HUGHES CREEK COMMUNITY GROUP

WATER MONITORING REPORT 1999-2007

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.

FRONT COVER : HUGHES CREEK MONITORING GROUP TESTING TURBIDITY FOR QAQC - HUGHES CREEK AT BUNGLE BOORI

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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 the data 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.

Waterwatch and Community Waterwatchers have monitored a number of sites along Hughes Creek and its tributaries since 1995. During 2007, the network monitored 10 sites on a monthly basis for four parameters. They were:

1. E.coli
2. Electrical Conductivity (Salinity)
3. Turbidity; and
4. Temperature.

Total Phosphorus samples were also taken regularly at Hughes Creek at the Goulburn Valley Highway (HUG020).

This report contains the following information:

1. Monitoring Plan
2. Information about water quality parameters
3. A tabular summary of all data with some interpretation collected at sites in the Hughes Creek sub-catchment
4. Graphical representation of turbidity, electrical conductivity and E.coli along the length of the waterway
5. Comparisons of local water quality data with State Environment Protection Policy (SEPP) guidelines

The report provides a summary of testing results since 1999 and should be used to stimulate discussion on the state of water quality in the Hughes Creek and its tributaries, and potential actions to improve water quality. There is the possibility of using water quality data collected in the program, to discover trends in water quality over time and to measure the effects of improvement works carried out in the sub-catchment.

Monitoring Plan

Name of Project Activity Area: Hughes Creeks

Monitoring Coordinator: Kirsten Hogan

Why are you monitoring ?

Waterwatch has an on-going objective to encourage the community to become involved in monitoring local waterways to learn more about water quality issues. The data that is collected through this monitoring program can be used to target on-ground works to improve water quality.

Hughes Creek residents originally began monitoring due to concerns with E.coli levels in Hughes Creek. The aim was to try and pinpoint any areas contributing to E.coli contamination in the creek.

During 2006/08, an intensive monitoring project targetting salinity is being undertaken across the Goulburn Broken Catchment. This Community Stream Sampling Project aims to identify areas in the Murray Darling Basin where salt stores are negatively affecting river quality and discharging saline water into the rivers. Data from this project will be used to prioritise areas for on-ground mitigation works and future investment in salinity management. Hughes Creek has also participated in teis program.

Who will use the data?

The community is the main user of Waterwatch data. However, the data is available to other organisations and individuals that have an interest in catchment water quality. These interest groups include the Australian Government, State Government agencies, local government, Catchment Management Authorities (CMAs), Natural Resource Management (NRM) bodies and managers, community groups and local farmers and landholders.

How will the data be used?

Waterwatch data is used by the community to understand issues regarding water quality in waterways. The data is then available to develop local action plans to improve water quality and to measure the effectiveness of these plans.

The Community Stream Sampling Project has specific objectives that include:

- *Identifying areas in the Murray Darling Basin where salt stores 'hot spots' are negatively affecting river quality and discharging saline water into the rivers;*
- *Providing information to assist community groups, Catchment Management Authorities and regional Natural Resource Management (NRM) bodies and NRM managers make decisions on prioritising areas for on ground works and future investment in salinity management.*
- *Establishing a web-based database to allow community groups, Catchment Management Authorities and regional Natural Resource Management bodies and NRM managers to access stream salinity data, salinity mapping and other geophysical and hydrological data to aid in decision-making for future investment*

Where will you monitor?

See Site list on page 6 ***– in separate document***

Who will be involved and how?

See Participant list on page 6 ***– in separate document***

What will be monitored?

E.coli is the main focus of this monitoring group. Turbidity, Electrical Conductivity, Temperature and sometimes Total Phosphorus are other parameters that are monitored by this group. Turbidity and Electrical conductivity are two of the parameters monitored to develop the Water Quality sub-index of the Index of Stream Condition in Victoria and Electrical Conductivity is the parameter required for the Community Stream Sampling project.

Data quality controls?

See Data Confidence Plan

What methods will you use?
When and how often will you monitor?

See Community Monitoring Manual for the methods and procedures used in the Waterwatch Program and the Community Stream Sampling Project.

A statistical analysis of water quality data requires monthly monitoring as a minimum.

How will the data be managed and reported?

All water quality data is sent to the local Waterwatch Coordinator for QA checks. The data is then forwarded to the Regional Data Management Coordinator for entry onto the Regional Waterwatch Database. Electrical Conductivity data is forwarded to the Bureau of Rural Sciences on a three monthly basis.

WATERWATCH
Goulburn/Broken Catchment
Communities Caring for Catchments

Australian Government
Bureau of Rural Sciences

Turbidity

Turbidity is the cloudiness in water and is the result of suspended material in the water. This suspended material decreases the ability of light to pass through the water and thus can limit plant growth beneath the surface. 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, algae and chemicals. However, the most frequent cause of turbidity in rivers and other water bodies is inorganic material from soil weathering and erosion.

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

- The water loses its ability to support a large variety of aquatic organisms. Where there is less light penetrating the water, there will be less photosynthesis occurring and therefore a lower level of oxygen in the water.
- The water becomes warmer because the 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 farming practices such as contouring and stubble retention.

Turbidity in the Hughes Creek

Hughes Creek and tributaries have been tested for turbidity by Waterwatch since 1999, and the community since the end of 2002. Table 1 below shows median results for each calendar year.

Site Code	Site Description	TURBIDITY MEDIANS (NTU)								
		1999	2000	2001	2002	2003	2004	2005	2006	2007
HUG002	**Hughes Creek on Springs Road**					**15***	**24***	**15**		*20*
HUG003	**Hughes Creek at 'Boathole' in Ruffy**	**13**	**4**		**12***	**12**	**14**	**12**	*12*	**12***
STW004	**Stewarts Creek on Highlands Road**							**7**	**8**	**11**
STW005	**Stewarts Creek on Dropmore Road**					**12**	**18**	**13**	**13**	**1**
COU003	*County Creek at Hills*				15*	17*	24	17*		
COU006	*County Creek above Stoney Creek*					17*	*10*	15*		*18*
COU010	*County Creek at Tarcombe*					17	16	14	*10*	15
PON010	***Ponkeen Creek at Tarcombe***				8*	6	8	10	9*	10
HUG008	**Hughes Creek at Bungle Boori**	**18**	**4***		**7***	**5**	**5**	**14**	**8***	**8**
HUG009	**Hughes Creek after camp ground on Wicket Hill Road**					**9**	**5**	**9**	*3*	*7**
HUG015	**Hughes Creek at Avenel**					**4***	**15***			
HUG020	**Hughes Creek at Goulburn Valley Highway**	**5***	*81*		**7**	**17**	**12**	**15**	**9**	**9.5**
JAC005	*Jack Creek at Highlands*					2	10	6	2	5

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 with * indicate <5 data sets used for interpretation.
- results in italic with no colour coding are one off "Snapshot" samples

Table 1

Table 1 and Figure 1 below show turbidity results in Hughes Creek varied from excellent to poor in 2007. It is surprising to see turbidities at the top end of Hughes Creek, such as Springs Road, and the Boathole in Ruffy, are higher than the more downstream sites such as at Goulburn Valley Highway.

Figure 1 shows the median turbidity at each site for 2007. It can be seen that County Creek has higher turbidity results than most other sites, however despite these, and the higher results upstream in Hughes Creek, the most downstream sites of Hughes Creek still have "Excellent" turbidity ratings. It can normally be assumed that turbidity will increase as a waterway moves downstream, so these are both surprising and pleasing results for 2007.

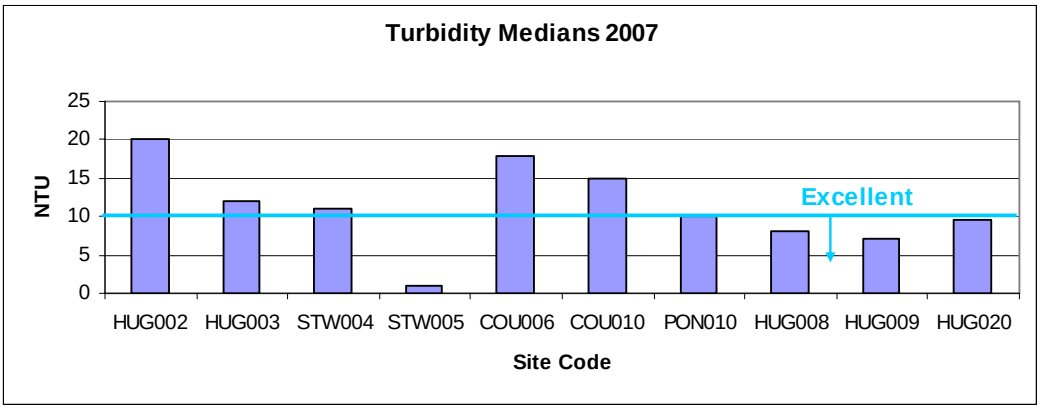

Fig 1

Figure 2 below shows the average median turbidity at each site for the nine year period that monitoring has been undertaken. This reflects the data for 2007 above, showing slightly elevated turbidities at the beginning of the catchment, and in County Creek, but still being between "Excellent" and "Fair" at the bottom end of the catchment.

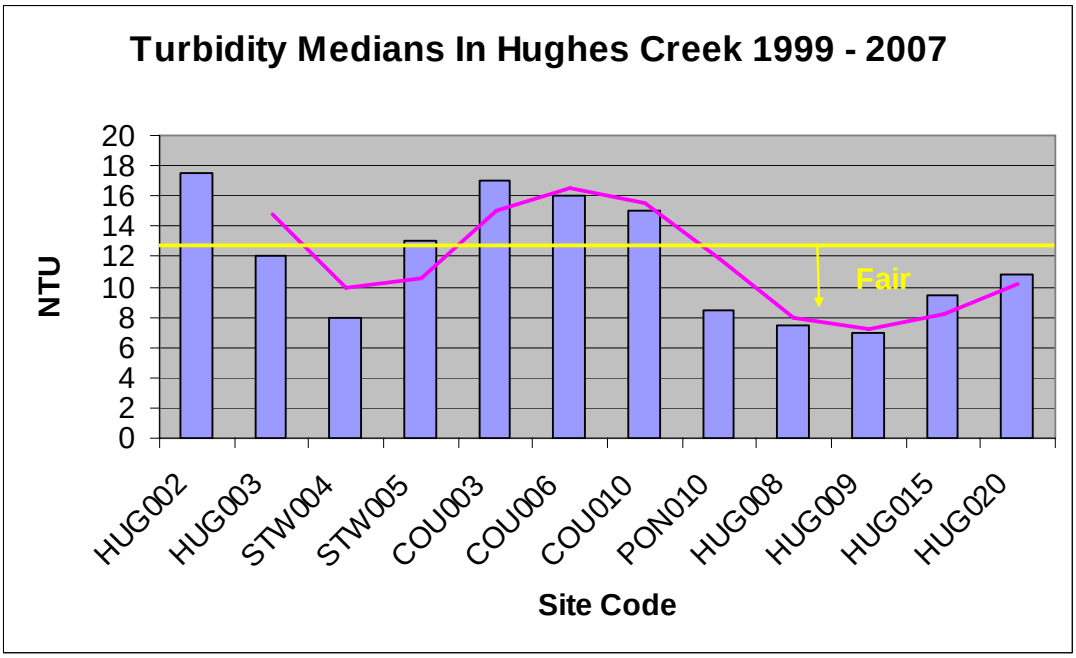

Fig 2

In comparison, another site further upstream in the catchment, the Goulburn River above Jamieson, will typically record "Excellent" turbidity levels, ranging between 1 and 5 NTU in 2006. In contrast, a site on the Goulburn River at Shepparton can produce results around 30 NTU, or sometimes a lot higher. All of these results are affected by such things as the presence of riparian vegetation along the waterways (a quality riparian zone acts as a filter for turbidity and phosphorus in run-off water) and local agricultural practices (land cleared for agricultural pursuits can contribute to turbidity if best practices aren't employed).

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 and western Victoria. The most concentrated problem area is in the Murray-Goulburn Irrigation District, but dryland salting problems also occurs around and to the west of Seymour.

Dryland salinity is caused when deep rooted trees are replaced with seasonal crops or grasses that do not pump the water into the atmosphere as efficiently. If trees are cleared higher up in a catchment, this can lead to dramatic rises in watertables. Solutions to reduce salinity levels include revegetation of recharge areas and buffer strips along local streams.
The following outline helps to put salt levels in perspective.

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 Hughes Creek

Hughes Creek and its tributaries have been tested for salinity since the end of 2002. Table 2 below shows median results for each calendar year.

Site Code	Site Description	SALINITY MEDIANS (EC)				
		2003	2004	2005	2006	2007
HUG003	Hughes Creek at 'Boathole' in Ruffy	177*	162	130*	*166*	
STW004	Stewarts Creek on Highlands Road			*296*		370
STW005	Stewarts Creek on Dropmore Road					300
COU003	*County Creek at Hills*		*256*	*179*		
COU010	*County Creek at Tarcombe*	272*	270*	*200*	*246*	300*
PON010	*Ponkeen Creek at Tarcombe*	221*	211*	*155*	*191*	
HUG008	Hughes Creek at Bungle Boori	256*	220	177	*235*	
HUG009	Hughes Creek after camp ground on Wicket Hill Road	263*	220	199*	-	290*
HUG015	Hughes Creek at Avenel	324*	256*			
HUG020	Hughes Creek at Goulburn Valley Highway	324	285	271	294	351

Rating: Conductivity for the Valleys –

<80 EC Excellent, <240 EC Good, <400 EC Fair, <600 EC Poor, >600 EC Degraded

Note: *- results with * indicate <5 data sets used for interpretation.*
- results in italic with no colour coding are one off "Snapshot" samples

Table 2

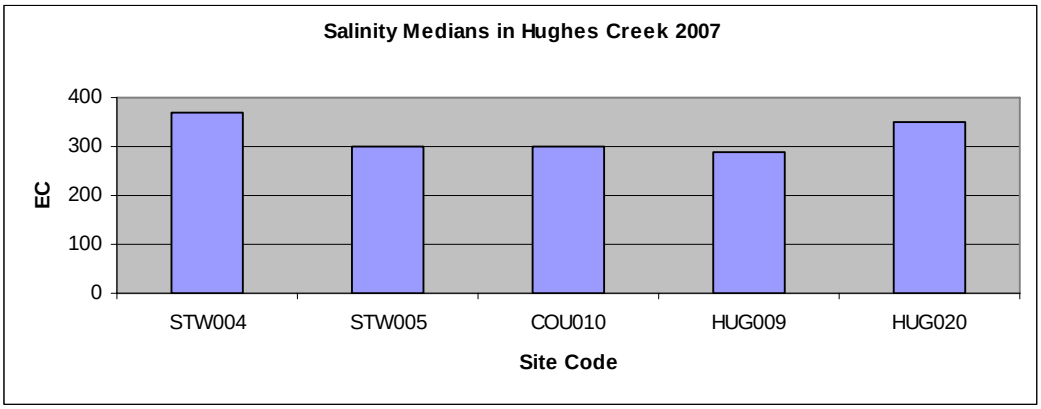

Fig 3

Figure 3 shows median results reveal an "FAIR" level of salinity at all sites monitored for salinity in 2007.

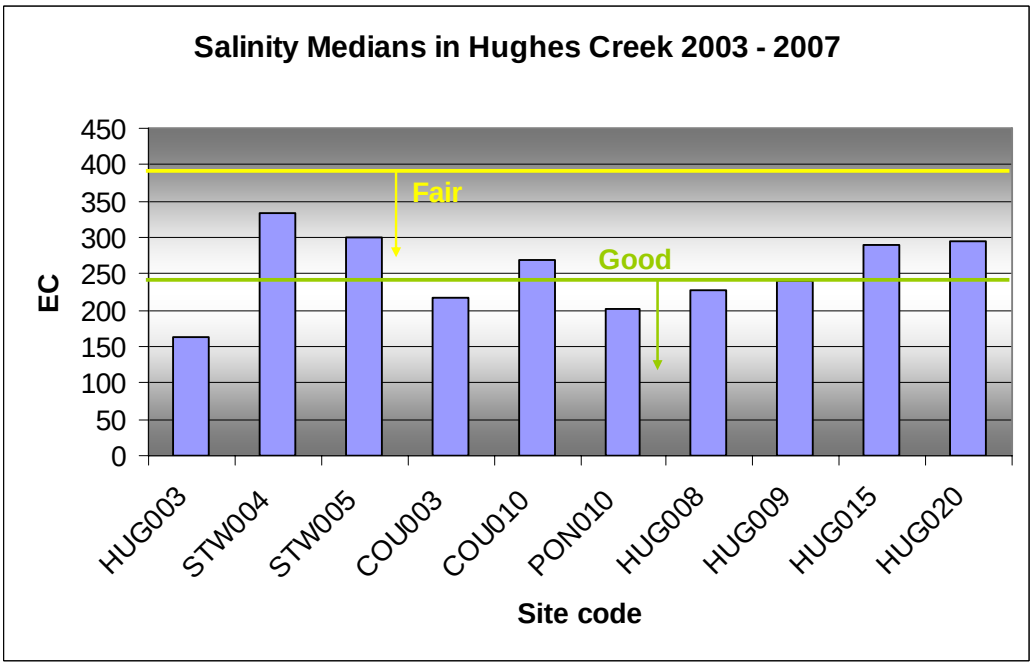

Fig 4

Average median salinity results for the period 2003 to 2007 displayed in Table 1 and Figure 4 show Stewarts Creek and County Creek have had slightly higher Electrical Conductivity results than Hughes Creek sites over the monitoring period, however all are still within the "FAIR" rating in the period 2003 to 2007. In general, salinity levels can be expected to rise as a waterway moves through a catchment. This has been demonstrated here with the median salinity levels rising marginally as the Creek moves down the catchment.

These are pleasing results as the salt levels are generally low. This information also becomes our baseline data, with the consistent results making it easy for Hughes Creek monitors to detect a problem should one arise.

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

An increase 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 can occur.

Nutrients in waterways (particularly phosphorus) became an important parameter to monitor when deciding the quality of water in a waterway when the Water Quality Strategy was produced for the Goulburn Broken Catchment. Phosphorus is also a parameter included in the chemical sub-index as part of the Victorian Index of Stream Condition rating system for measuring the condition of a waterway. Total phosphorus is used rather than soluble (reactive) phosphorus, as it includes all forms of phosphorus present in a waterway rather than the soluble component.

Phosphorus in Hughes Creek

Hughes Creek at Goulburn Valley Highway is the only site that has been tested for total phosphorus through to 2007. Because of the time involved and the resources required to test for total phosphorus, only the most downstream site is now being monitored for phosphorus.

Site Code	Site Description	TOTAL PHOSPHORUS MEDIANS (mg/L)				
		2003	2004	2005	2006	2007
HUG003	**Hughes Creek at 'Boathole' in Ruffy**	**0.08***	**0.06***	**0.04***	-	-
COU010	*County Creek at Tarcombe*	0.05*	0.05*	*0.03*	*<0.02*	-
PON010	*Ponkeen Creek at Tarcombe*	0.03*	0.05*			-
HUG008	**Hughes Creek at Bungle Boori**	**0.03**	**0.04***	**0.04**	-	-
HUG009	**Hughes Creek after camp ground on Wicket Hill Road**	**0.03***	**0.04***	**0.04**	-	-
HUG015	**Hughes Creek at Avenel**	**0.02***		-	-	-
HUG020	**Hughes Creek at Goulburn Valley Highway**	**0.02**	**0.04***	**0.04**	**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 no colour coding are one off "Snapshot" samples

Table 3

The total phosphorus levels in the Hughes Creek have been classified as "GOOD" for the last two years. In comparison, other sites further upstream in the catchment, such as the Goulburn River above Jamieson, King Parrot Creek or Sunday Creek in Broadford have recorded median total phosphorus for 2007 of 0.02 mg/L. The Goulburn River in Shepparton has also recorded total phosphorus of 0.02 mg/L. All of these results are affected by such things as the presence of riparian vegetation along the waterways (a quality riparian zone acts as a filter for turbidity and phosphorus in run-off water) and local agricultural practices (land cleared for agricultural pursuits can contribute to turbidity if best practices aren't employed). Rain events inevitably cause an increase in total phosphorus in a waterway.

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 Hughes Creek

Hughes Creek and tributaries have been tested for E.coli by Waterwatch and the community since the end of 2002. Table 4 below shows median results from 2002.

Site Code	Site Description	E.coli MEDIANS (orgs/100ml)					
		2002	2003	2004	2005	2006	2007
HUG002	**Hughes Creek on Springs Road**	**-**	**56***	**161***	**219**	**-**	*461*
HUG003	**Hughes Creek at 'Boathole' in Ruffy**	**65**	**74**	**281**	**103**	**308***	**99***
STW004	**Stewarts Creek on Highlands Road**				**677**	**50**	**103**
COU003	*County Creek at Hills*		-	-	*241**	-	*133*
COU006	*County Creek above Stoney Creek*		-	*89*	523*	-	*78*
COU010	*County Creek at Tarcombe*	488	687	581	517	1120*	548
PON010	***Ponkeen Creek at Tarcombe***	361	365	435	423	-	307
HUG008	**Hughes Creek at Bungle Boori**	**345**	**580**	**365**	**461**	**846***	**291**
HUG009	**Hughes Creek after camp ground on Wicket Hill Road**	**308**	**461**	**218**	**435**	*1553*	**336***
HUG015	**Hughes Creek at Avenel**	**-**	**-**	**-**	**-**	**-**	**-**
HUG020	**Hughes Creek at Goulburn Valley Highway**	**-**	**-**	**-**	**285***	**981***	**112***

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. Most of the sites sampled by the Hughes Creek Monitoring Group do not meet this guideline, but it must be noted that SEPP Guidelines use five samples within a 30 day period, whereas sites in Table 4 and Figure 5 are monitored once a month.

It can be seen from Figure 5 that somewhere between County Creek above Stony Creek and County Creek at Tarcombe there is quite a significant increase in E.coli levels. This maybe from Stony Creek entering and bringing in high readings, or maybe something is occurring somewhere along County Creek to result in the higher levels at County Creek at Tarcombe. These increased levels from County Creek and high levels from Ponkeen Creek are resulting in increased levels of E.coli in Hughes Creek at Bungle Boori also.

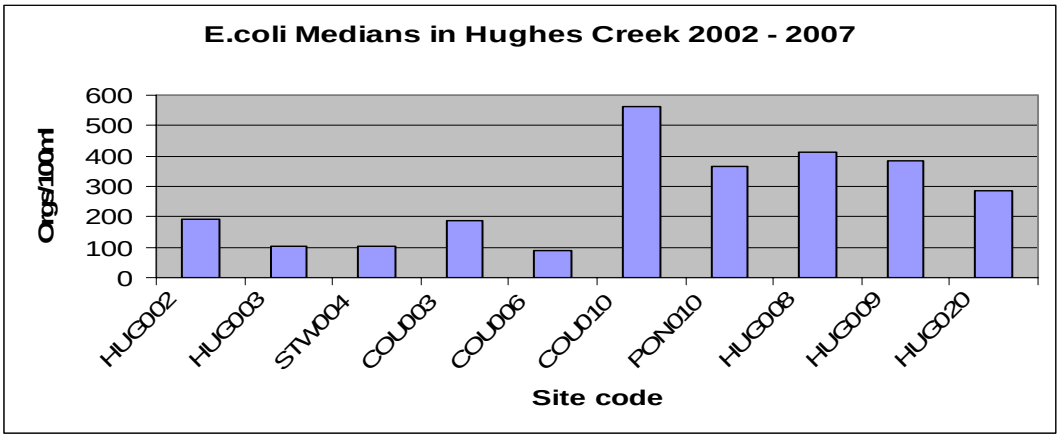

Fig 5

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.

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

Colours highlight the SEPP (WoV) segments and objectives applicable within the Goulburn Broken CMA region for the tests of relevance to the YRCG.

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 – A								
• all other areas	≤25	≤500	≥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
Murray and Western Plains								
• lowlands of Kiewa, Ovens, Goulburn & Broken catchments	≤45	≤900	≥85	110	≤30	≤500	≥6.4	≤7.7

Table 5

Note: SEPP objectives are long term theoretical goals for water quality. It is not expected that waterways will comply at this stage

2007 results in Hughes Creek Region compared to SEPP objectives – 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
HUG002 *Hughes Creek on Springs Road*								
HUG003 *Hughes Creek at 'Boathole' at Ruffy*								
STW004 *Stewarts Creek at Highlands Road*					24	450	5.5	6.0
STW005 *Stewarts Creek at Dropmore Road*					17	330	5.5	6.5
COU010 *County Creek at Tarcombe*					16			
PON010 *Ponkeen Creek at Tarcombe*					20			
HUG008 *Hughes Creek at Bungle Boori*					15			
HUG009 *Hughes Creek after camp ground on Wicket Hill Road*					9			
HUG020 *Hughes Creek at Goulbun Valley Highway*	20		63	92	12	359	6.8	7.4

Table 6

When comparing with SEPP objectives, three quarters of the readings taken should fall below the 75th percentile. All sites in the Hughes Creek monitoring program with greater than four data sets have been included in Table 5 above. It can be seen that Total phosphorus and electrical conductivity results are all within the SEPP guidelines, which is excellent considering that SEPP objectives are long term theoretical goals for water quality. It is not expected that waterways will comply at this stage. With the exception of Hughes Creek after the camp ground on Wicket Hill Road, all sites exceed SEPP objectives for turbidity. 25th percentiles for pH have not been met for both the Stewarts Creek sites. These results may not be regarded as "accurate", but rather an indication, as these two sites are tested for pH using strips, which are not deemed as reliable as a more accurate pH meter.

Macroinvertebrates

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 Hughes Creek were assessed against the SEPP WoV biological objectives (State Environmental Protection Policy – Waters of Victoria), outlined in 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.

Biological regions from the SEPP (WoV) are as follows:

1. **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 'edge' habitat i.e. slow to no flow areas which can include pool, undercut banks and backwaters. 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. 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.

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The Waterwatch sites for 2007 are

1. Hughes Creek at Picnic Point – Waterwatch code HUG010

2. Results

Table 7 has been reproduced from the SEPP WoV (Victorian Environment Protection Authority 2003). 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. All three objectives should be met in region B4 and failure to meet any one of the objectives should trigger further investigation.

Table 7 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
B4 riffle	23	5.5	N/A	22
B4 edge	26	5.5	N/A	22

N/A Not applicable in that region

Table 8. Biotic indices results for one site in the Goulburn Broken Waterwatch 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
HUG010 2007	Hughes Creek at Picnic Point	B4	Edge	37	5.8	N/O	*29	Pass
EDG 1998 EPA site	Hughes Creek at Hughes Creek Road	B4	Edge	35	5.5	N/O	NR Ausrivas used	Fail

Marginal value
Fail
N/O No objective set for that indicator in that SEPP (WoV) region
NR – Not Relevant as AUSRIVAS score used instead.
*The Key Families combined Habitat score was calculated using only autumn and spring edge samples as no riffle exists at the site.

3. Discussion

The data provided for Hughes Creek at Picnic Point shows that Hughes Creek is meeting the SEPP biological objectives for the edge sample in 2007. No riffle samples were taken as this site has a completely sandy substrate with no riffles present.

The edge habitat is predominately *Phragmites australis* (common reed) with some rushes and also knotweed species present.

TABLE 9

Families present in spring surveys for
HUG010 –Hughes Creek at Picnic Point Biological Region B4 - Edge
Shaded boxes represent Key Families for Key Families Combined Habitat score.

Order	Family	SIGNAL GRADE SEPP	Common name
Ephemeroptera	Leptophlebiidae	10	Mayfly nymph
Trichoptera	Calamoceratidae	8	Sleeping bag caddis larva
Diptera	Dixidae	8	U bent fly larva
Coleoptera	Scirtidae	8	Marsh beetle larva
Odonata SO Epicroctophora	Urothemistidae (Libellulidae)	8	Dragonfly nymph
Coleoptera	Dytiscidae	8	Diving beetle & larva
Trichoptera	Leptoceridae	7	Stick caddis larva
Odonata SO Epicroctophora	Hemicorduliidae (Corduliidae)	7	Dragonfly nymph
Decapoda	Parastacidae	7	Yabby
Plecoptera	Gripopterygidae	7	Stonefly nymph
Ephemeroptera	Caenidae	7	Mayfly nymph
Odonata SO Zygoptera	Synlestidae	7	Damselfly nymph
Odonata SO Epicroctophora	Gomphidae	7	Dragonfly nymph
Diptera	S.F. Tanypodinae	6	Non biting midge larva
Gastropoda	Ancylidae	6	Limpet
Hempitera	Gelastoceridae	6	Toad bug
Odonata SO Epicroctophora	Telephlebiidae (Aeshnidae)	6	Dragonfly nymph
Diptera	SF. Chironominae	6	Non biting midge larva
Trichoptera	Hydroptilidae	6	Micro caddis larva
Diptera	Tipulidae	5	Cranefly larva
Coleoptera	Gyrinidae	5	Whirligig beetle
Ephemeroptera	Baetidae	5	Mayfly nymph
Diptera	S.F. Orthocladiinae	5	Non biting midge larva
Coleoptera	Hydrochidae Hydrophilidae	5	Water scavenger beetle
Hemiptera	Hydrometridae	5	Water measurer
Diptera	Simuliidae	5	Blackfly larva
Hemiptera	Corixidae	5	Water boatmen
Diptera	Tabanidae	5	March fly larva
Trichoptera	Ecnomidae	4	Free swimming caddis larva
Hemiptera	Notonectidae	4	Backswimmer
Hemiptera	Gerridae	4	Water strider
Hemiptera	Veliidae	4	Water cricket
P. Platyhelminthes	Dugesiidae	3	Black flatworm
Gastropoda	Physidae	3	Pond snail
C. Hirudinea	Glossiphoniidae	3	Black leech
Gastropoda	Lymnaeidae	3	Pond snail right coil
Acarina		NA	Water mite
	No of Families 37 (36 for SIGNAL index)	Total 208	
		SIGNAL index score 5.8	

Monitoring in 2008

The Hughes Creek Monitoring Group is encouraged to continue their monitoring program in 2008 and into 2009. Monthly testing provides a statistically robust dataset than can be used to interpret the water quality along a waterway.

Results for 2007 show that the sub-catchment has elevated levels of turbidity when compared with the SEPP objective for a waterway in this part of the catchment. However, Electrical Conductivity and Total Phosphorus are well under the SEPP objectives which is excellent considering they are long term theoretical goals, and it is not expected waterways will meet them at this stage.

The results for Electrical Conductivity from this monitoring program are being forwarded to the Commonwealth Bureau of Rural Sciences for inclusion in the two year Community Stream Sampling Program.

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/cmEC) mountain	<30	<90	<150	<225	>225
Conductivity (uS/cmEC) valley	<80	<240	<400	<600	>600
Conductivity (uS/cmEC) 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 <8.0	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.

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- 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;
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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

Hughes Creek Project Report

For Samples from 01 Jan 2005 to 31 Dec 2007

SiteNo: HUG002 Hughes Creek on Springs Road

Date:	Time:	Sample Type:	Parameters: Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
09-Mar-05	**10:35 AM**	Grab	>2419				0.04		548		0	20
21-Apr-05	**12:00 PM**	Grab	>2419						238		0	15
26-Jul-05	**10:00 AM**	Grab	>2419						219		10	25
17-Aug-05	**12:00 PM**	Grab	>2419		136		0.07		68			12
26-Oct-05	**7:45 AM**	Grab	93						60		4	15
16-Jan-07	**9:00 AM**	Grab	>2419						461		5	20

SiteNo: HUG003 Ruffy "Boat Hole" on Upper Hughes Creek

Date:	Time:	Sample Type:	Parameters: Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
09-Mar-05	**10:00 AM**	Grab	>2419				0.06		1203		0	22
21-Apr-05	**10:00 AM**	Grab	>2419		171		<0.02		93		0	12
25-May-05	**9:40 AM**	Grab	1986						1414		6	<12
23-Jun-05	**7:30 PM**	Grab			47		0.01				12	12
17-Aug-05	**8:00 AM**	Grab	>2419		130		0.05		93			12
21-Sep-05	**12:00 PM**	Grab	>2419						112	mediu		10
26-Oct-05	**12:00 PM**	Grab	63						46		8	12
15-Mar-06	**12:00 PM**	Grab	>2419						866			
17-May-06	**12:00 PM**	Grab	1203						167		0	
29-Sep-06	**3:45 PM**	Grab	2419	6.8	166	13	0.05	9	308		0	12
17-Jan-07	**9:15 AM**	Grab	>2419						75		4	12
19-Jun-07	**9:00 AM**	Grab	2420						40	mediu	3	12
16-Oct-07	**8:45 AM**	Grab				205			122			
18-Dec-07	**9:35 AM**	Grab	>2420		170	18			210	low	0	12

Waterwatch Victoria Application (WVA) - Site Report
SiteNo: STW004 Stewarts Creek on Highlands Road

			Parameters:									
Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
21-Apr-05	6:00 PM	Grab	>2419						308		0	2
24-May-05	6:00 PM	Grab	>2419						1986		6	3
22-Jun-05	7:00 AM	Grab			296		<0.02				21	11
20-Jul-05	9:00 PM	Grab									0	<8
16-Aug-05	7:30 PM	Grab	166						55		13	<25
20-Sep-05	5:30 PM	Grab	1986						1553		2.5	0
25-Oct-05	5:45 PM	Grab	196			15			131		3	14
15-Nov-05	8:00 PM	Grab	>2419	6.5		12			1046		4.5	5
07-Feb-06	7:10 PM	Grab	1986	5.8		16			47		0	33
14-Mar-06	6:00 PM	Grab	>2419	5.7		17			435		27	15
26-Apr-06	6:00 PM	Grab	650	6		11			50		0	0.5
16-May-06	5:00 PM	Grab	>2419	6		11			579		0	3
29-Jun-06	10:00 AM	Grab		5.5		5						0.5
16-Jul-06	2:00 PM	Grab				13						25
25-Jul-06	4:40 PM	Grab		6		9					0	0.5
23-Aug-06	8:00 AM	Grab		6		6					0	0.5
20-Sep-06	6:30 AM	Grab	>2420	6.0		10			261		1	8
19-Oct-06	6:00 AM	Grab	66	6.0		11			1		0	12
15-Nov-06	6:30 AM	Grab	261	6.0		10			40		2	< 8
17-Jan-07	9:20 AM	Grab	>2419	6		21			236	0	0	35
21-Feb-07	7:15 AM	Grab								0		
20-Mar-07	6:30 PM	Grab	1046	6		17			308		40	19
18-Apr-07	7:40 AM	Grab	30	6		12			>2420		0	25
15-May-07	5:10 PM	Grab	83	6	680	14			16		4	10
19-Jun-07	6:00 AM	Grab	435	6.0	470	6			23		1	1
18-Jul-07	7:00 AM	Grab		5.5	370	3					19	11
04-Sep-07	7:00 AM	Grab		6	280	6					0	10

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
18-Sep-07	**5:45 PM**	Grab	154	6	350	11			101		4.5	1
15-Oct-07	**5:30 PM**	Grab	1986	5.5	340	14			88		0	10
18-Dec-07	**9:15 AM**	Grab	548	6	430	15			104		0	80

SiteNo: STW005 Stewarts Creek at Dropmore Road

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
07-Jan-05	**11:45 AM**	Grab									5	9
21-Jan-05	**11:15 AM**	Grab									4	15
04-Feb-05	**12:15 PM**	Grab									153	50
11-Mar-05	**1:00 PM**	Grab									0	12
13-May-05	**2:30 PM**	Grab									0	5
27-May-05	**12:15 PM**	Grab									1	8
10-Jun-05	**12:15 PM**	Grab									3	8
24-Jun-05	**11:00 AM**	Grab									2	28
12-Aug-05	**11:30 AM**	Grab									10	20
08-Sep-05	**8:15 AM**	Grab				11					0	20
25-Oct-05	**5:00 PM**	Grab				16					3	13
07-Feb-06	**6:00 PM**	Grab		6.3		20					0	35
14-Mar-06	**5:15 PM**	Grab		5.7		18					27	15
26-Apr-06	**5:30 PM**	Grab		6		12					0	1
16-May-06	**4:45 PM**	Grab		6		12					0	5
28-Jun-06	**4:45 PM**	Grab		6.5		7						12
17-Jul-06	**1:00 PM**	Grab				11						13
25-Jul-06	**4:05 PM**	Grab		6		10					0	13
23-Aug-06	**9:20 AM**	Grab		6		7					0	16
20-Sep-06	**7:20 AM**	Grab		6.0		11					1	25
19-Oct-06	**7:50 AM**	Grab		6.0		13					0	23
15-Nov-06	**7:15 AM**	Grab		6.0		10					2	12
17-Jan-07	**9:55 AM**	Grab		6		22					0	1

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
21-Feb-07	**8:40 AM**	Grab		6		21				Low	0	1
20-Mar-07	**6:00 PM**	Grab		5.5		18					40	72
18-Apr-07	**7:55 AM**	Grab		6		12					0	18
15-May-07	**5:20 PM**	Grab		6	420	14					4	1
19-Jun-07	**7:30 AM**	Grab		6.0	350	4.8					1	15
18-Jul-07	**7:20 AM**	Grab		5.5	310	3					19	19
04-Sep-07	**7:10 AM**	Grab		6.5	300	7					0	10
18-Sep-07	**5:15 PM**	Grab		6	300	13					4.5	1
15-Oct-07	**5:15 PM**	Grab		6	290	16					0	1
18-Dec-07	**10:15 AM**	Grab		6.5	250	19					0	1

SiteNo: COU003 County Creek at JJ Hill on Longwood Ruffy Road

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
09-Mar-05	**12:00 PM**	Grab	>2419				0.06		308		0	20
21-Apr-05	**12:00 PM**	Grab	>2419						206		0	15
25-May-05	**9:15 AM**	Grab	>2419						276		6	15
17-Aug-05	**12:00 PM**	Grab	261		179		<0.02		133			18
16-Oct-07	**8:15 AM**	Grab	158						133			
18-Dec-07	**9:30 AM**	Grab			270	19.5				low	0	15

SiteNo: COU006 County Creek above Stoney Creek

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
09-Mar-05	**9:30 AM**	Grab	>2419						125		0	15
25-May-05	**7:50 AM**	Grab	>2419						921		6	15
16-Jan-07	**8:45 AM**	Grab	>2419						78		0	18

Waterwatch Victoria Application (WVA) - Site Report

SiteNo: COU010 County Creek at bridge at Tarcombe

			Parameters:									
Date:	**Time:**	**Sample Type:**	**Tcolif orgs/100 mL**	**pH pH Units**	**EC µS/cm**	**Temp ° C**	**TPhos mg/L P**	**DO mg/L**	**Ecoli orgs/100 mL**	**Flow ML/day**	**Rainfall mm**	**Turb NTU**
09-Mar-05	**9:00 AM**	Grab	>2419						548		0	12
21-Apr-05	**7:00 AM**	Grab	>2419						517		0	12
25-May-05	**8:45 AM**	Grab	>2419						980		6	11
22-Jun-05	**2:25 PM**	Grab			200		0.03				28	22
26-Jul-05	**11:00 AM**	Grab	>2419						727		12	18
17-Aug-05	**9:55 AM**	Grab	>2419						517		18	15
21-Sep-05	**10:00 AM**	Grab	1986						488			12
26-Oct-05	**9:20 AM**	Grab									4	17
26-Oct-05	**12:00 PM**	Grab	133						96		6	20
15-Mar-06	**12:00 PM**	Grab	>2419						1120			
17-May-06	**12:00 PM**	Grab	>2419						1413		0	
29-Sep-06	**4:00 PM**	Grab	1986	7.1	246	14	<0.02	10.4	140		0	10
16-Jan-07	**8:30 AM**	Grab	>2419						1986		0	18
19-Jun-07	**9:55 AM**	Grab	>2420						154	mediu	5	15
19-Sep-07	**6:40 AM**	Grab	345		270	9.8			167		0	12
21-Nov-07	**7:30 AM**	Grab			300	20.2			1553		0	16
18-Dec-07	**6:30 AM**	Grab	>2420		310	17.8			548		0	13

SiteNo: PON010 Ponkeen Creek at bridge at Tarcombe

			Parameters:									
Date:	**Time:**	**Sample Type:**	**Tcolif orgs/100 mL**	**pH pH Units**	**EC µS/cm**	**Temp ° C**	**TPhos mg/L P**	**DO mg/L**	**Ecoli orgs/100 mL**	**Flow ML/day**	**Rainfall mm**	**Turb NTU**
09-Mar-05	**8:55 AM**	Grab	2419						579		0	8
21-Apr-05	**6:50 AM**	Grab	>2419						410		0	10
25-May-05	**8:20 AM**	Grab	>2419						435		6	10

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
22-Jun-05	2:15 PM	Grab			155		0.05				28	20
26-Jul-05	11:20 AM	Grab	>2419						921		15	15
17-Aug-05	9:15 AM	Grab	>2419						187		18	10
26-Oct-05	9:15 AM	Grab	106						106		4	15
15-Mar-06	12:00 PM	Grab	>2419						548			
29-Sep-06	4:10 PM	Grab	1553	6.8	191	14.0	0.02	9.8	276		0	9.3
16-Jan-07	8:15 AM	Grab	>2419						>2419		0	25
19-Jun-07	10:00 AM	Grab	>2420						145	mediu	5	20
19-Sep-07	7:00 AM	Grab	2420		200	9.3			115		0	10
21-Nov-07	7:45 AM	Grab			280	20			307		0	10
18-Dec-07	6:40 AM	Grab	1414		270	17.8			326		0	10

SiteNo: HUG008 Hughes Creek at Bungle Boori ford

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
09-Mar-05	8:30 AM	Grab	>2419						276		0	<8
21-Apr-05	8:30 AM	Grab	>2419		237		<0.02		613		0	5
25-May-05	8:30 AM	Grab	>2419						687		4	15
22-Jun-05	3:30 PM	Grab			216		0.06				32	28
26-Jul-05	11:45 AM	Grab	2419						461			25
17-Aug-05	12:00 PM	Grab	387		166		0.06		210			25
21-Sep-05	6:55 AM	Grab	2419		161		0.04		921			13
26-Oct-05	7:45 AM	Grab	727		177		0.03		345		2	11
15-Mar-06	12:00 PM	Grab	>2419						921			
17-May-06	7:00 AM	Grab	1986				0.05		770		0	5
29-Sep-06	4:15 PM	Grab	1986	7.3	235	17.4	0.02	9.7	140		0	10
17-Jan-07	7:45 AM	Grab	>2419				0.04		291		0	<8
19-Jun-07	9:30 AM	Grab	2420						1046	mediu	0	15
13-Aug-07	1:55 PM	Grab	140		270	10.9			99			10
19-Sep-07	7:15 AM	Grab	1120		270	10.2			411		0	5

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
16-Oct-07	**8:55 AM**	Grab	435		270	13.4			248		0	5
21-Nov-07	**7:30 AM**	Grab			290	20.1			230		0.25	25

SiteNo: HUG009 Hughes Creek after camping area on Wicket Hill Road

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
09-Mar-05	**8:40 AM**	Grab	>2419				0.04		172		0	6
21-Apr-05	**8:40 AM**	Grab	>2419		240		0.02		1414		0	<6
25-May-05	**9:55 AM**	Grab	>2419						579		4	17
22-Jun-05	**3:45 PM**	Grab			222		0.04				32	30
21-Sep-05	**7:05 AM**	Grab	387		161		0.04		160			5
26-Oct-05	**8:00 AM**	Grab	649		176		0.07		435		2	11
17-May-06	**7:15 AM**	Grab	>2419				<0.02		1553		0	3
17-Jan-07	**8:00 AM**	Grab	>2419				0.03		1553		0	<8
13-Aug-07	**2:30 PM**	Grab	201						166			
19-Sep-07	**7:25 AM**	Grab	1414		270	10.2			178		0	5
16-Oct-07	**9:05 AM**	Grab	548		290	13.9			326		0	5
21-Nov-07	**7:45 AM**	Grab			310	19.1			345		0.25	10

SiteNo: HUG010 Hughes Creek at Picnic Point at Kestral Vale

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
10-Apr-06	**3:00 PM**	Grab		6.5	260	16.1						7
12-Oct-06	**3:45 PM**	Grab		6.7	270	23.6						4
03-May-07	**2:30 PM**	Grab		6.7	330	15.8						6
13-Dec-07	**9:20 AM**	Grab		7.9	287	19.1		9.94			0	4

Waterwatch Victoria Application (WVA) - Site Report
SiteNo: HUG020 Hughes Creek at Goulburn Valley Highway

			Parameters:									
Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
16-Feb-05	2:00 PM	Grab		7.3	283	19	0.04	8.1			125	17
09-Mar-05	1:15 PM	Grab	2419	7.3	281	17	0.04	8.8	308		0	14
21-Apr-05	12:00 PM	Grab	141	7.4	275	14.5		9.7	141		0	12
25-May-05	11:00 AM	Grab		7.6	267	12	0.02	9.9			2	6
15-Jun-05	12:00 PM	Grab		7.3	277	0	0.03	10.3			0	13
21-Jul-05	11:35 AM	Grab			297	7		11.3			0	10
17-Aug-05	11:30 AM	Grab		0	203	9	0.09	10.6				23
21-Sep-05	1:30 PM	Grab	1553	7.2	210	13	0.04	9.7	261		0	21
26-Oct-05	11:20 AM	Grab	1986	7.1	254	17	0.05	8.1	866		40	21
16-Nov-05	1:00 PM	Grab		7.1	238	18	0.05	8.0			0	15
08-Feb-06	11:00 AM	Grab	2419	7.1	326	18	0.02	6.7	547		0	9
15-Mar-06	11:15 AM	Grab	>2419	7.2	322	17	<0.02	7.4	1414			15
27-Apr-06	1:30 PM	Grab		7.4	275	14	<0.02				0	7
17-May-06	1:00 PM	Grab		7.2	283	12	<0.02	9.8			0	13
26-Jul-06	12:30 PM	Grab		7	266	10	<0.02				0	11
23-Aug-06	11:35 AM	Grab		7	271	10	<0.02				0	7
30-Sep-06	2:30 PM	Grab		7.4	294	15.6	0.02	9.7			0	8.8
15-Nov-06	12:45 PM	Grab		7.1	309	14.5	<0.02	8.0			2	13
20-Dec-06	11:15 AM	Grab		7.3	484	18.0	0.04	5.4			0	8.9
17-Jan-07	12:50 PM									0	0	
21-Feb-07	12:15 PM	Grab								0		
21-Mar-07	12:10 PM									0	20	
18-Apr-07	12:10 PM									0	0	
16-May-07	12:40 PM	Grab		7.2	350	15.7	<0.02	8.0			5	13
19-Jun-07	11:50 AM	Grab		7.1	351	7.4	<0.02	10.2			0	6.9
18-Jul-07	12:10 PM	Grab		6.8	346	6.5	<0.02	10.2			7	14
14-Aug-07	12:05 PM	Grab	172	6.8	360	8.4	0.02		112		0	6.6

Waterwatch Victoria Application (WVA) - Site Report

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
19-Sep-07	**1:00 PM**	Grab		7.0	337	12.2	0.02	9.6			0	11
16-Oct-07	**12:30 PM**	Grab	986	7.4	350	16.8	<0.02	8.1	687		0	11
21-Nov-07	**1:10 PM**	Grab		7.1	379	20.8	0.03	2.9			0	7.8
18-Dec-07	**11:10 AM**	Grab	1120	7.1	358	20.6	0.05	4.5	58		0	8.0

SiteNo: JAC005 Jack Creek at Highlands

Parameters:

Date:	Time:	Sample Type:	Tcolif orgs/100 mL	pH pH Units	EC µS/cm	Temp ° C	TPhos mg/L P	DO mg/L	Ecoli orgs/100 mL	Flow ML/day	Rainfall mm	Turb NTU
12-Jan-05	**2:30 PM**	Grab				16.6					0	2
24-Jan-05	**2:00 PM**	Grab		5.5		17.7					0	2
08-Feb-05	**12:00 PM**	Grab									4.5	10
14-Mar-05	**12:00 PM**	Grab				14.8					0	2
05-May-05	**2:00 PM**	Grab				14.9					0	2
17-May-05	**12:00 PM**	Grab		5.5		9.9					0	2
15-Aug-05	**2:00 PM**	Grab									16.5	80
01-Sep-05	**12:00 PM**	Grab									65.5	50
19-Sep-05	**12:00 PM**	Grab				9.7					3.5	12
10-Oct-05	**12:00 PM**	Grab				10.5					2.5	10
31-Oct-05	**12:00 PM**	Grab		5.5		14.3					20.6	20
01-Dec-05	**1:00 PM**	Grab				14.7					1.5	2
18-Jan-06	**12:00 PM**	Grab				15.4					0	2
06-Feb-06	**12:00 PM**	Grab				15.1					0	2
20-Feb-06	**12:00 PM**	Grab		5.5		14.3					0	2
15-Mar-06	**12:00 PM**	Grab				13.1					21	2
21-Jun-06	**2:00 PM**	Grab									25	20

Waterwatch Victoria Application (WVA) - Site Report
SiteNo: TAU005 Taungarong Creek at Lades Road colvert

			Parameters:									
Date:	**Time:**	**Sample Type:**	**Tcolif orgs/100 mL**	**pH pH Units**	**EC µS/cm**	**Temp ° C**	**TPhos mg/L P**	**DO mg/L**	**Ecoli orgs/100 mL**	**Flow ML/day**	**Rainfall mm**	**Turb NTU**
07-Jan-05	**12:00 PM**	Grab									5	8
21-Jan-05	**11:30 AM**	Grab									4.5	10
04-Feb-05	**12:30 PM**	Grab									153.5	33
11-Mar-05	**1:15 PM**	Grab									0	21
13-May-05	**2:45 PM**	Grab									0	7
27-May-05	**12:30 PM**	Grab									0.5	12
10-Jun-05	**12:30 PM**	Grab									3	9
24-Jun-05	**11:15 AM**	Grab									1.5	40
12-Aug-05	**11:45 AM**	Grab									9.5	20
27-Aug-05	**12:00 PM**	Grab		5.5		11.5					0	55