch rating scale.

3. Annual median where a median is calculated year by year
   This shows the changes or trend in water quality over time.

4. Comparison of annual medians in the Howqua River with the SEPP guideline for water.
   The SEPP objectives identify the 'ideal' result range for environmental data at a particular location in a waterway.

HOWQUA RIVER

Monitoring Plan

Monitoring plans help Waterwatch monitors to collect accurate and precise data, interpret and report on data and to use time and resources efficiently.

Howqua River Monitoring Program

1. Why are we monitoring?

- *To investigate the effects on water quality of human activities along the Lower Howqua River*
- *To gauge the impact on water quality in the Howqua River from human activities on Mt Buller*
- *To measure the impact of recreational areas such as Running Creek campground on Howqua River.*
- *To understand the ecology of the Howqua River.*
- *To determine any hots spots for bacterial contamination in the Howqua River.*
- *To provide general water quality information.*

2. Who might be interested in using the data?

- *Parks Victoria, GBCMA, DSE, Local Shire, VicRoads.*
- *Local community such as media, Landcare?*
- *General public- via WW Internet site.*

3. How will the data be used?

- ***To educate local residents about bacterial contamination and general water quality issues in the Howqua River***
- *Data could be published in local newsletters.*
- *Data could be used to support applications for grants to improve the waterway.*

4. What parameters will the group monitor and how often (times per year)?

- *E coli - monthly*
- *Turbidity - monthly*
- *Electrical Conductivity - monthly*
- *Total Phosphorus - monthly*
- *pH - monthly*
- *Temperature - monthly*
- *Dissolved Oxygen - monthly*
- *Aquatic invertebrates – twice a year (autumn and spring).*

5. What methods will you use?

- *Colilert system for E coli.*
- *Standard Waterwatch procedures for other parameters.*

6. Where will you monitor (list of sites)?

Site Code	*Site Description*	*Easting*	*Northing*	*Monitor*
HOW003	*Howqua River d/s of Black Dog Creek*	*450302*	*5882778*	*Parks Victoria*
HOW005	*Howqua River at Tunnel Bend*	*444065*	*5883856*	*Park Victoria*
HOW006	*Howqua River at Sheep Yard Flat*	*441808*	*5883243*	*Parks Victoria*
HOW007	*Howqua River at Howqua Hills*	*441795*	*5882873*	*Parks Victoria*
HOW008	*Howqua River at Fry's Flat*	*440401*	*5883091*	*Parks Victoria*
HOW009	*Howqua River u/s of Running Creek campground*	*431764*	*5878234*	*Jack Donoghue*
RUN009	*Running Creek u/s of Howqua campground*	*431505*	*5878045*	*Jack Donoghue*
RUN010	*Running Creek d/s of Howqua campground*	*431503*	*5878338*	*Jack Donoghue*
HOW016	*Howqua River at Terika*	*428749*	*5879197*	*Jack Donoghue*
HOW020	*Howqua River at Jamieson Road bridge*	*425952*	*5879995*	*Waterwatch*

7. When and how often will you monitor?

- *Monthly*

8. Who in the group will be involved and what will they be doing?

Jack Donoghue will collect and test samples in the lower reaches of the Howqua (from Running Creek downstream)

Parks Victoria will collect samples in the upper reaches (upstream of Fry's Flat) and forward these samples to the Waterwatch laboratory for analysis.

9. How will the data be managed and presented?

- *Tamara Bruce will forward results to the Waterwatch Database Coordinator to be entered onto the Catchment database.*
- *Copies of all record sheets are kept by the local Waterwatch Coordinator.*
- *Waterwatch Internet Mapping Sites.*
- *End of Year report posters/booklets.*
- *Interpretative posters.*

10. How will the group ensure that the data is credible?

- *Attend local Waterwatch training sessions.*
- *Waterwatch facilitators will oversee the monitoring program.*
- *Possibly participate in regional QA/QC program.*

Turbidity

Turbidity is the cloudiness of water and is the result of suspended material in the water. The suspended material decreases the ability of light to pass through the water column and can limit plant growth. This, in turn, affects the fish and invertebrate communities which feed on and live in the plants. Turbidity may be caused by silt, micro-organisms, plant material and chemicals. However, the most frequent causes of turbidity in rivers and other water bodies are algae and inorganic material produced from soil weathering and erosion.

High levels of turbidity have a two-fold effect on water:

- It loses its ability to support a large variety and number of aquatic organisms. Where there is less light penetrating the water, there will be less photosynthesis which reduces the level of oxygen in the water.
- The water becomes warmer because any suspended material absorbs heat from the sun. This also decreases the amount of oxygen dissolved in water.

Turbidity can be controlled by the retention of vegetation along streams and good farming practices such as contouring, stubble retention and off-stream watering of stock.

Turbidity in the Howqua River

Waterwatch has monitored sites along the Howqua River since 1995. These tables and graphs summarise the data collected by *Howqua Valley Landcare Group*, *Parks Victoria* and *Waterwatch* over this monitoring period.

Site Code	Site Description	Turbidity Medians (NTU)												
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HOW003	**Howqua River below Black Dog Creek**	-	-	-	-	-	-	1.5*	-	1.3*	3.8*	-	2*	-
HOW005	**Howqua River at Tunnel Bend**	-	-	-	-	-	-	-	-	*1.3**	5*	-	1	2
HOW006	**Howqua River at Sheep Yard Flat**	-	*<10**	-	1*	-	-	2*	-	-	3.1*	-	1*	2*
HOW007	**Howqua River at Howqua Hills**	-	-	1*	-	1*	-	-	-	-	3.8*	-	1*	2
HOW008	**Howqua River at Fry's Flat**	-	-	-	-	-	-	-	-	-	2.6*	-	1*	2
HOW009	**Howqua River u/s of Running Creek Campground**	-	-	-	1.5*	2*	-	3*	6*	5*	4*	2.1	1	2
RUN009	*Running Creek u/s of campground*	-	-	-	-	-	-	-	-	-	-	2	1	2
RUN010	*Running Creek d/s of campground*	-	-	-	-	-	-	-	-	-	-	2	1	2
HOW016	**Howqua River at Terika**	-	-	-	-	-	-	11	-	4.5	2	2.4	1	2
HOW020	**Howqua River at Jamieson Road bridge**	8	3*	2*	1	2	2	6	2	4.5	2	2.4	1	14

Rating: Turbidity for the Valleys –
<10 NTU Excellent, <12.5 NTU Good, <15 NTU Fair, <22.5 NTU Poor, >22.5 NTU Degraded
Note: results in italic with * indicate <5 data sets used for interpretation.

Table 1

Turbidity results in the Howqua River have been found to be "EXCELLENT" over more than a decade of monitoring. Figure 1 represents the median turbidity at each site over the entire period of the Howqua River monitoring project.

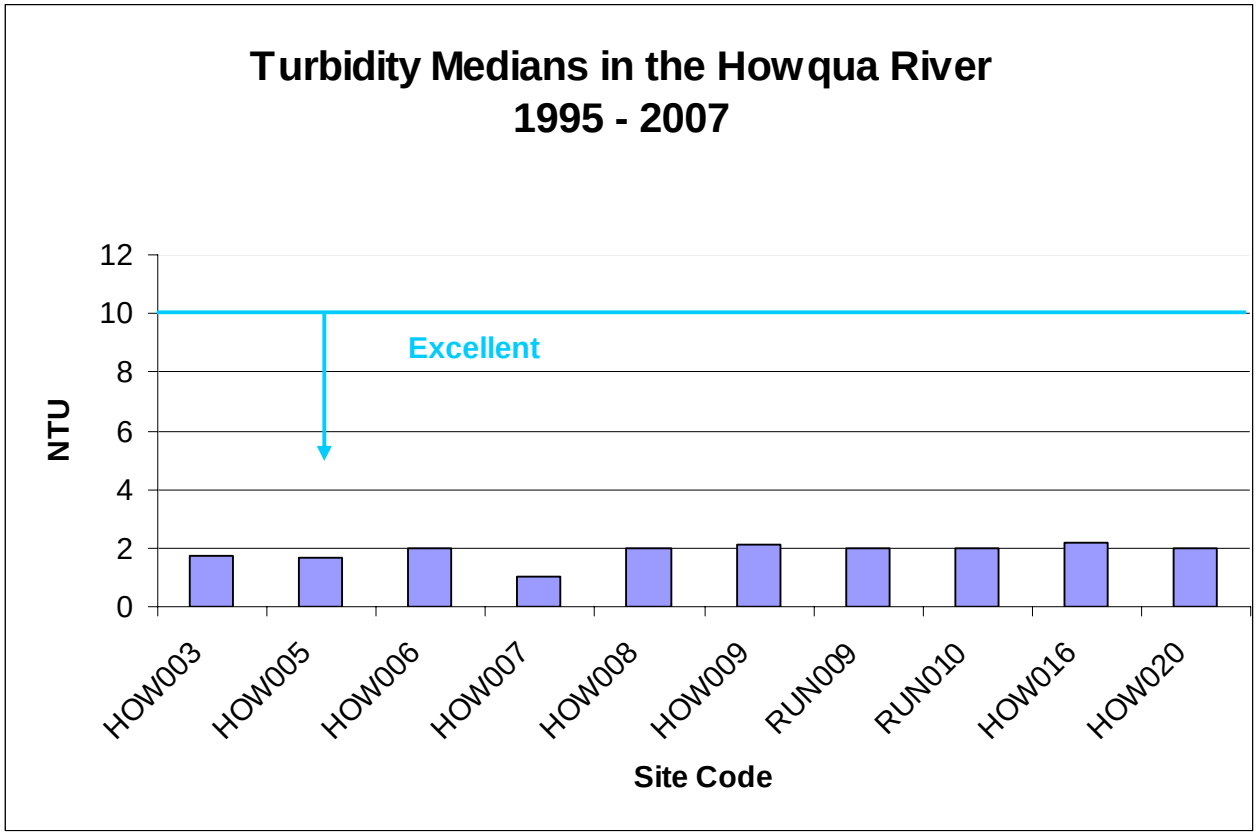

Fig 1

Turbidity medians for 2007, as shown in Figure 2 below, again show that results were "Excellent" for 2007, with the exception of Howqua River at Jamieson Road Bridge which rated as "Fair". These are great results considering the fires and the rainfall that has occurred since.

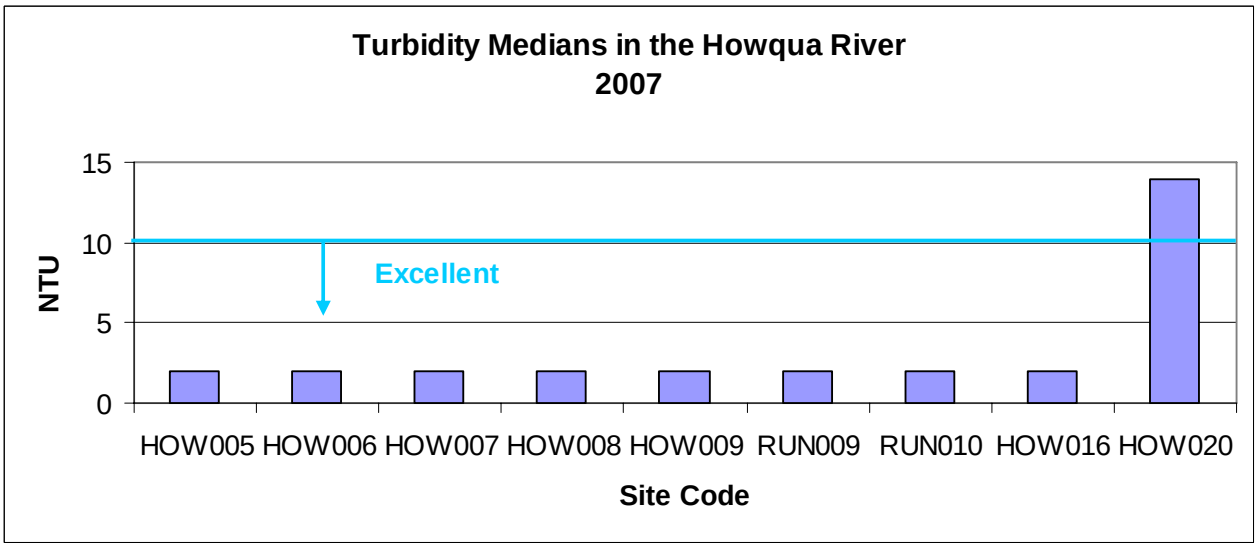

Fig 2

It must be noted that heavy rains after the summer fires removed large amounts of sediment, which resulted in an immediate dramatic decline in water quality at many of the sites in the project area. Raw data in Appendix C shows the short term "spikes" in turbidity (and E.coli) levels that have occurred after high rainfall events.

Figure 3 below shows a snapshot of the Howqua River sites on the 21st of March 2007 after a rainfall event of 45 mm. Turbidity levels significantly increased. As shown in the table and figures above, the medians for the Howqua River over the 12 year period, and in 2007 alone are mostly within the vicinity of 2 NTU, so the results below are extremely high in comparison. When looking at the raw data (see Appendix C) it can be seen that in the month following the collection of the results shown in this graph, the turbidities were back down to 2 NTU.

Factors that influenced the water quality in the area after the fires included the intensity of the fires, the ash remaining in the area of each monitoring site, soil exposure along the waterways, vegetation recovery and the intensity of each rainfall event.

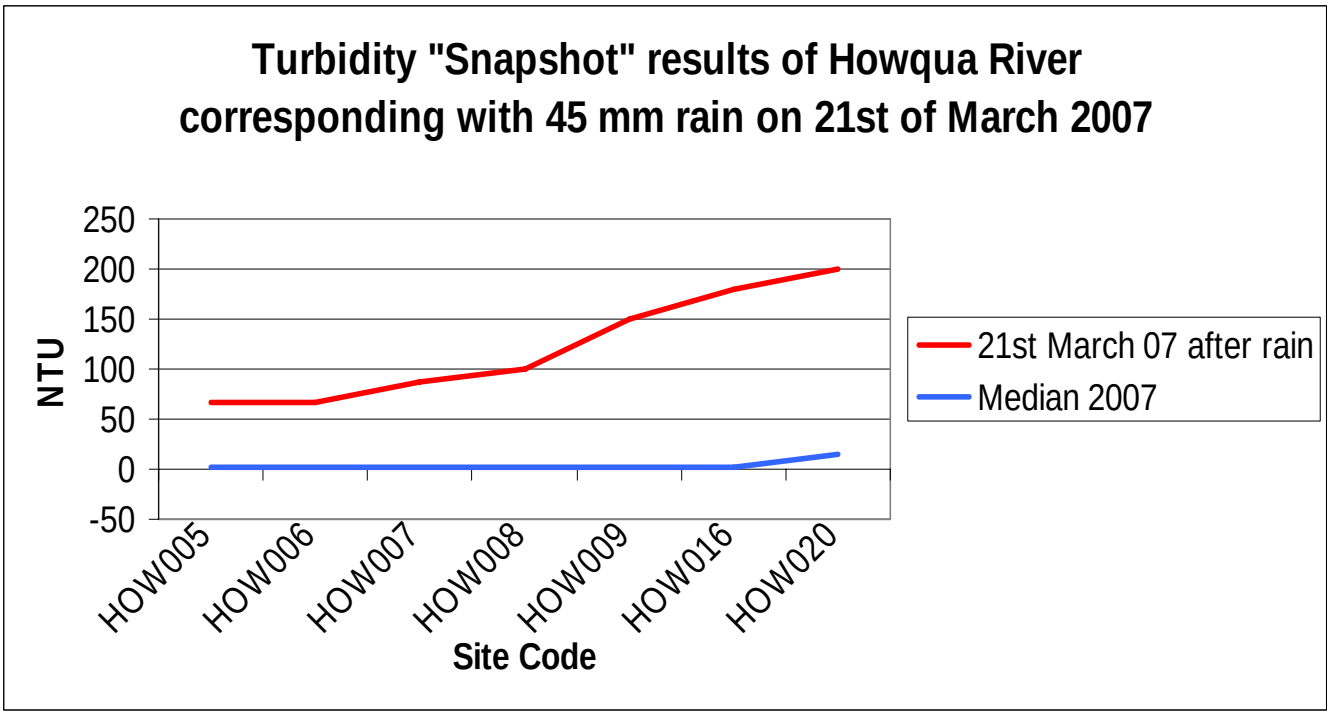

Fig 3

Salinity

Just as excess salt in our diets can be bad for our health, high salt levels in the environment negatively affect plants, animals and soils in and near waterways. Salinity is potentially the largest environmental problem facing Australia and is a major problem in Northern Victoria. The most concentrated problem areas are in the Shepparton Irrigation Region and areas around and to the west of Seymour. In the SIR, rising watertables have brought salinity closer to the surface, and at Seymour, dryland salting problems have occurred because deep rooted trees have been replaced by seasonal crops and grasses. Tree clearing can lead to dramatic rises in watertables. The solutions to salinity problems include revegetation of recharge areas and greater efficiency of irrigation in areas such as the SIR.

The information below explains the effect of salinity in agriculture.

0-800 EC

If you tested the water from your tap at home it would be within this range. This is good drinking water for people and suitable for all animals. When water of 300EC is used in overhead sprinklers by irrigation farmers, plants that are sensitive to salt may develop leaf scorch.

800-2500 EC

People can drink water within this range but it would start to taste very salty. This water is still suitable for all animals.

Peas, apricots and grapes can't be grown with water over 1,500 EC. If this water is used for irrigation farming, special care must be taken with drainage and choosing plants that are tolerant to salt. For example, lucerne can be irrigated with water of 2,000 EC and white clover with water of 1,000 EC, provided they are grown on sandy soil with good drainage.

2,500-10,000 EC

Water in this range is not suitable for people and should only be drunk in an emergency. When water over 4,000 EC is given to laying hens it causes their eggs to crack. Water over 6,000 EC is unsuitable for pigs and poultry. Highly saline water may also contain a high level of magnesium which can be harmful to stock. A water sample should be sent to a laboratory for analysis and specific advice obtained. This water is generally not used for irrigation farming except on some crops that have a very high tolerance to salt.

Pears, apples and tomatoes could not be grown with water in this range.

Over 10,000 EC

Don't drink this water! Water over 10,000 EC has an extremely high salinity. This water is unsuitable for people and for most animals. Only beef cattle and adult sheep can survive on water in this range. Irrigation farming is not possible with such highly saline water. In dryland areas only salt tolerant pastures will survive.

At 50,000 EC water has the same salinity as the sea. This water can be used for making concrete and flushing toilets as long as they are able to resist corrosion.

Salinity in the Howqua River

Waterwatch has monitored salinity in the lower reaches of the Howqua River from 1995 to 2007.

Site Code	Site Description	Salinity Medians (EC)												
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HOW003	**Howqua River below Black Dog Creek**	-	-	-	-	-	-	10*	-	39*	118*	-	32*	30*
HOW005	**Howqua River at Tunnel Bend**	-	-	-	-	-	-	-	-	39*	37*	-	35	40
HOW006	**Howqua River at Sheep Yard Flat**	-	-	-	*40**	-	-	10*	-	34*	36*	-	37*	40
HOW007	**Howqua River at Howqua Hills**	-	-	30*	-	20*	-	-	-	-	38*	-	40	50
HOW008	**Howqua River at Fry's Flat**	-	-	-	-	-	-	-	-	34*	35*	-	38	40
HOW009	**Howqua River u/s of Running Creek Campground**	-	-	-	50*	*60**	-	33*	53*	30*	25*	33*	-	50
RUN009	*Running Creek u/s of campground*	-	-	-	-	-	-	-	-	-	-	66*	87*	91
RUN010	*Running Creek d/s of campground*	-	-	-	-	-	-	-	-	-	-	67*	85*	90
HOW016	**Howqua River at Terika**	-	-	-	-	-	-	34*	-	38	30*	27*	47*	50
HOW020	**Howqua River at Jamieson Road bridge**	30	40	50	48	30	30	30	30*	39	30	30	52	55

Rating: Conductivity for the Valleys –
<80 EC Excellent, <240 EC Good, <400 EC Fair, <600 EC Poor, >600 EC Degraded
Note: results in italic with * indicate <5 data sets used for interpretation.

Table 2

Figures 4 and 5 below show Electrical Conductivity (salinity) at all sites on the Howqua River have consistently rated as "Excellent". The two sites on Running Creek have Electrical Conductivity medians only just above the "Excellent" rating, at 87 EC and 85 EC for the long term graph, although there are only results for these two sites for the last three years.

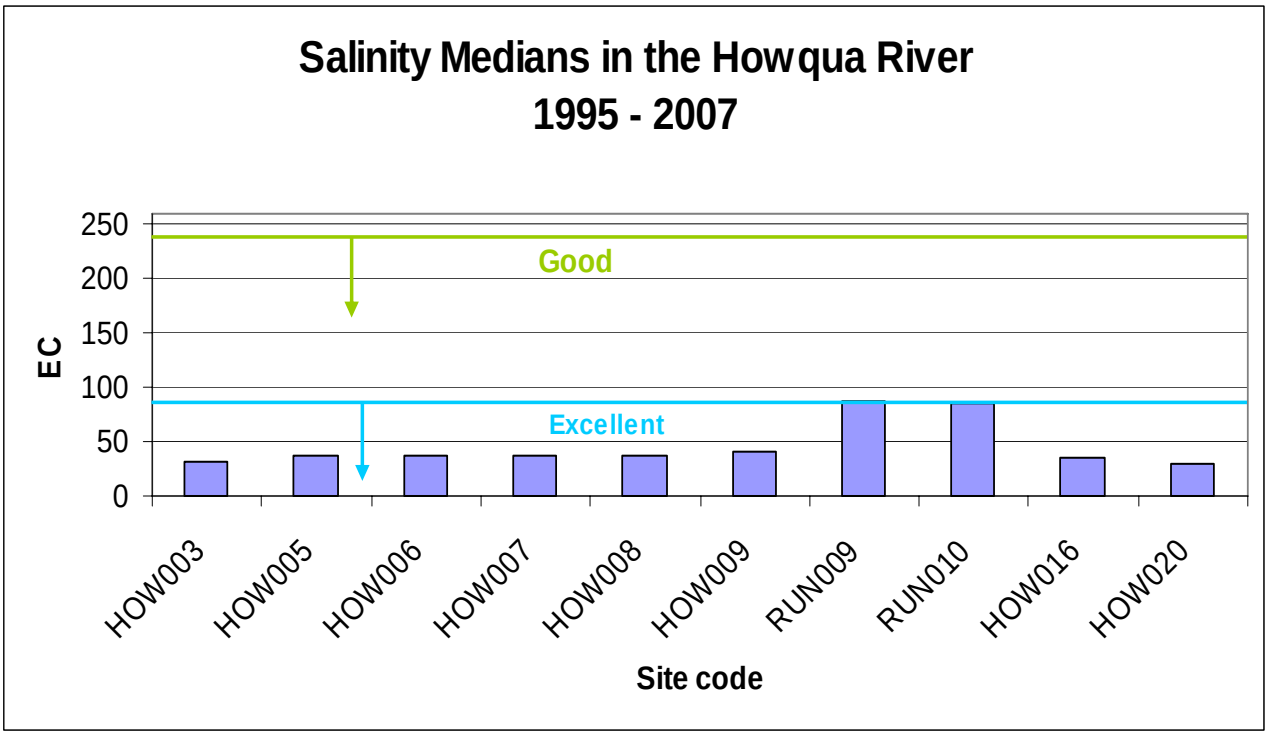

Fig 4

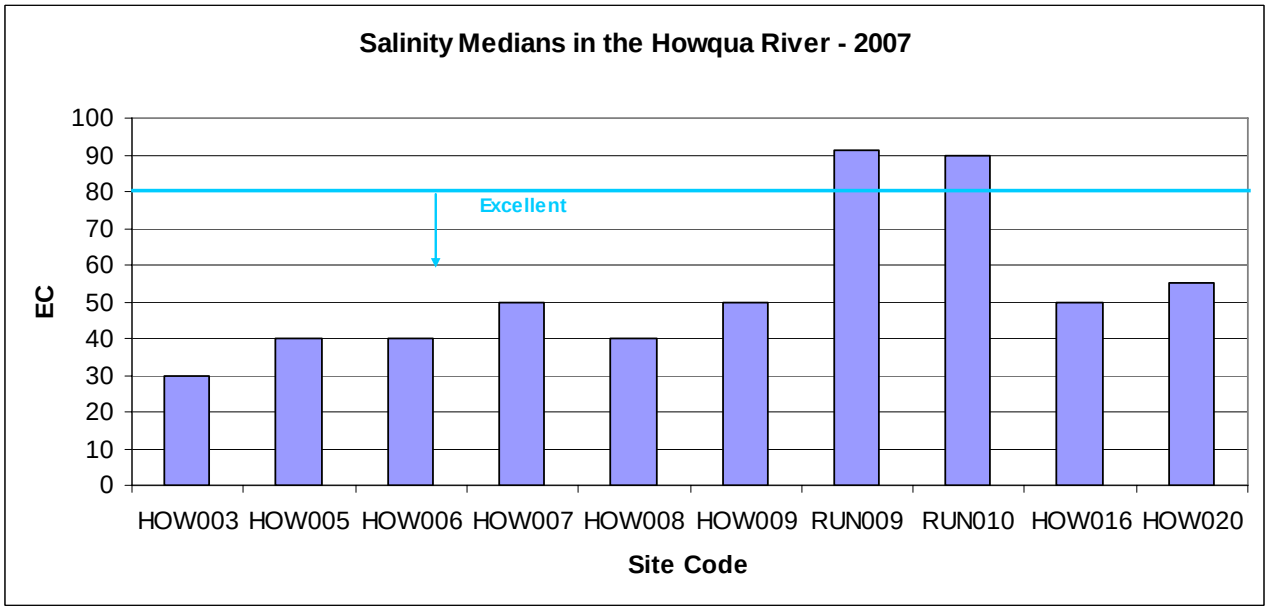

Fig 5

Phosphorus

Phosphorus is a nutrient that occurs naturally at low concentrations in water and it is essential for all forms of life. It comes from processes like the weathering of rocks and from the decomposition of organic matter such as plant litter. Other sources of phosphorus entering river systems include:

- ☐ sewage treatment works
- ☐ stormwater drains
- ☐ irrigation drains intensive agricultural industries
- ☐ runoff from agricultural land
- ☐ runoff from forests

Increases in phosphorus levels in streams may result from erosion, discharge of sewage, detergents, urban stormwater and rural runoff that contains fertilisers and animal and plant material. When the phosphorus concentration becomes too high, problems such as algal blooms, excessive growth of aquatic weeds and the loss of species diversity occurs.

Phosphorus in the Howqua River

Some sites in the Howqua River have been tested for phosphorus since 1995. Since 2003, the *Howqua Valley Landcare Group, Parks Victoria* and *Waterwatch* have conducted an extensive monitoring program at sites on the Howqua River. The tables and graphs below summarise the data collected to date.

Site Code	Site Description	Total Phosphorus MEDIANS (mg/L)												
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HOW003	Howqua River below Black Dog Creek	-	-	-	-	-	-	-	-	*<0.02**	0.02*	-	<0.02*	0.02
HOW005	Howqua River at Tunnel Bend	-	-	-	-	-	-	-	-	*0.02**	0.02*	-	<0.02*	0.02
HOW006	Howqua River at Sheep Yard Flat	-	-	-	0.1*	-	-	-	-	*0.02**	-	*0.02**	<0.02*	0.02
HOW007	Howqua River at Howqua Hills	-	-	0.05*	*0.04**	0.03*	-	-	-	-	0.02*	-	<0.02*	0.02
HOW008	Howqua River at Fry's Flat	-	-	-	-	-	-	-	-	-	0.04*	-	<0.02	0.02
HOW009	Howqua River u/s of Running Creek Campground	-	-	-	*<0.01**	-	-	0.04	*0.02**	0.02*	-	0.03*	-	-
HOW016	Howqua River at Terika	-	-	-	-	-	-	-	-	0.01*	-	-	-	-
HOW020	Howqua River at Jamieson Road bridge	0.02	0.06	0.02	0.02	0.04*	0.03	0.03	0.03*	0.01	0.02	0.02	0.02*	0.02

Ratings: Total Phosphorus for the Mountains, Valleys and Plains–
<0.01 mg/L Excellent, <0.025mg/L Good, <0.05mg/L Fair, <0.1mg/L Poor, >0.1mg/L Degraded

Note: ***results with * indicate <5 data sets used for interpretation.***
results in italic with *and no colour coding indicate a one off "snapshot" type sample.

Table 3

Intensive monitoring has been carried out for Total Phosphorus in the Howqua River. Figure 6 below shows that all sites rate as "Good". Unfortunately the lowest accurate result Waterwatch is able to gain with its Total Phosphorus testing method is "<0.02", so it may well be that these sites have even lower results, but Waterwatch is unable to confirm this.

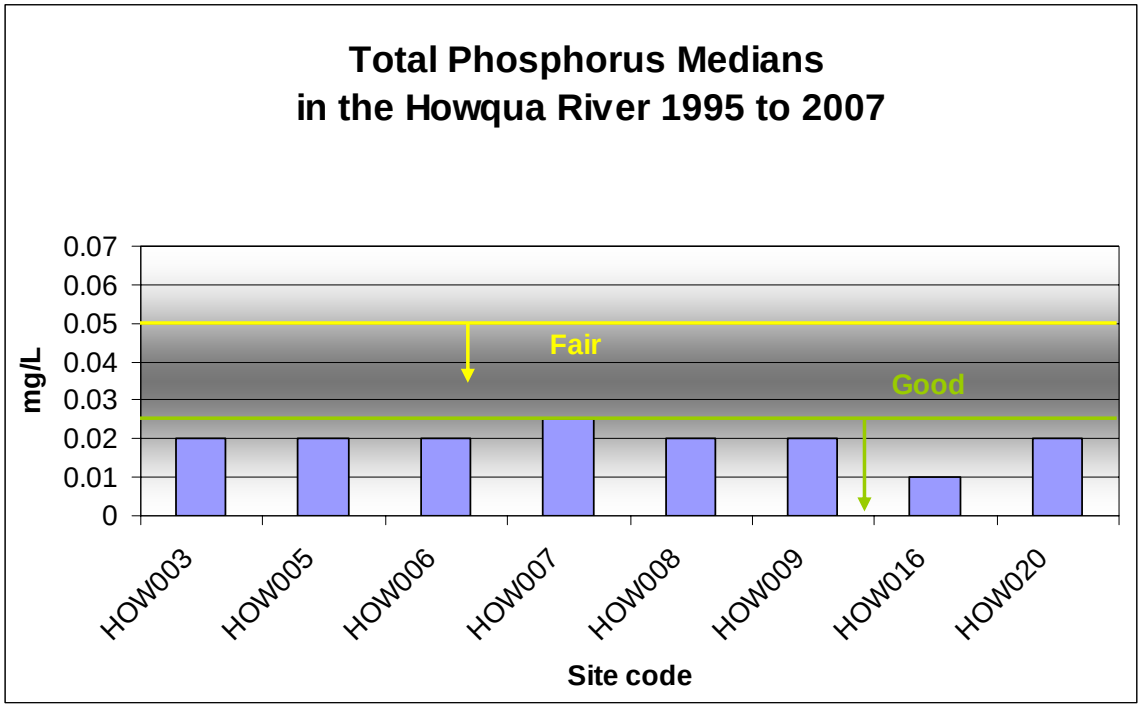

Fig 6

E.coli

Microbiological quality of a water-body is generally measured by testing for bacteria that are indicators of faecal pollution. Water intended for human consumption should contain none of these bacteria.

Indicator organisms are bacteria whose presence in water gives a simple and meaningful indication that faecal contamination has occurred. Such organisms are always present in high numbers in the faeces of humans (and other warm blooded animals and birds).

One of the major indicator organisms of faecal pollution is *Escherichia coli (E. coli).* When indicator bacteria are detected in water, their presence indicates that excrement from birds, animals or humans has recently polluted the water and that all types of pathogens (bacteria, viruses, protozoans and parasites) may also be present.

E. coli is a member of the coliform group of bacteria which grow naturally in the intestines of all warm-blooded animals. It is the predominant coliform in fresh faeces and so its presence in water is indicative of recent faecal contamination. The *E. coli* count does not differentiate between bacteria of bird, animal or human origin but, as animals and birds can act as carriers of human intestinal pathogens, the presence of *E. coli* should always be considered to have sanitary significance.

SEPP E coli Objectives for Waterways

Beneficial Use	Description	E coli (orgs/100ml)
		Median of 5 samples at regular intervals within 30 days
Primary Contact	Swimming, bathing and other direct water-contact sports	≤150
Secondary Contact	Boating and fishing	≤1,000

Some generalisations to help with interpretation:

- E coli can fluctuate widely even to the extent of increases from "tens" to "hundreds" without necessarily indicating contamination from a pollution source;
- If this magnitude of increase occurred regularly between two sampling sites and a known possible source was implicated, then there is some evidence of contamination;
- Normally, E coli levels will greatly increase after rainfall;
- Contamination from sewage can cause E coli levels up to 500,000 or more close to the point of entry of the sewage.

E.coli in the Howqua River

Howqua River and Running Creek have been tested for E.coli by Waterwatch and the community since the end of 2002. The table and graph below show median results from 2002.

Site Code	Site Description	E.coli MEDIANS (orgs/100ml)					
		2002	2003	2004	2005	2006	2007
HOW003	Howqua R. below Black Dog Creek	18	13	20	15	16	6
HOW005	Howqua R. at Tunnel Bend	23	11	14	19	14	14
HOW006	Howqua R. at Sheep Yard Flat	53	47	28	21	13	9
HOW007	Howqua R. at Howqua Hills	-	25	17	21	45	11
HOW008	Howqua R. at Fry's Flat	125	20	99	23	29	9
HOW009	Howqua R. u/s of Running Ck Campground	-	19*	40*	154*	83	26
RUN009	*Running Creek u/s of campground*	-	-	-	*178*	*41*	*7*
RUN010	*Running Creek d/s of campground*	-	-	-	*178*	*12*	*9*
HOW016	Howqua R. at Terika	-	20*	22*	91	110	32
HOW020	Howqua R. at Jamieson Road bridge	-	11*	34	109*	231	37

Note: - results with * indicate <5 data sets used for interpretation.

Table 4

SEPP Guidelines suggest E.coli less than 150 organisms/100 ml sample for primary contact such as swimming or bathing. With the exception of three of the sites in Table 4 above, highlighted in green, all in 2005, all of the sites monitored for E.coli meet this guideline. It must be noted, however, that SEPP Guidelines use five samples within a 30 day period, whereas sites shown above are monitored once a month as a rule, and these medians are calculated over the 12 months of the calendar year.

It can be seen from Table 4 and Figure 7 that median E.coli levels are low.

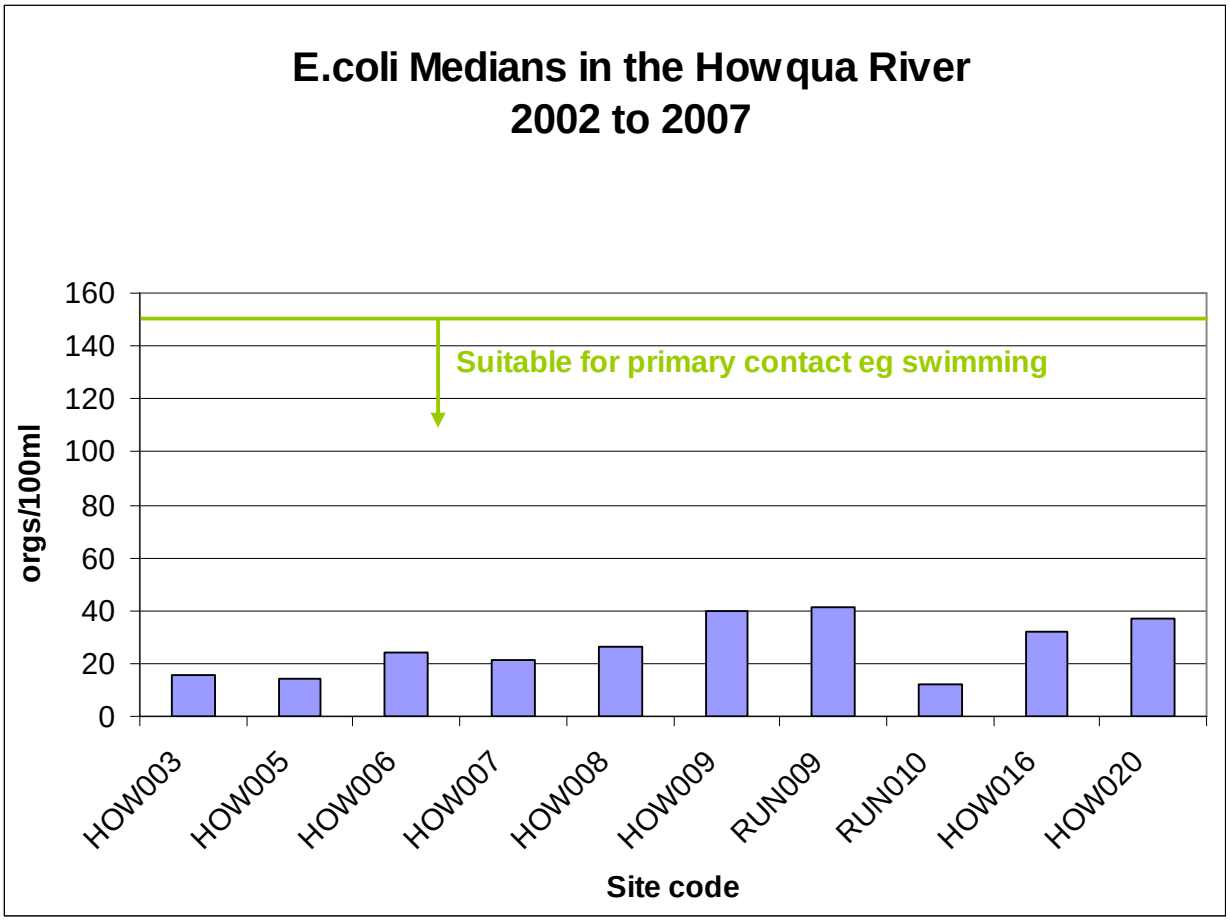

Fig 7

Table 5 below gives an indication of possible E.coli levels that could be expected in different sample types. The Howqua River results fit well within the "Clean Water" category when looking at overall medians, and some sites fall within the "Very, Very Clean Water" category for 2007 medians, as would be expected for their location.

Description	E coli Number	Possible Location
Very, Very Clean Water	**10** organisms per 100 ml	Pristine mountain stream or lake
Clean Water	**100** orgs per 100 ml	Upper mountain of non-polluted stream
Moderate Water	**1,000** orgs per 100 ml	Lowland river with agricultural or treated sewage contribution (Up to 5,000 following rain)
Agricultural Dam with Cattle Pollution	**Up to 10,000** orgs per 100 ml	
Septic Tank Effluent	**100,000** orgs per 100 ml	
Raw Sewage	**1,000,000 to 10,000,000** orgs per 100 ml	

Table 5

SEPP Compliance

The State Environment Protection Policy (SEPP) Waters of Victoria (WoV) water quality objectives identify the 'ideal' result range for environmental data at a particular location in a waterway. If a site fails a SEPP objective for one parameter, it indicates a possible problem for the whole system, not just for the one parameter and not just for the one site). It is recommended that an ecological risk assessment (ERA) be undertaken to determine if there is a risk to the values (or "beneficial uses") associated with that stream.

Basically, any set of results that fails the objective is a red flag to look more closely at what's going on. This differs from aiming for a particular turbidity or total phosphorus result, as an ERA may determine that it is acceptable to exceed the SEPP objectives for some parameters depending on the use/value of the waterway.

The SEPP (WoV) water quality objectives that apply to current Victorian Water Quality Monitoring Network (VWQMN) sites in the Goulburn Broken CMA region are given.

A minimum of 11 samples collected from monthly monitoring over a one-year period is required to assess against SEPP (WoV) water quality objectives. Colours refer to the SEPP (WoV) segments that apply to the site.

SEPP (WoV) Environmental Quality Objectives for Rivers and Streams – water quality

SEGMENT	INDICATOR							
	Total phosphorus (ug/L)	Total nitrogen (ug/L)	Dissolved oxygen % saturation		Turbidity (NTU)	Electrical conductivity (uS/CM)	pH (pH units)	
	75th percentile	75th percentile	25th percentile	maximum	75th percentile	75th percentile	25th percentile	75th percentile
Forests – B								
• all areas except Otways	≤25	≤350	≥90	110	≤5	≤100	≥6.4	≤7.7
Cleared Hills and Coastal Plains								
• mid-reaches of Ovens, Goulburn and Broken catchments	≤25	≤600	≥85	110	≤10	≤500	≥6.4	≤7.7
• Delatite River at Tonga Bridge	≤25	≤500	≥85	110	≤10	≤500	≥6.4	≤7.7
• Goulburn River at Eildon	≤25	≤600	≥85	110	≤10	≤500	≥6.4	≤7.7

Table 6

Results in the Howqua River in 2007 below, compared to SEPP objectives above – water quality

SEGMENT	INDICATOR							
	Total phosphorus (ug/L)	Total nitrogen (ug/L)	Dissolved oxygen % saturation		Turbidity (NTU)	Electrical conductivity (uS/CM)	pH (pH units)	
	75th percentile	75th percentile	25th percentile	maximum	75th percentile	75th percentile	25th percentile	75th percentile
HOW003 *Howqua R. d/s of Black Dog Creek*	20					33		
HOW005 *Howqua R. at Tunnel Bend*	20				3.5	41		
HOW006 *Howqua R. at Sheep Yard Flat*	20				18	42		
HOW007 *Howqua R. at Howqua Hills*	20				2	51		
HOW008 *Howqua R. at Fry's Flat*	20				2	42		
HOW009 *Howqua R. u/s Running Ck. campground*					12	60		
RUN009 *Running Ck. u/s of Howqua campground*					3.5	145		
RUN010 *Running Ck. d/s of Howqua campground*					24	145		
HOW016 *Howqua R. at Terika*					12	60		
HOW020 *Howqua R. at Jamieson Road bridge*	20		92	180	52	82	7.3	7.6

Table 7

To meet the SEPP Objectives, three quarters of the readings taken should not exceed the 75th percentile. In the case of the Howqua River, more than half of the sites fail to meet the 75th percentile for turbidity. This is possibly due to the fires. Both of the sites on Running Creek also fail to meet the 75th percentile for electrical conductivity, and the Howqua River at Jamieson Road bridge fails to meet the maximum dissolved oxygen objective. It must be noted that SEPP objectives are long term theoretical goals for water quality. It is not expected that waterways will comply at this stage

Macro-invertebrates

Why do a Macro-invertebrate Survey?

Macro-invertebrates are animals without backbones that live at least a part of their life in water.

One reason for studying macro-invertebrates (or waterbugs) is that they can be useful indicators of the ecological health of freshwater habitats. Some aquatic invertebrates are more tolerant to pollution than others.

If a stream is polluted, tolerant bugs will usually be found in larger numbers than the intolerant or sensitive ones. However, if a habitat is close to pristine, or in its natural state, tolerant types of bugs will be found alongside the more sensitive bugs which will be in equal or greater numbers than the tolerant.

Sites and habitats within the Howqua River were assessed against the SEPP WoV biological objectives (State Environmental Protection Policy – Waters of Victoria), outlined in the tables below.

There are many ways of analysing and interpreting invertebrate data to assess ecological condition. Currently five biological indices are used in Victoria for assessing the condition of aquatic ecosystems. These fall into three categories:

- a measure of diversity – number of families.
- biotic indices – the SIGNAL and EPT indices
- measuring of community composition – numbers of key families.

The development of these indices for assessing ecosystem condition has included the establishment of environmental quality objectives to aid in their interpretation. In recognition of the fact that aquatic communities will vary naturally across the State, the State has been characterised into five biological regions. The biological indices and their respective environmental quality objectives have been developed specific to the invertebrate communities within each region (EPA Victoria, 2003a). These biological indices and their associated environmental quality objectives have been set down in the ***State Environmental Protection Policy (Waters of Victoria)*** SEPP (WoV) and its schedules.

USING THE BIOLOGICAL INDICES

Separate assessments are made for riffle and edge habitats. In order to make a complete and accurate assessment of a site, the biological samples must be collected in both autumn and spring, and the invertebrate data from both seasons combined in the calculation of the indices

1. Number of Families.

The number of invertebrate families found at a site can give a reasonable representation of the ecological health of a stream as healthy streams generally have more families. **The Number of Families** index is calculated by simply summing the total ‘families’ of invertebrates present at a site.

Throughout a biological region, the expected number of families will vary according to quality of habitat and stream size, with larger streams, in general, supporting more taxa. Mild nutrient enrichment can increase the number of families due to an increase in food supply. Reduction in the expected number of families present can be caused by poor quality habitat and by various pollutants.

2. The SIGNAL biotic index.

SIGNAL (Stream Invertebrate Grade Number- Average Level) is an index of water quality based on the tolerance of aquatic biota to pollution (Chessman 1995). Using data from various studies of pollutants in south-eastern Australian streams, most, but not all, families of aquatic invertebrates have been assigned sensitivity grades according to their tolerance or intolerance to various pollutants. The list of invertebrate families and SIGNAL scores currently in use is based largely on those in the original publication (Chessman 1995). Oligochaeta has been added and assigned a score of one**. See Appendix B, Sub-appendix 2**.

The SIGNAL index is calculated by summing together the sensitivity grades of each of the families found at a site that have been assigned a sensitivity grade, and then by dividing the number of graded families present. The output is a single number, between zero and ten, reflecting the degree of water pollution. Generally, high quality sites have high SIGNAL scores and, low quality sites have low SIGNAL scores.

Table 2: Generic key to SIGNAL scores

SIGNAL score	Water Quality
>7	Excellent
6-7	Clean water
5-6	Mild pollution
4-5	Moderate pollution
<4	Severe pollution

3. The EPT biotic index

The EPT index is the total number of families in the generally pollution sensitive insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). It is calculated by summing together the number of families in these three orders present at a site. Any loss of families in these groups usually indicates disturbance.

The EPT index cannot be used in all stream systems due to the natural variations in the biogeographical distribution of the relevant taxa. For example, due to their ecological preference for well oxygenated, cool water streams, stoneflies and some mayfly families are naturally uncommon in the warmer, slower flowing waters that are typical of lowland regions.

4. Key Invertebrate Families

This index focuses mainly on the loss of key taxa that are indicative of good habitat and water quality. It is based on a pre-determined list of invertebrate families that are expected to occur in each of the biological regions of the State as defined in the State Environmental protection Policy (*Waters of Victoria*). **See Appendix B, Sub-appendix 1**.

The families included in each list are those which:

- are typically found in non-degraded streams in that region;
- are representative of particular habitat types, such as riffles, woody debris, fringing vegetation, macrophytes or pools in that region;
- represent reasonable to good water quality and tend to disappear as conditions deteriorate, and
- are commonly collected when present, using the rapid bioassessment method.

Because the lists incorporate taxa from a range of habitat types, stream sizes and stream types, it is unlikely that a site would contain all families. Thus, the environmental quality objective for the Key Families index requires the presence of a proportion, not all, of the listed families.

Unlike the other indices, edge and riffle habitats are not distinguished with the key Families index. Both habitats must be sampled where present and the data from both samples and both seasons (autumn and spring) combined when making an assessment.

To calculate the Key Families index, simply compare the list of families present at a site with the appropriate list of key families as specified in the ***State Environmental Protection Policy (Waters of Victoria*)**. The key families score is the total number of these key families present at a site.

Goulburn Broken Waterwatch Macro-invertebrate survey results, including the Howqua River in 2007

Biological regions from the SEPP (WoV) are as follows

1. **Forests B (B3) –** upland region similar in altitude to Forests A (B2) but with lower rainfall and less steep stream slopes. Forested area but with greater degree of clearing for forestry, grazing and intensive agriculture than Forests A. Cool water streams with very coarse substrate and variable riparian vegetation providing less shading than Forests A. Slightly elevated alkalinity but low when compared to lowland regions.

2. **Cleared Hills and Coastal Plains (B4) –** lowland region with low rainfall, gradients and altitude. Substantial clearing for intensive agriculture has resulted in poor riparian vegetation. Warm water streams with high alkalinity and low to moderate turbidity and salinity. Stream substrate is predominately moderate to fine grained particles.

1. Sampling, identification and data collation

Sampling was conducted in accordance with the Victorian Rapid Bio-assessment (VRBA) sampling protocol (Victorian EPA). This involved collecting water quality data and sampling aquatic invertebrates from available stream habitats. Sampling was undertaken in autumn 2007 and spring 2007. Samples were collected from 'riffle' habitat i.e. slow to fast areas where the water breaks over the substrate, and 'edge' habitat i.e. slow to no flow areas which can include pool, undercut banks and backwaters. Riffle samples (also known as kick samples) were collected using a fine mesh net held downstream and kicking the substrate for a total of ten metres at each site. Edge samples (also known as sweep samples) were taken using a fine mesh net and sweeping the net through the water as well as in amongst the vegetation in the edge and pool sections of the stream for approximately ten metres. Both habitats were sampled where present. Each sample was emptied into a white sorting tray and aquatic invertebrates were picked from the sample for 30 minutes and placed in 70% ethanol for preservation and later identification in the laboratory.

Aquatic invertebrates were identified in the laboratory to Family level where possible with the exception of Acarina (mites), identified to Class level and Chironomidae (midges) identified to Sub Family.

The Waterwatch sites for 2007 are

1. The Howqua River at Tunnelbend - Waterwatch code HOW005
2. The Goulburn River at Burns Bridge – Waterwatch code – GOU008
3. The Delatite River behind Merrijig Primary School - Waterwatch code – DEL010

For comparison, some EPA sites have been included from 1997

1. Howqua River at 'Terika'- - Running Creek – EEW
2. Goulburn River (Upper) at Burns Bridge – EEV

2. Results

Table 8 has been reproduced from the SEPP WoV (Victorian Environment Protection Authority 2003). The objectives for biological indicators of environmental quality are given for each of the biological regions and habitats covered by this AshWatch report.

To meet objectives, sites assessed must return values equal to or greater than the values given in Table 7. If one or two habitats at a site fail, an overall failure is given to the site. Failure of a site to meet all four objectives for region B3 is considered an alert; however an overall pass is given to the site.
All three objectives should be met in region B4 and failure to meet any one of the objectives should trigger further investigation.

Table 8 Objectives for biological indicators of environmental quality as listed in the SEPP WoV (Victorian Environmental Protection Authority 2003)

Indicators Region & Habitat	No of Families	SIGNAL index score	EPT index score	Key families combined habitat
B3 riffle	23	6.0	10	26
B3 edge	24	5.8	9	26
B4 riffle	23	5.5	N/A	22
B4 edge	26	5.5	N/A	22

N/A Not applicable in that region

Table 9. Biotic indices results for three sites in the Goulburn Broken Waterwatch AshWatch Program 2007 assessed against SEPP WoV objectives for biological indicators of environmental quality.

Site code/ year	Site location	Biological Region	Habitat	Number of families score	SIGNAL index score	EPT	Key Families Combined Habitat score	Site Pass Fail
HOW005 2007	Howqua River at Tunnel bend	B3	Riffle	31	6.6	14	41	Pass
HOW005 2007	Howqua River at Tunnel Bend	B3	Edge	29	6.4	14	41	Pass
GOU008 2007	Goulburn River at Burns Br Jamieson	B3	Riffle	24	6.8	14	32	Pass
GOU008 2007	Goulburn River at Burns Br Jamieson	B3	Edge	18	6.0	7	32	Fail
DEL010 2007	Delatite River at Merrijig	B4	Riffle	27	6.5	13	29	Pass
DEL010 2007	Delatite River at Merrijig	B4	Edge	29	6.2	12	29	Pass
EEW 1997	Howqua River at 'Tareka'	B3	Riffle	32	6.5	14	NR	Pass
EEW 1997	Howqua River at 'Tareka'	B3	Edge	36	6.7	15	NR	Pass
EEV 1997	Goulburn River at Burns bridge	B3	Riffle	30	6.6	15	NR	Pass
EEV	Goulburn River at	B3	Edge	33	6.2	11	NR	Pass

1997	Burns Bridge							

Marginal value
Fail
NR – Objective was not required as AUSRIVAS results were available

3. Discussion

The Howqua River at Tunnelbend was surveyed in March and October and it is currently meeting the SEPP guidelines in all biological indices for both riffle and edge sampling techniques. In fact, the Howqua is well above the SEPP guidelines in three of the four indices these being Number of families, SIGNAL score and EPT Taxa.

The Goulburn River at Burns Bridge was surveyed in March and October and it is currently meeting the SEPP guidelines in all biological indices for the riffle samples but it is NOT meeting two of the three indices (Number of families and EPT Taxa) for the edge samples.

This site was severely turbid during the March sample (a reading of 260 NTU's instead of the usual 2 or 3 NTU's) and it was very difficult to complete the survey. Clean water had to be brought in to enable the sample to be analysed. The Number of families for the riffle only just met the guidelines (24 present) and is highlighted as marginal. It was noted that in March, the family of mayflies known as Leptophlebiidae were missing, but they did reappear in October.

Also, the Goulburn site was chosen because of the suitability of the riffle and the edge did not have a lot of fringing vegetation and macrophytes in the selected stretch of river. This may be one of the reasons for the much lower than expected number of families detected.

The Delatite River at Merrijig was surveyed in March and October and it is currently meeting the SEPP guidelines in all biological indices for both riffle and edge sampling techniques. In fact, the Delatite is well above the SEPP guidelines in two of the three indices, those being the SIGNAL score and the Key Families Combined Habitat score.

When comparing the Waterwatch data with the EPA SEPP data from 1997, one must be wary of drawing too many conclusions, due to the age of the data and the events that have occur in the time period between the two sampling dates. Droughts, fires and other environmental factors make valid comparisons difficult. It is more meaningful to compare the Waterwatch data to the SEPP data.

TABLE 10
HOW005 - Howqua River Riffle - at Tunnelbend 2007
Region B3 – Forest B Families present in combined autumn and spring surveys for Riffle sample
Key Families for Key Families Combined Habitat score shaded in purple.

Order	Family	SIGNAL GRADE SEPP	Common name
Plecoptera	Eustheniidae	10	Stonefly nymph
Trichoptera	Coloburiscidae	10	Spiny horse mayfly
Trichoptera	Helicopsychidae	10	Snail caddis larva
Trichoptera	Philopotamidae	10	Free caddis larva
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Trichoptera	Glossosomatidae	8	Sand case caddis larva
Trichoptera	Calamoceratidae	8	Sleeping bag caddis larva
Trichoptera	Conoesucidae	8	Caddis larva plant case
Diptera	Dixidae	8	Black U bend larva
Diptera	Athericidae	7	Fly larva
Plecoptera	Gripopterygidae	7	Stonefly nymph
Trichoptera	Hydrobiosidae	7	Free swimming caddis larva
Coleoptera	Elmidae	7	Riffle beetle
Trichoptera	Leptoceridae	7	Stick caddis larva
O. Odonata S.O Epiproctophora	Gomphidae	7	Dragonfly nymph
Ephemeroptera	Caenidae	7	Mayfly nymph
O. Odonata S.O Epiproctophora	Telephlebiidae (Aeshnidae)	6	Dragonfly nymph
Diptera	S.F. Podonominae	6	Non biting midge larva
Acarina		N/A	Water mite
Diptera	Ceratopogonidae	6	Pog larva
Diptera	S.F. Tanypodinae	6	Non biting midge larva
Diptera	S.F Chironominae	6	Non biting midge larva
Diptera	Tabanidae	5	March fly larva
Trichoptera	Hydropsychidae	5	Free caddis larva
Coleoptera	Psephenidae	5	Water penny larva
Diptera	Simuliidae	5	Blackfly larva
Ephemeroptera	Baetidae	5	Mayfly nymph
Diptera	Tipulidae	5	Fly larva
Coleoptera	Gyrinidae	5	Whirligig beetle larva
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Megaloptera	Corydalidae	4	Dobson fly larva
C. Oligochaeta		1	Aquatic worm
	No of families 32 (31 for SIGNAL score)	Total 206	
		SIGNAL index score 6.6	

TABLE 11
HOW005 - Howqua River - Edge at Tunnelbend – 2007 Biological Region B3
Families present on combined autumn and spring surveys for Edge sample.
Key Families for Key Families Combined Habitat score shaded in purple.

Order	Family	SIGNAL GRADE	Common name
Coleoptera	Ptilodactylidae	10	Beetle larva
Trichoptera	Helicopsychidae	10	Snail caddis larva
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Ephemeroptera	Oniscigastridae	10	Mayfly nymph
Trichoptera	Atriplectidae	10	Vulture caddis larva
Trichoptera	Philorheithridae	8	Sand case caddis larva
Diptera	Dixidae	8	U bend fly larva
Trichoptera	Calamoceratidae	8	Sleeping bag caddis larva
Trichoptera	Conoesucidae	8	Hooped case caddis larva Some silk cases
Plecoptera	Notonemouridae	8	Stonefly nymph
Trichoptera	Hydrobiosidae	7	Free caddis larva
Plecoptera	Gripopterygidae	7	Stonefly nymph
Trichoptera	Leptoceridae	7	Stick caddis larva
Trichoptera	Hydroptilidae	6	Micro caddis larva
Diptera	Ceratopogonidae	6	Pog larva
Diptera	S.F Tanypodinae	6	Non biting midge larva
Diptera	S.F. Chironominae	6	Non biting midge larva
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Trichoptera	Hydropsychidae	5	Free caddis larva
Diptera	Simuliidae	5	Blackfly larva
Ephemeroptera	Baetidae	5	Mayfly nymph
Coleoptera	Dytiscidae	5	Diving beetle larva
Coleoptera	Hydrophilidae	5	Water scavenger beetle larva
Hemiptera	Corixidae	5	Water boatman
Hemiptera	Gerridae	4	Water strider
Hemiptera	Veliidae	4	Small water strider
Hemiptera	Notonectidae	4	Backswimmer
C. Gastropoda	Physidae	3	Pond snail
C. Oligochaeta		1	Aquatic worm
	No of families 29	Total 186	
		SIGNAL index score 6.4	

TABLE 12
GOU008 - Goulburn River - Riffle at Burns Bridge 2007 Biological Region B3 - Forest B
Families present in combined autumn and spring surveys for Riffle sample.
Key Families for Key Families Combined Habitat score shaded in purple.

Order	Family	SIGNAL GRADES	Common name
Trichoptera	Coloburiscidae	10	Mayfly nymph
Trichoptera	Philopotamidae	10	Free caddis larva
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Ephemeroptera	Ameletopsidae	10	Mayfly nymph
Trichoptera	Atriplectidae	10	Vulture caddis larva
Trichoptera	Calamoceratidae	8	Sleeping bag caddis larva
Trichoptera	Glossosomatidae	8	Saddle case caddis larva
Plecoptera	Gripopterygidae	7	Stonefly nymph
Coleoptera	Elmidae	7	Riffle beetle
Trichoptera	Leptoceridae	7	Stick caddis larva
Trichoptera	Hydrobiosidae	7	Free caddis larva
O. Odonata S.O Epiproctophora	Gomphidae	7	Dragonfly nymph
O. Odonata S.O Epiproctophora	Synthemistidae (Corduliidae)	7	Dragonfly nymph
Ephemeroptera	Caenidae	7	Mayfly nymph
Acarina		N/A	Water mite
Diptera	S,F, Tanypodinae	6	Non biting midge larva
Diptera	S.F. Chironominae	6	Non biting midge larva
Trichoptera	Hydropsychidae	5	Free caddis larva
Coleoptera	Psephenidae	5	Water penny larva
Diptera	Simuliidae	5	Blackfly larva
Ephemeroptera	Baetidae	5	Mayfly nymph
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Coleoptera	Hydrophilidae	5	Water scavenger beetle
Trichoptera	Ecnomidae	4	Free caddis larva
C. Oligochaeta		1	Aquatic worm
	No of Families		
	25 (24 for SIGNAL Index score))	Total 162	
		SIGNAL index score 6.8	

TABLE 13
GOU008 - Goulburn River – Edge at Burns Bridge 2007 Biological Region B3 – Forest B
Families present in combined autumn and spring surveys for Edge sample.
Key Families for Key Families Combined Habitat score shaded in purple.

Order	Family	SIGNAL GRADE	Common name
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Ephemeroptera	Coloburiscidae	10	Mayfly nymph
Trichoptera	Calamoceratidae	8	Sleeping bag caddis larva
Trichoptera	Conoesucidae	8	Hooped case caddis larva
Coleoptera	Scirtidae	8	Marsh beetle larva
Trichoptera	Leptoceridae	7	Stick caddis larva
Plecoptera	Gripopterygidae	7	Stonefly nymph
Diptera	S.F. Chironominae	6	Non biting midge larva
Acarina		N/A	Water mite
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Coleoptera	Hydrophilidae	5	Water scavenger beetle
Coleoptera	Dytiscidae	5	Diving beetle
Trichoptera	Hydropsychidae	5	Free caddis larva
Diptera	Simuliidae	5	Blackfly larva
Hemiptera	Corixidae	5	Water boatman
Hemiptera	Gerridae	4	Water strider
Hemiptera	Veliidae	4	Small water strider
C. Oligochaeta		1	Aquatic worm
	No of families 18 (17 for SIGNAL index score)	Total 103	
		SIGNAL index score 6.0	

TABLE 14
DEL010 - Delatite River - Riffle at Merrijig 2007
Biological Region B4 Cleared Hills and Coastal Plains
Families present in combined autumn and spring surveys for riffle sample.
Key Families for Key Families Combined Habitat score shaded in purple.

Order	Family	SIGNAL GRADE	Common name
Coleoptera	Ptilodactylidae	10	Beetle larva
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Trichoptera	Philopotamidae	10	Free swimming caddis larva
Ephemeroptera	Coloburiscidae	10	Mayfly nymph
Trichoptera	Calamoceratidae	8	Sleeping bag caddis larva
Trichoptera	Glossosomatidae	8	Saddle case caddis larva
Trichoptera	Conoesucidae	8	Hoop case caddis larva
Coleoptera	Elmidae	7	Riffle beetle, larva
Plecoptera	Gripopterygidae	7	Stonefly nymph
Trichoptera	Hydrobiosidae	7	Free caddis larva
Trichoptera	Leptoceridae	7	Plant case caddis larva
O. Odonata S.O Epiproctophora	Gomphidae	7	Dragonfly nymph
Ephemeroptera	Caenidae	7	Mayfly nymph
C. Acarina		N/A	Water mite
Diptera	S.F. Tanypodinae	6	Non biting midge larva
Diptera	S.F Chironominae	6	Non biting midge larva
Diptera	Ceratopogonidae	6	Pog larva
Diptera	S.F. Podonominae	6	Non biting midge larva
Diptera	Simuliidae	5	Blackfly larva
Trichoptera	Hydropsychidae	5	Free caddis larva
Ephemeroptera	Baetidae	5	Mayfly nymph
Diptera	Tipulidae	5	Cranefly larva
Coleoptera	Psephenidae	5	Water penny larva
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Megaloptera	Corydalidae	4	Dobsonfly larva
Trichoptera	Ecnomidae	4	Free swimming caddis larva
C. Oligochaeta		1	Aquatic worm
	No of families 27 (26 for SIGNAL index score)	Total 169	
		SIGNAL index score 6.5	

TABLE 15
DEL010 -Delatite River - Edge behind Merrijig PS 2007
Biological region B4 Cleared Hills and Coastal Plains
Families present in combined autumn and spring surveys for Edge sample.
Key Families for Key Families Combined Habitat score shaded in purple.

Order	Family	SIGNAL GRADE	Common name
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Ephemeroptera	Coloburiscidae	10	Mayfly nymph
Ephemeroptera	Oniscigastridae	10	Mayfly nymph
Trichoptera	Philopotamidae	10	Free swim caddis larva
Diptera	Dixidae	8	Black U bend larva
Trichoptera	Conoesucidae	8	Hooped case caddis larva
Plecoptera	Notonemouridae	8	Stonefly nymph
Plecoptera	Gripopterygidae	7	Stonefly nymph
Trichoptera	Leptoceridae	7	Stick caddis larva
Trichoptera	Hydrobiosidae	7	Free swim caddis larva
Odonata S.O Epiproctophora	Corduliidae	7	Dragonfly nymph
Odonata S.O Epiproctophora	Gomphidae	7	Dragonfly nymph
Trichoptera	Hydroptilidae	6	Micro caddis larva
Diptera	S.F. Tanypodinae	6	Non biting midge larva
Diptera	Ceratopogonidae	6	Pog larva
Diptera	S.F. Podonominae	6	Non biting midge larva
Diptera	S.F Chironominae	6	Non biting midge larva
Diptera	Simuliidae	5	Blackfly larva
Ephemeroptera	Baetidae	5	Mayfly nymph
Coleoptera	Dytiscidae	5	Diving beetle
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Hemiptera	Corixidae	5	Water boatman
Coleoptera	Hydrophilidae	5	Water scavenger beetle larva Berosus
Hemiptera	Gerridae	4	Water strider
Hemiptera	Notonectidae	4	Backswimmer
Trichoptera	Ecnomidae	4	Free caddis larva
Hemiptera	Veliidae	4	Small water strider
C. Gastropoda	Physidae	3	Snail sinister coil, mottled shell
C. Oligochaeta		1	Aquatic worm
	No of families 29	Total 179	
		SIGNAL index score 6.2	

Howqua River General Comments

With all sites in the upper catchment it could be expected that results would generally be very good. In 2007 after the fires we found:

a) With the exception of the Howqua River at Jamieson Road Bridge, turbidity was low. This is a pleasant surprise considering the intensity of the fires and the resultant destruction of vegetation, and heavy rains that have occurred since the fires.

b) Salinity was low

c) Phosphorus was low, and met the SEPP Objective at all sites monitored for Total Phosphorus.

d) E.coli levels were low

e) Macroinvertebrates passed at the Howqua River site when assessed against SEPP WoV objectives for biological indicators of environmental quality

f) Overall an excellent result considering the occurrence of the fires.

These results have so far been distributed to

- Goulburn Broken Catchment Management Authority
- Waterwatch State Office

Appendix A

Chemical Test Ratings

The figures below are a guide for each of the water quality tests to help you interpret your results in terms of water quality.

Index of Stream Conditions (ISC) Ratings for each of the parameters.

Parameter	Excellent	Good	Fair	Poor	Degraded
Conductivity (uS/cm EC) mountain	<30	<90	<150	<225	>225
Conductivity (uS/cm EC) valley	<80	<240	<400	<600	>600
Conductivity (uS/cm EC) plain	<100	<250	<500	<750	>750
Turbidity (NTU) mountain	<5.0	<7.5	<10	<12.5	>12.5
Turbidity (NTU) valley	<10	<12.5	<15	<22.5	>22.5
Turbidity (NTU) plain	<15	<17.5	<20	<30	>30
pH	6.0 - 7.5	5.5 - 6 or <8.	8.0 - 8.5	5.0 - 5.5 or 8.5 - 9.0	< 5.0 or > 9.0
Reactive Phosphorus (mg/L)	< 0.008	< 0.02	< 0.04	< 0.08	> 0.08
Total Phosphorus (mg/L)	< 0.01	< 0.025	< 0.05	< 0.10	> 0.10
Nitrates (mg/L)	< 0.05	< 0.1	< 0.2	< 0.4	> 0.4

Appendix B

ASSESSING THE CONDITION OF AQUATIC ECOSYSTEMS

There are many ways of analysing and interpreting invertebrate data to assess ecological condition. Currently five biological indices are used in Victoria for assessing the condition of aquatic ecosystems. These fall into three categories:

- a measure of diversity – number of families.
- biotic indices – the SIGNAL and EPT indices
- measuring of community composition – numbers of key families.

The development of these indices for assessing ecosystem condition has included the establishment of environmental quality objectives to aid in their interpretation. In recognition of the fact that aquatic communities will vary naturally across the State, the State has been characterised into five biological regions. The biological indices and their respective environmental quality objectives have been developed specific to the invertebrate communities within each region (EPA Victoria, 2003a) These biological indices and their associated environmental quality objectives have been set down in the ***State Environmental Protection Policy (Waters of Victoria)*** SEPP (WoV) and its schedules.

USING THE BIOLOGICAL INDICES

Separate assessments are made for riffle and edge habitats. In order to make a complete and accurate assessment of a site, the biological samples must be collected in both autumn and spring, and the invertebrate data from both seasons combined in the calculation of the indices

1. Number of Families.

The number of invertebrate families found at a site can give a reasonable representation of the ecological health of a stream as healthy streams generally have more families. **The Number of Families** index is calculated by simply summing the total 'families' of invertebrates present at a site.

Throughout a biological region, the expected number of families will vary according to quality of habitat and stream size, with larger streams, in general, supporting more taxa. Mild nutrient enrichment can increase the number of families due to an increase in food supply. Reduction in the expected number of families present can be caused by poor quality habitat and by various pollutants.

2. The SIGNAL biotic index.

SIGNAL (Stream Invertebrate Grade Number- Average Level) is an index of water quality based on the tolerance of aquatic biota to pollution (Chessman 1995). Using data from various studies of pollutants in south-eastern Australian streams, most, but not all, families of aquatic invertebrates have been assigned sensitivity grades according to their tolerance or intolerance to various pollutants. The list of invertebrate families and SIGNAL scores currently in use is based largely on those in the original publication (Chessman 1995). Oligochaeta has been added and assigned a score of one**. See Appendix 2**.

The SIGNAL index is calculated by summing together the sensitivity grades of each of the families found at a site that have been assigned a sensitivity grade, and then by dividing the number of graded families present. The output is a single number, between zero and ten, reflecting the degree of water pollution. Generally, high quality sites have high SIGNAL scores and, low quality sites have low SIGNAL scores.

Table 2: Generic key to SIGNAL scores

SIGNAL score	Water Quality
>7	Excellent
6-7	Clean water
5-6	Mild pollution
4-5	Moderate pollution
<4	Severe pollution

3. The EPT biotic index

The EPT index is the total number of families in the generally pollution sensitive insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). It is calculated by summing together the number of families in these three orders present at a site. Any loss of families in these groups usually indicates disturbance.

The EPT index cannot be used in all stream systems due to the natural variations in the biogeographical distribution of the relevant taxa. For example, due to their ecological preference for well oxygenated, cool water streams, stoneflies and some mayfly families are naturally uncommon in the warmer, slower flowing waters that are typical of lowland regions.

4. Key Invertebrate Families

This index focuses mainly on the loss of key taxa that are indicative of good habitat and water quality. It is based on a pre-determined list of invertebrate families that are expected to occur in each of the biological regions of the State as defined in the State Environmental protection Policy (*Waters of Victoria*). See Appendix 1.

The families included in each list are those which:

- are typically found in non-degraded streams in that region;
- are representative of particular habitat types, such as riffles, woody debris, fringing vegetation, macrophytes or pools in that region;
- represent reasonable to good water quality and tend to disappear as conditions deteriorate, and
- are commonly collected when present, using the rapid bioassessment method.

Because the lists incorporate taxa from a range of habitat types, stream sizes and stream types, it is unlikely that a site would contain all families. Thus, the environmental quality objective for the Key Families index requires the presence of a proportion, not all, of the listed families.

Unlike the other indices, edge and riffle habitats are not distinguished with the key Families index. Both habitats must be sampled where present and the data from both samples and both seasons (autumn and spring) combined when making an assessment.

To calculate the Key Families index, simply compare the list of families present at a site with the appropriate list of key families as specified in the ***State Environmental Protection Policy (Waters of Victoria*)**. The key families score is the total number of these key families present at a site.

APPENDIX 1. KEY FAMILIES USED TO CALCULATE SEPP (WATERS OF VICTORIA) OBJECTIVES

SEPP (WoV) SEGMENT				
Highlands	**Forests A**	**Forests B**	**Cleared Hills and Coastal Plains**	**Murray and Western Plains**
Aeschnidae	Aeschnidae	Aeschnidae	Aeschnidae	Aeschnidae
Acarina	Acarina	Acarina	Acarina	Acarina
Aphroteniinae	Ameletopsidae	Ameletopsidae	Ancylidae	Ancylidae
Austroperlidae	Ancylidae	Ancylidae	Atyidae	Atyidae
Baetidae	Athericidae	Athericidae	Baetidae	Baetidae
Blepharoceridae	Austroperlidae	Atriplectidae	Caenidae	Caenidae
Calocidae	Baetidae	Atyidae	Calamoceratidae	Calamoceratidae
Ceratopogonidae	Blepharoceridae	Austroperlidae	Ceinidae	Ceinidae
Chironominae	Caenidae	Baetidae	Ceratopogonidae	Ceratopogonidae
Coloburiscidae	Calocidae	Caenidae	Chironominae	Chironominae
Conoesucidae	Ceratopogonidae	Calamoceratidae	Coenagrionidae	Coenagrionidae
Dixidae	Chironominae	Calocidae	Conoesucidae	Corbiculidae
Dugesiidae	Coloburiscidae	Ceinidae	Corixidae	Cordylophora
Elmidae	Conoesucidae	Ceratopogonidae	Dixidae	Corixidae
Eusiridae	Corduliidae	Chironominae	Dugesiidae	Culicidae
Eustheniidae	Corixidae	Coenagrionidae	Dytiscidae	Dytiscidae
Gripopterygidae	Corydalidae	Coloburiscidae	Ecnomidae	Ecnomidae
Helicophidae	Dixidae	Conoesucidae	Elmidae	Gerridae
Hydrobiosidae	Dugesiidae	Corduliidae	Gomphidae	Gomphidae
Hydropsychidae	Dytiscidae	Corixidae	Gripopterygidae	Gripopterygidae
Hydroptilidae	Ecnomidae	Corydalidae	Gyrinidae	Gyrinidae
Leptoceridae	Elmidae	Dixidae	Hydrobiidae	Hydrobiidae
Leptophlebiidae	Empididae	Dolichopodidae	Hydrobiosidae	Hydrometridae
Limnephilidae	Eusiridae	Dugesiidae	Hydrometridae	Hydrophilidae
Nannochoristidae	Eustheniidae	Dytiscidae	Hydrophilidae	Hydroptilidae
Neoniphargidae	Glossosomatidae	Ecnomidae	Hydropsychidae	Hyriidae
Notonemouridae	Gomphidae	Elmidae	Hydroptilidae	Janiridae
Oligochaeta	Gripopterygidae	Empididae	Leptoceridae	Leptoceridae
Orthocladiinae	Gyrinidae	Gerridae	Leptophlebiidae	Leptophlebiidae
Philopotamidae	Helicophidae	Glossosomatidae	Mesoveliidae	Mesoveliidae
Philorheithridae	Helicopsychidae	Gomphidae	Nepidae	Naucoridae
Psephenidae	Hydrobiosidae	Gripopterygidae	Notonectidae	Nepidae

SEPP (WoV) SEGMENT				
Highlands	**Forests A**	**Forests B**	**Cleared Hills and Coastal Plains**	**Murray and Western Plains**
Scirtidae	Hydrophilidae	Gyrinidae	Oligochaeta	Notonectidae
Simuliidae	Hydropsychidae	Helicophidae	Orthocladiinae	Oligochaeta
Siphlonuridae	Leptoceridae	Helicopsychidae	Parastacidae	Orthocladiinae
Tanypodinae	Leptophlebiidae	Hydrobiidae	Physidae	Parastacidae
Tipulidae	Limnephilidae	Hydrobiosidae	Psephenidae	Physidae
	Notonemouridae	Hydrophilidae	Pyralidae	Planorbidae
	Oligochaeta	Hydropsychidae	Scirtidae	Pleidae
	Oniscigastridae	Hydroptilidae	Simuliidae	Pyralidae
	Orthocladiinae	Leptoceridae	Stratiomyidae	Simuliidae
	Philopotamidae	Leptophlebiidae	Tanypodinae	Stratiomyidae
	Philorheithridae	Mesoveliidae	Tipulidae	Tanypodinae
	Polycentropodidae	Notonectidae	Veliidae	Veliidae
	Psephenidae	Odontoceridae		
	Ptilodactylidae	Oligochaeta		
	Scirtidae	Oniscigastridae		
	Simuliidae	Orthocladiinae		
	Tanypodinae	Parastacidae		
	Tipulidae	Philopotamidae		
	Veliidae	Philorheithridae		
		Physidae		
		Planorbidae		
		Polycentropodidae		
		Psephenidae		
		Ptilodactylidae		
		Scirtidae		
		Simuliidae		
		Stratiomyidae		
		Synlestidae		
		Tanypodinae		
		Temnocephalidea		
		Tipulidae		
		Veliidae		

APPENDIX 2. SIGNAL BIOTIC INDEX GRADES USED TO CALCULATE SEPP (WATERS OF VICTORIA) OBJECTIVES

Family	Grade	Family	Grade	Family	Grade
Aeshnidae	6	Gerridae	4	Oligochaeta	1
Ameletopsidae	10	Glossiphoniidae	3	Oniscigastridae	10
Amphipterygidae	8	Glossosomatidae	8	Orthocladiinae	5
Ancylidae	6	Gomphidae	7	Osmylidae	8
Aphroteniinae	8	Gordiidae	7	Palaemonidae	5
Athericidae	7	Gripopterygidae	7	Paracalliopidae	7
Atriplectididae	10	Gyrinidae	5	Paramelitidae	5
Atyidae	6	Haliplidae	5	Parastacidae	7
Austroperlidae	10	Hebridae	6	Perthiidae	6
Baetidae	5	Helicophidae	10	Philopotamidae	10
Belostomatidae	5	Helicopsychidae	10	Philorheithridae	8
Blepharoceridae	10	Hydraenidae	7	Physidae	3
Caenidae	7	Hydridae	4	Planorbidae	3
Calamoceratidae	8	Hydrobiidae	5	Pleidae	5
Calocidae	8	Hydrobiosidae	7	Podonominae	6
Ceinidae	5	Hydrometridae	5	Polycentropodidae	8
Ceratopogonidae	6	Hydrophilidae	5	Protoneuridae	7
Chironominae	6	Hydropsychidae	5	Psephenidae	5
Clavidae	5	Hydroptilidae	6	Psychodidae	2
Coenagrionidae	7	Hygrobiidae	5	Ptilodactylidae	10
Coloburiscidae	10	Hymenosomatidae	4	Pyralidae	6
Conoesucidae	8	Isostictidae	7	Scirtidae	8
Corbiculidae	6	Janiridae	5	Sialidae	4
Corduliidae	7	Leptoceridae	7	Simuliidae	5
Corixidae	5	Leptophlebiidae	10	Sphaeriidae	6
Corydalidae	4	Lestidae	7	Sphaeromatidae	5
Culicidae	2	Libellulidae	8	Spionidae	5
Curculionidae	7	Limnephilidae	8	Spongillidae	5
Diamesinae	6	Lymnaeidae	3	Staphylinidae	5
Dixidae	8	Megapodagrionidae	7	Stratiomyidae	2
Dolichopodidae	6	Mesoveliidae	4	Synlestidae	7
Dugesiidae	3	Muscidae	3	Tabanidae	5
Dytiscidae	5	Nannochoristidae	10	Talitridae	5
Ecnomidae	4	Naucoridae	5	Tanypodinae	6
Elmidae	7	Nepidae	5	Tasimiidae	7
Empididae	4	Neurorthidae	8	Temnocephalidea	6
Ephydridae	2	Noteridae	9	Tetrastemmatidae	5
Erpobdellidae	3	Notonectidae	4	Thaumaleidae	7
Eusiridae	8	Notonemouridae	8	Tipulidae	5
Eustheniidae	10	Ochteridae	5	Veliidae	4
Gelastocoridae	6	Odontoceridae	8		

Appendix C

Howqua Report

For Samples from 01 Jan 2006 to 07 May 2008

SiteNo: HOW003 Howqua River d/s of Black Dog Creek

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
			Parameters:									
04-Jan-06	2:20 PM	Grab								7		
01-Mar-06	12:00 PM	Grab			0					9		
04-Apr-06	1:05 PM	Grab			0	2			32	28		
10-May-06	1:30 PM	Grab								49		
26-Jul-06	10:30 AM	Grab								17		
23-Aug-06	11:55 AM	Grab			0	2			31	4		<0.02
18-Oct-06	12:40 PM	Grab	18.0		0	1.1		steady	30	26		<0.02
15-Nov-06	1:05 PM	Grab	11.4		0	7.9		steady	34	14		<0.02
18-Apr-07	12:55 PM	Grab							40	5		<0.02
16-May-07	12:00 PM	Grab								12		
19-Jun-07	11:10 AM	Grab								7		<0.02
18-Jul-07	1:30 PM	Grab	6.0		18	2		steady	30	2		<0.02
14-Aug-07	1:15 PM	Grab	7.6		2	2		steady	30	3		<0.02
19-Sep-07	11:55 AM	Grab	9.1			1		steady	30	6		<0.02
17-Oct-07	12:00 PM	Grab	12		0	4.4		med	29			<0.02
21-Nov-07	12:20 PM	Grab	17		5	1		steady	30			<0.02
19-Dec-07	1:36 PM	Grab	15		2	1		steady	30			
16-Jan-08	1:00 PM	Grab	18		0	1		steady	30	13		<0.02

SiteNo: HOW005 Howqua River at Tunnel Bend

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
			Parameters:									
04-Jan-06	3:05 PM	Grab								10		
01-Feb-06	12:00 PM	Grab			0					28		
01-Mar-06	12:00 PM	Grab			0					5		

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
04-Apr-06	1:45 PM	Grab			0	1			37	40		
10-May-06	2:15 PM	Grab								178		
26-Jul-06	11:20 AM	Grab								12		
23-Aug-06	1:00 PM	Grab			0	1			35	0		<0.02
18-Oct-06	1:20 PM	Grab	20.3		0	0.9		steady	40	14		<0.02
26-Oct-06	1:30 PM	Grab	15.2	6.3	0	4		steady	30			
15-Nov-06	1:50 PM	Grab	12.8		0	1.6		steady	35	28		<0.02
21-Mar-07	1:45 PM	Grab	17	7.1	45	66	103	steady	66	548	9.3	
26-Mar-07	2:30 PM	Grab	15.2	6.8	0	4		steady	40			
18-Apr-07	1:40 PM	Grab							41	14		<0.02
16-May-07	12:00 PM	Grab								19		
19-Jun-07	12:00 PM	Grab								25		<0.02
18-Jul-07	2:15 PM	Grab	6.1		18	2		steady	40	3		<0.02
14-Aug-07	2:05 PM	Grab	7.7		0	2		steady	30	7		<0.02
19-Sep-07	12:50 PM	Grab	9.6			1		steady	30	7		0.02
15-Oct-07	9:30 AM	Grab	10.2	6.8		2	93		33		10.3	
17-Oct-07	12:50 PM	Grab	12.7		0	1.6		med	33			<0.02
21-Nov-07	1:00 PM	Grab	18		5	1		steady	40			<0.02
19-Dec-07	2:25 PM	Grab	17		2	1		steady	40			
16-Jan-08	1:45 PM	Grab	21		0	1		steady	40	17		<0.02
07-Apr-08	2:30 PM	Grab	11.6	7.1		4	101		38		11.2	

SiteNo: HOW006 Howqua River at Sheep Yard Flat

Parameters:

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
04-Jan-06	3:15 PM	Grab								12		
01-Mar-06	12:00 PM	Grab			0					13		
04-Apr-06	1:55 PM	Grab			0	1			37	46		
10-May-06	2:25 PM	Grab								285		
26-Jul-06	11:30 AM	Grab								4		

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
23-Aug-06	**1:10 PM**	Grab			0	1			35	0		<0.02
18-Oct-06	**1:40 PM**	Grab	20.7		0	0.7		steady	40	9		<0.02
15-Nov-06	**2:05 PM**	Grab	14.4		0	1.5		steady	37	199		<0.02
21-Mar-07	**2:05 PM**	Grab	17.3	7.1	45	66	103	steady	66		9.3	
18-Apr-07	**1:50 PM**	Grab							42	9		<0.02
16-May-07	**12:00 PM**	Grab								41		
19-Jun-07	**12:10 PM**	Grab								9		<0.02
18-Jul-07	**2:30 PM**	Grab	6.3		18	2		steady	40	4		<0.02
14-Aug-07	**2:15 PM**	Grab	7.1		2	2		steady	30	9		<0.02
19-Sep-07	**1:00 PM**	Grab	8.9			1		steady	30	2		<0.02
17-Oct-07	**1:00 PM**	Grab	12.6		0	1		med	33			<0.02
21-Nov-07	**1:10 PM**	Grab	18		5	1		steady	40			<0.02
19-Dec-07	**2:35 PM**	Grab	18		2	1		steady	40			
16-Jan-08	**2:00 PM**	Grab	21		0	1		steady	40	30		<0.02

SiteNo: HOW007 Howqua River at Howqua Hills d/s of Blackbird Creek

Parameters:

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
04-Jan-06	**3:30 PM**	Grab								37		
01-Mar-06	**12:00 PM**	Grab			0					19		
04-Apr-06	**2:15 PM**	Grab			0	1			37	150		
10-May-06	**2:55 PM**	Grab								225		
26-Jul-06	**11:40 AM**	Grab								71		
23-Aug-06	**1:30 PM**	Grab			0	1			41	1		<0.02
18-Oct-06	**2:10 PM**	Grab	20.8		0	0.8		steady	40	23		<0.02
15-Nov-06	**2:25 PM**	Grab	14		20	1.3		falling	40	53		<0.02
21-Mar-07	**2:30 PM**	Grab	18	7.1	45	87	98	steady	68	866	8.6	
18-Apr-07	**2:10 PM**	Grab							51	35		<0.02
16-May-07	**12:00 PM**	Grab								124		
19-Jun-07	**12:35 PM**	Grab								11		<0.02

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
18-Jul-07	**2:55 PM**	Grab	6.7		18	2		steady	50	3		<0.02
14-Aug-07	**2:45 PM**	Grab	7.5		2	2		steady	50	3		<0.02
19-Sep-07	**1:25 PM**	Grab	8.9			1		steady	30	8		<0.02
17-Oct-07	**1:45 PM**	Grab	13.7		0	1		med	46			0.02
18-Oct-07	**2:10 PM**	Grab	20		0	2		falling	40			
21-Nov-07	**1:30 PM**	Grab	17		5	1		steady	50			0.02
19-Dec-07	**3:00 PM**	Grab	18		2	1		steady	50			
16-Jan-08	**2:10 PM**	Grab	21		0	1		steady	50	72		0.02

SiteNo: HOW008 Howqua River at Fry's Flat

Parameters:

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
04-Jan-06	**3:20 PM**	Grab								23		
01-Mar-06	**12:00 PM**	Grab			0					35		
04-Apr-06	**2:05 PM**	Grab			0	1			38	66		
10-May-06	**2:35 PM**	Grab								365		
26-Jul-06	**11:55 AM**	Grab								19		
23-Aug-06	**1:15 PM**	Grab			0	1			35	0		<0.02
18-Oct-06	**1:50 PM**	Grab	20.4		0	0.6		steady	40	9		<0.02
15-Nov-06	**2:05 PM**	Grab	14		20	1.3		falling	40	172		<0.02
21-Mar-07	**3:00 PM**	Grab	18.7	7.1	45	100	101	steady	81	921	8.7	0.13
18-Apr-07	**2:00 PM**	Grab							43	13		<0.02
16-May-07	**12:00 PM**	Grab								46		
19-Jun-07	**12:20 PM**	Grab								7		<0.02
18-Jul-07	**2:45 PM**	Grab	6.6		18	2		steady	40	6		<0.02
14-Aug-07	**2:25 PM**	Grab	7.2		2	2		steady	40	5		<0.02
19-Sep-07	**1:10 PM**	Grab	9.0			1		steady	40	9		<0.02
17-Oct-07	**1:30 PM**	Grab	14		0	0.8		med	35			0.03
18-Oct-07	**1:50 PM**	Grab	20		0	2		falling	40			
21-Nov-07	**1:20 PM**	Grab	18		5	1		steady	40			0.03

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
19-Dec-07	2:45 PM	Grab	19		2	1		steady	40			
16-Jan-08	10:40 AM	Grab	19		0	1		steady	40	435		<0.02

SiteNo: HOW009 Howqua River upstream of the Running Creek Campground

Parameters:

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
01-Feb-06	10:25 AM	Grab	22.9		0	1		steady		166		
01-Mar-06	8:40 AM	Grab	17.7		0	1		steady		96		
04-Apr-06	10:15 AM	Grab	13.4		0	3.7			51	69		
03-May-06	10:25 AM	Grab	12.1			1		steady				
26-Jul-06	9:05 AM	Grab	6.3			1		steady		23		
23-Aug-06	12:05 PM	Grab	7.0		0	1		steady	42	4		
15-Nov-06	10:40 AM	Grab	14			2		falling	49	105		
17-Jan-07	10:00 AM	Grab	23	7.3	0	228		steady	96			0.31
21-Mar-07	10:35 AM	Grab	15		40	150		steady	80	>2420		
18-Apr-07	9:15 AM	Grab	14		0	2		steady	60	26		
16-May-07	9:40 AM	Grab	12.8		12	12		steady	50	261		
19-Jun-07	10:00 AM	Grab	7		2	5		steady	40	15		
18-Jul-07	10:20 AM	Grab	6.5		16	2		steady	50	7		
14-Aug-07	8:40 AM	Grab	6.3		0	2		steady	40	27		
19-Sep-07	1:50 PM	Grab	10.3		0	1		steady	40	8		
18-Dec-07	11:30 AM	Grab	20	7.3	0	2	86	steady	49	26	7.9	<0.02
23-Jan-08	11:25 AM	Grab	20		0	2		steady	49	60		

SiteNo: HOW016 Howqua River at Flow Gauging Station at Terika

Parameters:

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
01-Feb-06	**10:55 AM**	Grab	23.1		0	1				161		
01-Mar-06	**9:10 AM**	Grab	17.5		0	1				127		
04-Apr-06	**10:40 AM**	Grab	13.4		0	3.1			51	93		
03-May-06	**10:50 AM**	Grab	12.4			1						
26-Jul-06	**9:45 AM**	Grab	6.3			1				9		
23-Aug-06	**12:30 PM**	Grab	7.4		1	1			43	2		
15-Nov-06	**11:05 AM**	Grab	14			1		falling	48	158		
17-Jan-07	**9:30 AM**	Grab	23	7.3	0	23		falling	83			0.08
21-Mar-07	**11:30 AM**	Grab	15.4		40	180		steady	80	>2420		
18-Apr-07	**9:50 AM**	Grab	14.7		0	2		steady	60	58		
16-May-07	**10:20 AM**	Grab	12.9		12	12		steady	50	201		
19-Jun-07	**10:22 AM**	Grab	7		2	5		steady	50	20		
18-Jul-07	**10:40 AM**	Grab	6.7		16	2		steady	50	20		
14-Aug-07	**9:05 AM**	Grab	6.7		0	2		steady	40	28		
19-Sep-07	**1:55 PM**	Grab	10.2		0	1		steady	50	6		
18-Dec-07	**12:40 PM**	Grab	20	7	0	2	93	steady	51	36	8	0.02
19-Mar-08	**10:05 AM**	Grab	21		0	1		steady	60			

SiteNo: HOW020 Howqua River at Jamieson Road Bridge

Parameters:

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
01-Feb-06	**11:15 AM**	Grab	23.6		0	1				231		
01-Mar-06	**9:30 AM**	Grab	17.6			1				240		
04-Apr-06	**11:10 PM**	Grab	13.8		0	3.8			52	276		
03-May-06	**11:10 AM**	Grab	12.8			1						
26-Jul-06	**12:25 PM**	Grab	7	7.9	6	1			46	11	5	<0.02
23-Aug-06	**12:50 PM**	Grab	8.0		0	1			45	6		<0.02
16-Oct-06	**11:05 AM**	Grab	14	7.6	0	1	132		52		12	0.02
12-Dec-06	**11:50 AM**	Grab	19.8		0	4.25			63			
20-Dec-06	**11:50 AM**	Grab	19.8		0	4.52			63			0.03

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Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
17-Jan-07	**9:20 AM**	Grab	23	7.3		80		falling	80			
23-Jan-07	**9:30 AM**	Grab				32		steady	186			
06-Feb-07	**9:30 AM**	Grab				4		steady	133			
21-Feb-07	**1:30 PM**	Grab	26	8.2	0	3.3		falling	110		11.1	<0.02
26-Feb-07	**9:30 AM**	Grab		7.4		233		steady	139			
06-Mar-07	**9:30 AM**	Grab	17	7.6		56	180	steady	112		16	
20-Mar-07	**12:20 PM**	Grab	19	7.4	20	24	106	steady	99		9.6	
21-Mar-07	**12:15 PM**	Grab	16.2		40	200		steady	80	>2420		0.03
29-Mar-07	**9:30 AM**	Grab	15			223	111	steady	82		10.7	
18-Apr-07	**4:00 PM**	Grab		7.6	0	10.8	106	steady	60	79	10	<0.02
04-May-07	**11:40 AM**	Grab	14	7.7	17	500	100	steady	79		9.2	
16-May-07	**12:15 PM**	Grab	13.1	7.5	12	19	103	steady	55	>2420	9.7	<0.02
05-Jun-07	**11:00 AM**	Grab	7.5	7.4	0	27	112	steady	53		13	
19-Jun-07	**10:45 AM**	Grab	7	7.4	2	13.4		steady	50	26		<0.02
02-Jul-07	**12:00 PM**	Grab	9.3	7.5	17	30		rising	55			
18-Jul-07	**11:05 AM**	Grab	6.9	7.2	16	10	87	steady	50	28	10.3	0.02
14-Aug-07	**9:20 AM**	Grab	6.8		0	2		steady	40	25		0.02
20-Aug-07	**11:15 AM**	Grab	21	7.5	0		93	steady	54		8.3	
19-Sep-07	**2:25 PM**	Grab	10		0	2		steady	46			
20-Sep-07	**1:05 PM**	Grab	15	7.8	3	1	122	steady	50	22	12	0.02
09-Oct-07	**3:50 PM**	Grab	15		0	2	97	steady	42		9.7	
16-Oct-07	**2:45 PM**	Grab	15		0	3	104	steady	45		10	
08-Nov-07	**1:10 PM**	Grab	14		0	52	90	steady	52		8.8	
20-Nov-07	**4:45 PM**	Grab	25	7.3	0	2	90	steady	52		7.1	
04-Dec-07	**5:05 PM**	Grab	20	6.9	20	2	80	steady	50		7.4	
18-Dec-07	**1:30 PM**	Grab	21	7	0	3	93	steady	51	46	8	0.02
19-Mar-08	**10:25 AM**	Grab	21	7.5	0	1	90	steady	50		8	

Waterwatch Victoria Application (WVA) - Site Report

SiteNo: JAM015 Jamieson River above Eildon at Woods Point Road Bridge

Date:	Time:	Sample Type:	Parameters: Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
26-Jul-06	**11:55 AM**	Grab	7	7.8	6	1			32		8	<0.02
23-Aug-06	**10:30 AM**	Grab			0	1			73			<0.02
20-Sep-06	**12:45 PM**	Grab	13	7.6	3	2	122		35		12	0.02
16-Oct-06	**10:40 AM**	Grab	14	7.6		1	117		43		12	0.02
15-Nov-06	**10:30 AM**	Grab	15	7.8	3	5			53			
20-Dec-06	**10:30 AM**	Grab	19.1	7.6	0	3.00			73			<0.02
17-Jan-07	**10:50 AM**	Grab	24.8	7.5		4.3		steady	124			<0.02
21-Feb-07	**11:10 AM**	Grab	24.1	7.2	0	3.5	120	steady	105		11	<0.02
26-Feb-07	**1:20 PM**	Grab		7.6		34		steady	112			
20-Mar-07	**11:50 AM**	Grab	19	7.2	20	11	106	steady	86		9.6	<0.02
29-Mar-07	**10:00 AM**	Grab	15.6			101	111	steady	65		11	
18-Apr-07	**3:45 PM**	Grab	15.7	7.3	0	8	105	steady	54		10.3	<0.02
02-May-07	**12:00 PM**	Grab	13	7.6	8	9.2	103	steady	62		9.9	
16-May-07	**11:20 AM**	Grab	12.4	7.1	12	65	103	steady	47		10.1	<0.02
05-Jun-07	**10:45 AM**	Grab	7.8	7.6	0	38	93	steady	39		11	
19-Jun-07	**11:45 AM**	Grab	6	7.3		14		steady	41			<0.02
02-Jul-07	**11:00 AM**	Grab	9	7.6	17	33		rising	46			
18-Jul-07	**11:55 AM**	Grab	6.8	6.9	16	18	87	steady	37		10.3	<0.02
14-Aug-07	**9:25 AM**	Grab	7.0		0			steady	33			<0.02
19-Sep-07	**1:30 AM**	Grab	10		0	2		steady	35	10		<0.02
09-Oct-07	**3:10 PM**	Grab	14		0	2	98	steady	32		10	
08-Nov-07	**12:45 PM**	Grab	14		0	19	91	steady	36		9.3	
20-Nov-07	**4:15 PM**	Grab	23	7.3	0	7	91	steady	39		7	0.02
04-Dec-07	**4:45 PM**	Grab	19	7	20	15	89	steady	38		8.2	
18-Dec-07	**10:45 AM**	Grab	19	7.1	0	5	83	steady	40	128	7.4	
19-Mar-08	**10:30 AM**	Grab	20	7.4	0	7	91	steady	55		8.1	

Waterwatch Victoria Application (WVA) - Site Report
RUN009 Running Creek u/s of Campground at Howqua

Date:	Time:	Sample Type:	Parameters: Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
01-Feb-06	10:00 AM	Grab	16.6		0	1				249		
01-Mar-06	8:15 AM	Grab	12.8		0	1				>2419		
26-Jul-06	8:45 AM	Grab	6.9			1				10		
23-Aug-06	11:40 AM	Grab	7.2		0	1			87	11		
15-Nov-06	10:55 AM	Grab	10			1		stag	101	41		
17-Jan-07	12:00 PM				0			dry				
18-Apr-07	8:45 AM	Grab	13.8		0	1		steady	160	99		
16-May-07	9:15 AM	Grab	13.9		12	45		falling	160	1553		
19-Jun-07	9:25 AM	Grab	8		2	5		steady	130	7		
18-Jul-07	10:00 AM	Grab	7.4		16	2		steady	90	3		
14-Aug-07	8:05 AM	Grab	6.8		0	2		steady	80	7		
19-Sep-07	1:25 PM	Grab	11.5		0	1		steady	90	0		
18-Dec-07	12:00 PM	Grab	19	7	0	1	99	steady	91	17	9	<0.02
23-Jan-08	11:10 AM	Grab	21	6.6	0			steady	93	76		
19-Mar-08	9:05 AM	Grab	18		0	1		steady	100			

SiteNo: RUN010 Running Creek below Campground at Howqua

Date:	Time:	Sample Type:	Parameters: Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
01-Feb-06	10:10 AM	Grab	18.4		0	1				161		
01-Mar-06	8:30 AM	Grab	13.4		0	1				81		
03-May-06	10:19 AM				0							
26-Jul-06	8:50 AM	Grab	6.9			1				12		
23-Aug-06	11:50 AM	Grab	7.3		0	1			85	6		

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Temp ° C	pH pH Units	Rainfall mm	Turb NTU	% O2 Sat	Flow ML/day	EC µS/cm	Ecoli orgs/100 mL	DO mg/L	TPhos mg/L P
15-Nov-06	**10:25 AM**	Grab	10			1		stag	102	6		
17-Jan-07	**12:00 PM**				0			dry				
18-Apr-07	**9:00 AM**	Grab	13.5		0	1		steady	160	133		
16-May-07	**9:25 AM**	Grab	13.8		12	45		falling	170	1414		
19-Jun-07	**9:35 AM**	Grab	8		2	50		steady	130	9		
18-Jul-07	**10:10 AM**	Grab	7.4		16	2		steady	90	2		
14-Aug-07	**8:30 AM**	Grab	6.5		0	2		steady	80	6		
19-Sep-07	**1:35 PM**	Grab	11.5		0	1		steady	90	3		
18-Dec-07	**11:45 AM**	Grab	19	6.9	0	1	98	steady	19	13	8	<0.02
23-Jan-08	**11:20 AM**	Grab	21	6.6	0			steady	93	61		
19-Mar-08	**9:15 AM**	Grab	18		0	1		steady	100			

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