Aquatic ecosystem condition reports

2009 panel assessment of creeks and drains in the South East NRM region

Issued November 2011

EPA 964/11: This information sheet describes the outcome of the panel assessment of creeks and drains in the South East Natural Resources Management (NRM) region during 2009.

Introduction

The Environment Protection Authority (EPA) coordinates a monitoring, evaluation and reporting (MER) program on the aquatic ecosystem condition of South Australian creeks and rivers. This MER program is designed to meet several objectives:

- Providing a statewide monitoring framework for creeks and rivers that revolves through the NRM Regions with sufficient frequency to allow for State of the Environment Reporting purposes.
- Describing aquatic ecosystem condition for broad general public understanding.
- Identifying the key pressures and management responses to those pressures.
- Providing a useful reporting format that can support environmental decision making within government, community and industry.

This information sheet provides a summary of the scientific work used in assessing monitoring data from creeks and rivers. Aquatic ecosystem science is not always rigid and precise; it is often open to different interpretations in several respects. Therefore, the EPA has decided that the best way to assess the condition of streams is through an expert panel deliberation that uses a consistent descriptive modelling approach. The panel members comprised an environmental consultant, a biologist from the biomonitoring team at the Australian Water Quality Centre (AWQC), and two biologists from the EPA (the authors of this assessment). All have at least 10 years experience in monitoring and assessing a range of streams across South Australia.

The panel members were:

- Peter Goonan, EPA (primary author)
- Tracy Corbin, EPA
- Sonia Barter, AWQC
- Chris Madden, Freshwater Macroinvertebrates.

This information sheet is a technical document that contains relatively sophisticated concepts and content. It summarises the scientific assessment of data collected from creeks and drains in the South East NRM region during 2009.

The assessment

The expert panel assessed 71 sites sampled in the South East (SE) during 2009. Members of the expert panel individually rated each site using a descriptive model for interpreting change in aquatic ecosystems in relation to increasing levels of disturbance (Davies and Jackson 2006). The assumption was that biological (ecological) condition deteriorates as the degree of human disturbance in the catchment increases, and conversely, the best condition occurs where there is little to no human disturbance of the environment (Figure 1).

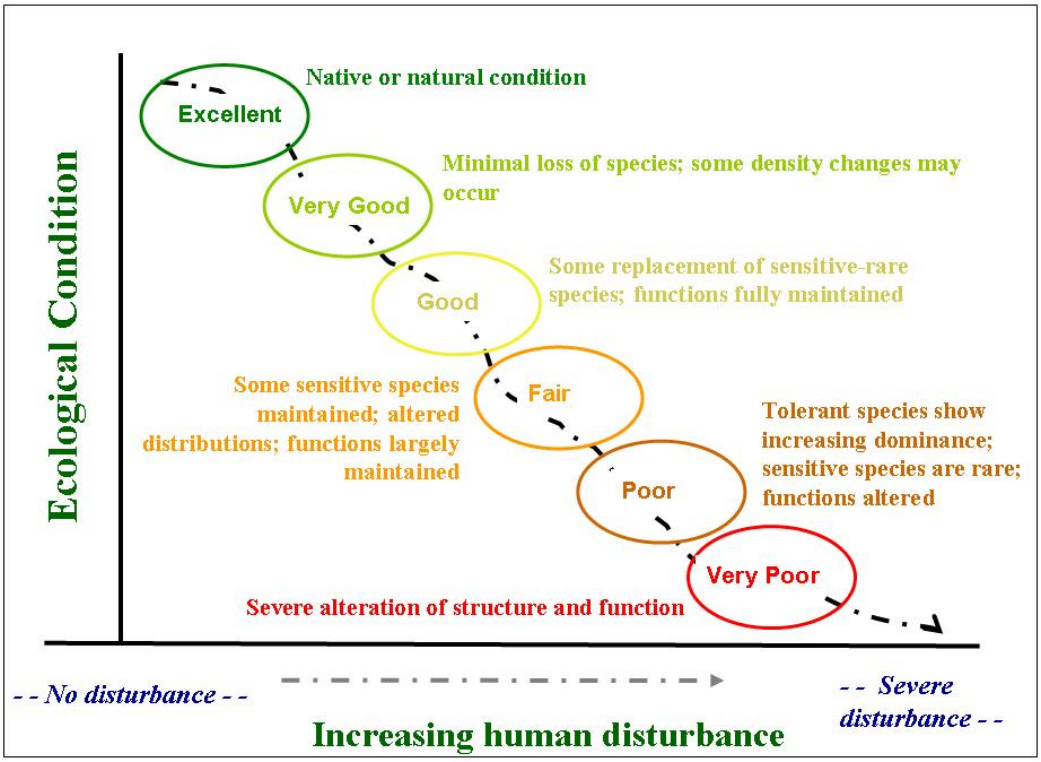

Figure 1 **Human disturbance gradient showing the six different ecological condition grades or ratings ranging from excellent (best) to very poor (worst) with a brief definition of each**

The process used to grade or rate sites involved the following steps. Firstly, a conceptual model describing the ecological responses to a general disturbance gradient in the SE was developed, reviewed and updated (Table 1). Secondly, a taxa list was compiled for the region based on data collected in 2009, describing the expected biotic assemblage for each of six possible ratings (Table 2). Thirdly, each site was given a rating based on the macroinvertebrate assemblages, vegetation assemblages and extent, water chemistry and sediment condition recorded during autumn and spring sampling periods. Lastly, the individual ratings derived by the panel members were combined to produce an overall, or final, rating for each site (Table 3).

The final reported ratings were derived by initially determining the mode (most common rating from the panel ratings for each site), and in cases where two possible ratings were still possible, a precautionary philosophy was used to select the poorer rating.

The ratings in the model range from Excellent to Very Poor. However, given the degree of land clearance and development in the region, the panel considered that Excellent no longer occurs and that Very Good was also not evident in 2009, probably due to the combined effects of the prolonged drought in a largely drained agricultural region.

Consequently, two sites were assessed as Good, 24 Fair, 40 Poor and five were Very Poor. In the majority of cases, the panel members assigned similar ratings or were within one rating class of each other. Four sites, however, were

assigned a range of different ratings by the panel, including Blackford Drain near Kingston, Reedy Creek Road Drain, Reedy Creek-Wilmot Drain and Tatiara Creek at Bordertown. The latter site produced the most varied results with two panel members assigning a Fair rating and the other members assigning a Very Poor rating; the latter result was selected as the final rating for this report using the approach to scoring that was agreed by the panel.

Table 1 Conceptual model of ecological responses to a disturbance gradient in the South East NRM region

Rating	Excellent	Very Good	Good	Fair	Poor	Very Poor
Stressor description	As naturally occurs: not present in SE as constructed drains and four streams near Bordertown have been heavily cleared for agriculture.	Least impacted: not present, based on 2009 data as constructed drains and four streams near Bordertown have been heavily cleared for agriculture; small creeks and drains in lower SE may demonstrate this state on occasions.	Best condition sites showing initial signs of nutrient enrichment: not common in SE where drains and few natural streams largely occur in an agricultural setting; most likely to occur in small creeks and drains in lower SE.	Moderate nutrient enrichment: commonly occurring in SE where many drains and agricultural creeks show enrichment effects.	Gross nutrient enrichment: commonly occurring in SE where many drains and agricultural creeks show high levels of enrichment effects.	Severely altered: recently constructed drains and urban drains providing limited habitat and poor water quality for ecosystem values to be supported or to have established.
Biological assemblages	Native assemblages; usually with many rare or sensitive species present; typically high EPT[1] richness; no symptoms of stress and no introduced aquatic species present. Note that ephemeral habitats may have a rich fauna of colonising insects (eg beetles, waterbugs and dipterans) but usually abundances of all species are low.	Best of what is left assemblages; high richness; intolerants and specialist taxa dominate abundances; may include some introduced species present in low abundances.	Typical assemblages for least impacted waterways; good richness; generalist assemblage that includes at least some rare and sensitive species; emerging symptoms of stress in relation to nutrients and fine sediments; at least some remnant native vegetation present.	Impaired assemblages; generalists and tolerant taxa dominate numbers which usually includes some very abundant taxa; sensitive and rare taxa, if present, in very low numbers; usual absence of some taxa expected for the available habitats present; at least some trees present in the local catchment and banks.	Degraded assemblages; tolerants and generalists dominate but numbers generally reduced although 1–2 generalist taxa may be present in high abundances; only 1–2 rare or sensitive species present in low abundances or absent; often few or 1–2 scattered trees in the local catchment and banks.	Severely degraded assemblages with few taxa and generally low abundances; may have large number of one tolerant taxon such as oligochaetes, mosquito larvae, amphipods (*Austrochiltonia*) or chironomids (*Chironomus, Procladius* and *Tanytarsus)*; can include organic feeders from highly polluted waters such as syrphid larvae; vegetation often completely comprised introduced species with little to no remnant native vegetation.

Rating	Excellent	Very Good	Good	Fair	Poor	Very Poor
Water chemistry conditions	As naturally occurs; no human contaminants present and pest species not impacting on water quality (eg nutrients, hormones).	Best condition sites with associated water quality; high proportion natural features means well oxygenated and low in nutrients and turbidity.	Largely unremarkable water quality with at least some nutrients present at higher than expected concentrations, coupled with at least one plant indicator showing emerging signs of enrichment effects (eg either chlorophyll *a* >10 ug/L, macrophyte cover >10% cover and/or filamentous algae >35% cover) but site not overwhelmed.	Fair water quality with generally saturated dissolved oxygen (when sampled during the day), at least one nutrient present at high concentrations and high algal and higher plant growths (eg either chlorophyll *a* >10 ug/L, macrophyte cover >10% cover and/or filamentous algae >35% cover) evident on occasions.	Poor water quality with generally saturated dissolved oxygen (when sampled during the day), nutrients present at high concentrations and high plant productivity evident at the site (eg usually chlorophyll *a* >10 ug/L, macrophyte cover >10% cover and filamentous algae >35% cover on occasion).	Very poor water quality with at least one parameter at a toxicant concentration that limits aquatic diversity; often very low dissolved oxygen and may be saline and enriched in nutrients but algal and plant growth limited.
Physical habitat and flow patterns	Natural habitat and flow patterns; no farm dams present; range of sediment types and not always anaerobic.	Near natural habitat and flow regimes; mostly well vegetated catchments with few dams present; range of sediment types and not always anaerobic.	Good habitat structure and flow patterns; extent of dam development has not caused an obvious loss of riffle habitats; range of sediment types and not always anaerobic.	Fair habitat structure and flow patterns; many dams may be present in the catchment; anaerobic fine sediments usually present except when large algal growths present.	Poor habitat structure and flow patterns; may have many dams present in the catchment; anaerobic fine sediments usually present except when large algal growths present.	Severe modifications to physical habitat and flow patterns; little to no remnant native vegetation remaining; cleared agricultural or urban sites; anaerobic fine sediments often dominate.

Rating	Excellent	Very Good	Good	Fair	Poor	Very Poor
Human activities and sources in the catchment	No obvious human disturbances but may include roads and sparse residential housing that is sewered; no point sources and diffuse pollution not detectable by the extent of native vegetation surrounding the waterway.	No significant human disturbances but may include some sewered housing and roads; no point source discharges and diffuse pollution not obviously affecting the aquatic ecosystem due to the extent of native vegetation surrounding the waterway.	Effects of human disturbance becoming obvious; point sources may be present but do not dominate flows; good riparian zones help to mitigate diffuse pollution effects.	Point and diffuse source enrichment effects evident; riparian zone not effective at mitigating nutrients and fine sediment entering waterway.	Obvious point and diffuse source enrichment effects present; unbuffered channel; major changes to catchment landuse with little remnant vegetation remaining and agriculture and/or urban uses dominate.	Severe point and/or diffuse source effects that may include toxicant responses; effects dominate water quality and biological responses with little signs of the original waterway evident; unbuffered channel that has undergone extreme modifications in an agricultural or urban setting.

[1] EPT = Ephemeroptera + Plecoptera + Trichoptera which refers to a commonly used biological index that counts the number of species and/or individuals of the mayflies, stoneflies and caddisflies collected, with these insects expected to represent the more sensitive macroinvertebrate species in a sample.

Table 2 List of biota expected to occur for each rating in the South East.

Note: Excellent and Very Good ratings were not considered to occur in the region in 2009. Attributes listed follow the sequence described by Davies & Jackson (2006).

Rating	Good	Fair	Poor	Very Poor
Attribute 1*: Rare and regionally endemic long-lived taxa not often collected	**Decapoda** *Euastacus bispinosus* and *Geocharax*	**Decapoda** *Euastacus bispinosus* and *Geocharax*	**Decapoda** *Geocharax*	None present
Attribute 2*: Sensitive, rare or vulnerable specialist taxa with narrow environmental requirements	**Ephemeroptera** *Centroptilum elongatum, Offadens, Atalophlebia*; **Trichoptera** *Lingora* and *Taschorema;* **Diptera** *Austrosimulium* and *Apsectrotanypus*; **Fish** Yarra Pygmy Perch, Southern Pygmy Perch, Congolli	**Ephemeroptera** *Offadens, Atalophlebia*; **Trichoptera** *Lingora* and *Taschorema*; **Diptera** *Apsectrotanypus*; **Fish** Southern Pygmy Perch, Congolli	**Ephemeroptera** *Atalophlebia*; **Fish** Southern Pygmy Perch	None present
Attribute 3: Regionally uncommon, restricted, or ubiquitous taxa	**Mollusca** *Angrobia*; ***Amphipoda*** *Austrogammarus*; **Decapoda** *Paratya*; **Diptera** *Dixidae*; **Coleoptera** *Aulonogyrus*; **Plant** *Vallisneria*	**Mollusca** *Angrobia*; **Amphipoda** *Austrogammarus*; **Decapoda** *Paratya*; **Hemiptera** *Diplonychus*, *Naucoris congrex, Paraplea, Ranatra*; **Diptera** *Dixidae*; **Coleoptera** *Aulonogyrus*; **Plant** *Vallisneria*	**Hemiptera** *Diplonychus*, *Naucoris congrex, Paraplea, Ranatra*	None present
Attribute 4: Opportunistic or generalist taxa	**Mollusca** *Glyptophysa*; **Acarina** *Arrenurus, Piona;* **Decapoda** *Amarinus*; **Ephemeroptera** *Cloeon, Tasmanocoenis*; **Trichoptera** *Notalina, Oecetis, Triplectides, Hellyethira*; **Odonata** Coenagrionidae *(Ischnura),* Lestidae *(Austrolestes),*	**Acarina** *Arrenurus, Piona;* **Mollusca** *Glyptophysa*; **Decapoda** *Amarinus*; **Ephemeroptera** *Cloeon, Tasmanocoenis*; **Trichoptera** *Notalina, Oecetis, Triplectides, Hellyethira, Ecnomus*; **Odonata** Coenagrionidae *(Ischnura),* Lestidae *(Austrolestes)*,	**Acarina** *Arrenurus*, *Piona*; **Mollusca** *Glyptophysa*; **Ephemeroptera** *Cloeon, Tasmanocoenis*; **Trichoptera** *Notalina, Oecetis, Triplectides, Hellyethira*; **Odonata** Coenagrionidae *(Ischnura),* Lestidae *(Austrolestes)*,	**Diptera** Chironomidae *[Procladius, Chironomus* (often in large numbers)*]*; **Coleoptera** *Necterosoma*

Rating	Good	Fair	Poor	Very Poor
	Libellulidae *(Orthetrum, Diplacodes), Hemicordulia* and *Hemianax*; **Diptera** *Simulium* and Chironomidae *(Cricotopus, Thienemaniella, Cladotanytarsus, Rheotanytarsus)*; **Coleoptera** *Sternopriscus, Limnoxenus, Paracaena*	*Libellulidae (Orthetrum, Diplacodes), Hemicordulia* and *Hemianax*; **Diptera** *Simulium* and Chironomidae *(Cricotopus, Cladotanytarsus, Procladius, Corynoneura, Chironomus, Tanytarsus, Dicrotendipes)*; **Coleoptera** *Sternopriscus, Limnoxenus, Paracaena, Onychohydrus,* Haliplidae	*Hemicordulia and Hemianax*; **Diptera** *Simulium* and Chironomidae *(Cricotopus, Procladius, Corynoneura, Chironomus, Tanytarsus, Dicrotendipes, Polypedilum)*; **Coleoptera** *Sternopriscus, Necterosoma, Limnoxenus, Paracaena, Onychohydrus,* Haliplidae	
Attribute 5: Tolerant taxa	**Oligochaeta**; **Amphipoda** *Austrochiltonia*; **Diptera** *Anopheles, Culex*	**Turbellaria**; **Oligochaeta**; **Mollusca** *Coxiella*; **Amphipoda** *Austrochiltonia*; **Collembola** Hypogastruridae; **Diptera** *Anopheles*, *Culex*; **Hemiptera** *Micronecta, Sigara, Anisops*	**Turbellaria**; **Oligochaeta**; **Mollusca** *Coxiella,* Hydrobiidae; **Amphipoda** *Austrochiltonia*; **Collembola** Hypogastruridae; **Diptera** *Anopheles, Culex,* Ceratopogonidae and Ephydridae; **Hemiptera** *Micronecta, Sigara, Anisops, Enithares, Agraptocorixa*	**Oligochaeta** (often in large numbers); **Amphipoda** *Austrochiltonia*; **Collembola** Hypogastruridae; **Diptera** *Anopheles, Culex, Aedes,* Ceratopogonidae and Syrphidae; **Hemiptera** *Micronecta, Anisops*
Attribute 6: Non-endemic or introduced taxa	**Mollusca** *Physa, Potamopyrgus* in low numbers	**Mollusca** *Physa, Potamopyrgus*; **Fish** *Gambusia*	**Mollusca** *Physa, Potamopyrgus*; **Fish** *Gambusia*	**Mollusca** *Physa*; **Fish** *Gambusia* (rarely due to poor water quality)
Attribute 7: Ecosystem function	Initial enrichment patterns becoming evident and often extending over much of the watercourse. Usually the organic nitrogen TKN^2 concentration high and either chlorophyll biomass over 10 ug/L, macrophytes or filamentous algae over 10% cover at the site, but not	Moderate enrichment patterns becoming evident with high algal and aquatic plant growths extending over much of the watercourse; filamentous algae covers over 35% of the benthos on occasion; sediments usually well aerated except when	Gross enrichment patterns becoming evident with very high algal and aquatic plant growth extending widely throughout watercourse; filamentous algae covers much of the benthos on occasion; sediments well aerated when plant growth high	Algal and aquatic plant growth minimal due to poor water quality and possibly a toxicant effect; low productivity and high decomposition rates evident; typically affected by secondary salinisation, highly enriched in nutrient concentrations, ephemeral

Rating	Good	Fair	Poor	Very Poor
	overwhelmed by nutrient effects (yet).	primary production periodically declines following floods; water column nutrient concentrations usually high.	but when crashes occur may become sulfidic due to organic breakdown; typically high nutrient concentrations in the water despite high primary productivity.	waters. In exceptional circumstances when concentrated sewage effluent enters waters the phytoplankton biomass may be very high but does not persist in the receiving environment.
Summary of biological patterns evident for rating	Moderate to high taxa richness due to large numbers of tolerant and sensitive taxa. Vegetation assemblages provide habitat opportunities for many adult insects to utilise.	Moderate to high taxa richness due to large number of generalist taxa and usually includes some rare and sensitive species in low numbers. Scattered trees near water provide some limited habitat for adult insects to utilise.	Moderate to low species richness and usually at least one tolerant taxon present in 100s to 1,000s. In-stream vegetation provides major habitat complexity for adult insects to utilise.	Low species richness and usually low abundances, although may get large numbers of one pollution tolerant taxon on occasion. Absence of in-stream and riparian vegetation means no significant habitat opportunities for many types of adult insect stages to utilise.

* Other taxa previously collected from region include rare and sensitive specialist species such as:

- Ephemeroptera (mayflies): Atalophebia aurata from Bakers Range Drain in 1977; Ulmerophlebia pipinna from Cress Creek, Hitchcock Drain, Eight Mile Creek; Leptoperla primitiva from Eight Mile Creek; and Nousia fuscula from one site in the region.
- Plecoptera (stoneflies): Dinotoperla brevipennis from Eight Mile Creek; Dinotoperla evansi from a few locations in the region in the 1990s; and Austrocerca tasmanica from Naracoorte Creek and Mosquito Creek in the 1990s.

[2] TKN – is short for total Kjeldahl nitrogen which is the sum of organic nitrogen and ammonia.

Table 3 Ratings given by the four panel members and final overall rating for each of the 71 sites monitored in the South East NRM region during 2009

Site name	Very Good	Good	Fair	Poor	Very Poor	Final rating
Benara Creek, Lake Bonney SE		3	1			**Good**
Piccaninnie Blue Lake Outlet, Piccaninnie Ponds Conservation Park	2	2				**Good**
Avenue Flat–K Drain, near Lucindale			3	1		**Fair**
Baker Range Drain, west from Penola			3	1		**Fair**
Butchers Gap Drain, near Butchers Gap Conservation Park			4			**Fair**
Deep Creek, near Riddock Bay		2	2			**Fair**
Drain 44, near northern end of Lake Bonney SE			4			**Fair**
Drain C, southwest from Bool Lagoon		1	3			**Fair**
Drain L, near Robe		1	3			**Fair**
Drain M, near Kangaroo Inn			3	1		**Fair**
Drain M, northeast from Beachport			3	1		**Fair**
Eight Mile Creek, Riddock Bay		2	2			**Fair**
Henry Creek, south from the Tilley Swamp Conservation Park		1	3			**Fair**
Jerusalem Creek, east from Port MacDonnell		2	2			**Fair**
Marcollat Watercourse, near Bimbimbi Swamp			4			**Fair**
Morambro Creek, southeast from Padthaway		1	3			**Fair**
Mosquito Creek, Struan		1	3			**Fair**
Nalang Creek, near Olive Bank			4			**Fair**
Naracoorte Creek, Naracoorte			3	1		**Fair**
Naracoorte Creek, northeast from Naracoorte			4			**Fair**
Narrow Neck Drain, near Rendelsham			3	1		**Fair**
Picks Swamp Outlet Drain, west from Piccaninnie Ponds Conservation Park			3	1		**Fair**
Tatiara Creek, northeastern Bordertown			4			**Fair**
Unnamed Drain, near Tilley Swamp			3	1		**Fair**
Yelloch Creek, northeast from Struan			4			**Fair**

Site name	Very Good	Good	Fair	Poor	Very Poor	Final rating
Yelloch Creek, south of Hynam			4			**Fair**
Baker Range Drain, near Mount Burr			1	3		**Poor**
Biscuit Flat Drain, Biscuit Flat				4		**Poor**
Blackford Drain, near Kingston SE		1	1	2		**Poor**
Blackford Drain, near Mount Scott Conservation Park			2	2		**Poor**
Bray Drain, near Lake Hawdon South			2	2		**Poor**
Drain 31, Millicent			1	3		**Poor**
Drain 31, near Millicent				4		**Poor**
Drain 56, near Snuggery				4		**Poor**
Drain at Bevilaqua Ford, south from Rendelsham			2	2		**Poor**
Drain B, near Penola Conservation Park			2	2		**Poor**
Drain E, near Lochaber Swamp				4		**Poor**
Drain K, between Lucindale and Robe			2	2		**Poor**
Drain L, east from Lake Hawdon North			1	3		**Poor**
Drain L, north from Biscuit Flat			2	2		**Poor**
Drain M, near Beachport			1	3		**Poor**
Drain M, near Callendale			1	3		**Poor**
Drain M, near western edge of Bool Lagoon			2	2		**Poor**
Glencoe Drain, south from Kalangadoo				4		**Poor**
Hitchcox Main Drain, near Brown Bay			1	3		**Poor**
Jacky White Drain, near Avenue Flat			1	3		**Poor**
Kingston Main Drain, southeast from Kingston SE				4		**Poor**
Lake Frome North Drain, near Southend			1	3		**Poor**
Lake Frome Outlet Drain, Southend			1	3		**Poor**
Marcollat Watercourse at Jip Jip Waterhole, near Jip Jip Conservation Park			2	2		**Poor**
Mosquito Creek, east from Joanna near the SA/Victorian Border			2	2		**Poor**
Mosquito Creek, west from Struan				3	1	**Poor**

Site name	Very Good	Good	Fair	Poor	Very Poor	Final rating
Naracoorte Creek, west from Naracoorte				4		**Poor**
Naracoorte Creek, western edge of Naracoorte			2	2		**Poor**
Pelican Point Drain, near Carpenter Rocks			2	2		**Poor**
Reedy Creek Road Drain, near Mount Burr		1		3		**Poor**
Reedy Creek–K Drain, between Robe and Lucindale				4		**Poor**
Reedy Creek–Mount Hope Drain, near Mullins Swamp			2	2		**Poor**
Reedy Creek–Wilmot Drain, near Greenways			1	3		**Poor**
Reedy Creek–Wilmot Drain, near Reedy Creek Conservation Park			1	2	1	**Poor**
Stony Creek, near eastern edge of Lake Bonney SE			2	2		**Poor**
Sutherland Drain, near Beachport			1	3		**Poor**
Taratap Drain, south from Tilley Swamp Conservation Park				3	1	**Poor**
Tatiara Creek, east from Bordertown			1	3		**Poor**
Tatiara Creek, north from Bordertown				3	1	**Poor**
Wilmot Drain, near Earth Quake Springs			2	2		**Poor**
Didicoolum Drain, near Marcollat Hall				2	2	**Very Poor**
Drain 57, near Snuggery					4	**Very Poor**
Drain C2, near Coonawarra				2	2	**Very Poor**
Seymour–Robertson Drain, Bool Lagoon				2	2	**Very Poor**
Tatiara Creek, Bordertown			2		2	**Very Poor**

Reference

Davies SP and SK Jackson 2006, 'The biological condition gradient: a descriptive model for interpreting change in aquatic ecosystems', *Ecological Applications,* Volume 16, pp 1251–1266.

Further information

Legislation

Legislation may be viewed on the Internet at: <www.legislation.sa.gov.au>

Copies of legislation are available for purchase from:

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