

Aquatic ecosystem condition reports

2011 panel assessment of creeks and rivers in the Adelaide and Mount Lofty Ranges NRM region

Issued September 2012

EPA984/12: This information sheet describes the outcome of the panel assessment of creeks and rivers in the Adelaide and Mount Lofty Ranges, NRM region based on monitoring data collected in 2011.

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 Adelaide and Mount Lofty Ranges NRM region during 2011.

Site selection

A total of 72 sites were sampled in the Adelaide and Mount Lofty Ranges (AMLR) NRM region during autumn and spring 2011. The majority of sites were selected at random from a stream reach database that has been developed for South Australia by the EPA. A statistically valid approach was adopted using an unequal probability of selection criterion to ensure a similar number of sites were generated for each stream order. Streams rise as a large network of small feeder channels that rarely hold water unless they exist as a chain-of-ponds. Wherever first order tributaries join they turn into second order streams, where second order streams join they form a third order stream and so on further down the stream network. This was carried out to allow the results to be scaled up to report on the condition of all waters in the region (Stevens and Olsen 2004).

Site randomisation

Only sites located within 250 m from the nearest road were included in the final listing of potential sites to minimise the distance involved in walking across farmland (Catchment Simulations Solution 2011). The sites were then overlain on topographic maps and viewed using Google Maps™ to ensure they were located in a stream network and appeared suitable to sample (eg not in a dam). Any unsuitable sites were omitted and the next randomly selected site was evaluated for its suitability to sample. The final selection of sites was carried out by the field sampling team, resulting in a small number of sites being relocated up to a few hundred metres from the original coordinates to avoid potential conflicts with farming practices (eg presence of stock) or proximity to a dam.

For the AMLR NRM Region, nearly 67,000 stream order 1 sites were available for final selection whereas there were only a few thousand sites from stream orders 6 and 7 that were potentially available. Since there are so few large streams in the region, only 10 sites were selected from the combined grouping of stream orders 6 or 7; 10 sites were sampled from each of the other stream orders.

Prior knowledge

In order to build on previous (20 years) knowledge of the streams in the region, sampling was also carried out on five of the 'best condition' and five of the 'worst condition' streams from the AMLR NRM Region to provide some context to the condition gradient for the region using 2011 data.

Water allocation planning

Another two sites (WAP 1 and 2) were also included to provide additional information to the AMLR NRM in relation to water allocation planning and assessment work.

The assessment

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 in this assessment is 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).

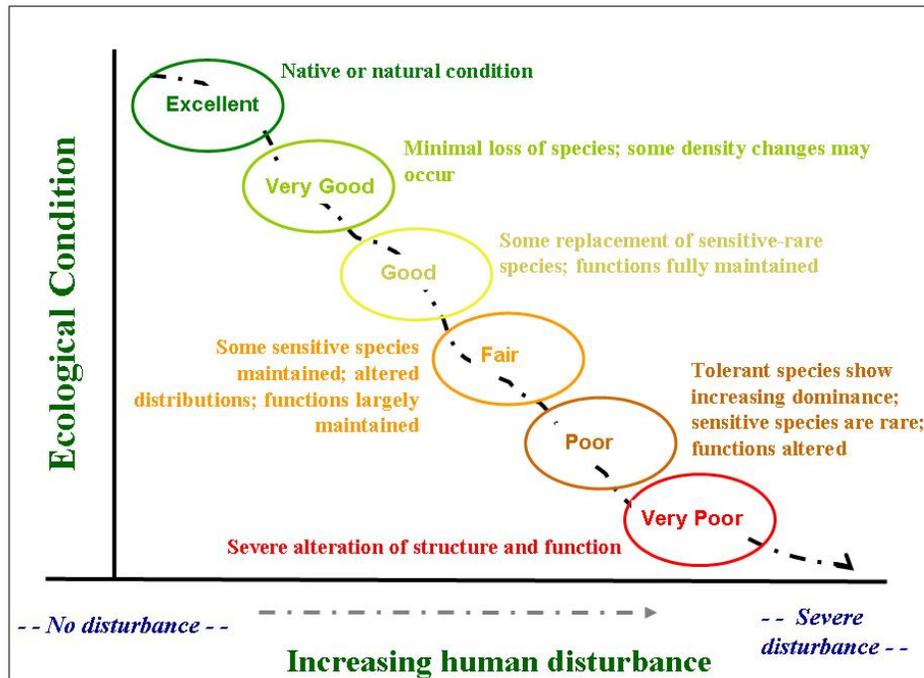


Figure 1 Human disturbance gradient showing the six different ecological condition grades or ratings ranging from excellent (best) to very poor (worst) with a brief definition of each condition

The process used to grade or rate sites involved the following steps.

- 1 A conceptual model describing the ecological responses to a general disturbance gradient in the AMLR NRM region was developed, reviewed and updated by the panel (Table 1).
- 2 A species list was compiled for the region based on data collected in 2011, describing the expected biotic assemblage for each of six possible ratings (Table 2).
- 3 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. Note that for sites that were consistently dry, only the vegetation data, sediment and habitat features were used to provide a rating.
- 4 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 rating (most common rating from the panel ratings for each site), and in cases where there were two ratings for a site, a precautionary philosophy was used to select the lower of the two ratings.

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 concluded that Excellent probably no longer occurred and was certainly not evident from the sites sampled in 2011.

2011 results

Overall, the results are summarised as

Condition rating	Number of sites
Excellent	0
Very Good	1
Good	10
Fair	27
Poor	24
Very Poor	10

The panel members assigned the same rating to 48 sites and the results for the remaining 24 sites only differed by the one rating class of each other. The panel remained equally split between two possible ratings for only five sites, resulting in the poorer rating being assigned to the following sites (refer to Table 3 for their ratings).

Site code	Site name
1.13	Unnamed creek, west from Myponga Beach
2.7	Tributary of Blackfellows Creek, 1.5 km southwest from Mount Hayfield
2.11	Tributary of Lyndoch Creek, 3 km southeast from Lyndoch
3.13	Tributary of the Torrens River, 3 km north from Mount Pleasant
5.8	Walkers Creek, 4.5 km southeast from Freeling

The results have been summarised in to represent the different types of sites sampled during the program. The ratings were consistent across stream orders, despite most sites from stream orders 1 and 2 being dry during both seasons sampled in 2011.

The previously identified 'best condition' sites included 4 Good and 1 Fair, with the better rating assigned to sites with extensive areas of flowing riffles and pool habitats in both autumn and spring, whereas the Fair rating was recorded from Scott Creek which lacked extensive areas of shallow, fast-flowing riffles.

The 'worst condition' sites were assigned 2 Fair and 3 Poor ratings. The sites from the South Para River on the outskirts of Gawler, and Sturt River at Bedford Park near the start of the channelised stream rated Fair, which was better than expected; the other sites from Cox, Inverbrackie and Hahndorf creeks all rated Poor which was expected, given landuse practices in their catchments.

The WAP sites from the Torrens River near Mount Pleasant were both assigned a Fair rating, which was not surprising since they were located in close proximity to each other in the upper reaches of the river.

Table 1 Conceptual model of ecological responses to a disturbance gradient in the Adelaide and Mount Lofty Ranges NRM region

Response category	Rating					
	Excellent	Very good	Good	Fair	Poor	Very poor
Stressor description	As naturally occurs; probably no longer present in the western Mount Lofty Ranges due to the level of vegetation clearance and landscape modification. Streams with natural vegetation communities, such as First and Sixth creeks and low order streams in the upper South Para River in the Mount Lofty Ranges, and coastal creeks on the southern Fleurieu Peninsula (eg Aaron Creek, lower Deep Creek) may represent this state on occasions but generally the presence of introduced species and nutrient enrichment precludes rating sites in the region as Excellent.	Least impacted streams with largely natural vegetation communities, such as First and Sixth creeks and low order streams in the upper South Para River in the Mount Lofty Ranges, and coastal creeks on the southern Fleurieu Peninsula (eg Aaron Creek, lower Deep Creek). Very few introduced species and little sign of nutrient enrichment.	Showing initial signs of enrichment: likely to occur in streams with large areas of natural vegetation remaining in their catchments and generally characterised by permanent/near permanent, flowing, freshwater habitats but may also include more ephemeral habitats. Numerous streams in the watersheds of all the water reservoirs in the region would be expected to represent this condition in most years.	Moderate nutrient enrichment: likely to commonly occur in the region due to the extent of vegetation clearance and associated agricultural development.	Gross nutrient enrichment or degradation: likely to commonly occur in the region due to the extent of vegetation clearance and associated agricultural development and urbanisation. Ephemeral and saline streams in the region are likely to show extensive enrichment effects due to the lack of substantial dilution flows in most years.	Severely altered: may occur in the region in urban stream reaches, downstream from wastewater discharges and highly degraded ephemeral and more permanent streams in extensively cleared agricultural settings. Sites assigned to this rating will be affected by a toxicant or other disturbance that significantly limits the diversity and abundance of aquatic life present in a stream.

Response category	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).	Least disturbed with high proportion of natural features means well oxygenated water and low nutrients and turbidity; may be highly coloured due to tannins from native vegetation.	Largely unremarkable water quality but 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 >10ug/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 >10ug/L, macrophyte cover >10% cover and filamentous algae >35% cover most of the time).	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 present and not always anaerobic.	Near natural habitat and flow regimes; mostly well vegetated catchments with few dams present; range of sediment types present 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 present and not always anaerobic.	Fair habitat structure and flow patterns; many dams may be present in the catchment; anaerobic fine sediments usually present, except for coarse sandy sediments or when large algal growths oxygenate the sediments.	Poor habitat structure and flow patterns; may have many dams present in the catchment; anaerobic fine sediments usually present except when large algal growths are present and aerate the sediments.	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.

Response category	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 rural housing; no point sources, and diffuse pollution not detectable due to the extent of vegetation surrounding each stream.	No significant human disturbances but may include some rural housing and roads; no point source discharges and diffuse pollution not obviously affecting the aquatic ecosystem due to the extent of native vegetation surrounding each stream.	Effects of human disturbance becoming obvious; point sources may be present but do not dominate flows; good buffer zones and/or riparian vegetation present that help to mitigate diffuse pollution effects from surrounding land uses.	Point and diffuse source enrichment effects evident; riparian zone not effective at mitigating nutrients and fine sediment typically enters these waterways.	Obvious point and diffuse source enrichment effects present; unbuffered channel with ineffective or no riparian vegetation remaining other than introduced grasses; 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 response with little signs of the original waterway evident; unbuffered channel that has undergone extreme modifications in an agricultural or urban setting.

Table 2 List of biota expected to occur for each rating in the Adelaide and Mount Lofty Ranges NRM region

Note: Excellent probably no longer occurs in the region.

Attribute	Rating				
	Very Good	Good	Fair	Poor	Very Poor
Attribute 1 Rare and/or regionally endemic	Ephemeroptera <i>Tasmanophlebia</i> ; Trichoptera <i>Ulmerochorema</i> ; Diptera <i>Austrothaumalea</i> ; Fish <i>Galaxias olidus</i>	Ephemeroptera <i>Tasmanophlebia</i> ; Trichoptera <i>Ulmerochorema</i> ; Diptera <i>Austrothaumalea</i> ; Fish <i>Galaxias olidus</i>	Fish <i>Galaxias olidus</i>	None present	None present
Attribute 2 Sensitive, rare or vulnerable specialist taxa with narrow environmental requirements	Ephemeroptera <i>Offadens</i> , <i>Centroptilum</i> , <i>Nousia fuscula</i> ; Plecoptera <i>Illiesoperla</i> , <i>Riekoperla</i> ; Trichoptera <i>Lingora</i> , <i>Triplectides similis</i> , <i>Taschorema</i> , <i>Ulmerochorema</i> , <i>Oxyethira columba</i> , <i>Leptorussa</i> , <i>Tasimiidae</i> ; Odonata <i>Hemigomphus</i> , <i>Austrogomphus</i> ; Diptera <i>Paracnephia</i> ; Hemiptera <i>Hydrometra</i> ; Coleoptera <i>Sclerocyphon</i> , <i>Simsonia</i>	Ephemeroptera <i>Offadens</i> , <i>Centroptilum</i> , <i>Nousia</i> <i>fuscula</i> ; Plecoptera <i>Illiesoperla</i> , <i>Riekoperla</i> Trichoptera <i>Lingora</i> , <i>Triplectides similis</i> , <i>Taschorema</i> , <i>Ulmerochorema</i> , <i>Apsilochorema</i> , <i>Anisocentropus</i> ; Odonata <i>Hemigomphus</i> , <i>Austrogomphus</i> ; Diptera <i>Paracnephia</i> ; Hemiptera <i>Hydrometra</i> ; Coleoptera <i>Sclerocyphon</i> , <i>Simsonia</i>	Ephemeroptera <i>Offadens</i> ; Plecoptera <i>Illiesoperla</i> ; Trichoptera <i>Lingora</i> , <i>Triplectides</i> <i>similis</i> , <i>Taschorema</i> , <i>Ulmerochorema</i> , <i>Apsilochorema</i> , <i>Anisocentropus</i>	None present	None present
Attribute 3 Sensitive, ubiquitous taxa	Ephemeroptera <i>Koornonga</i> , <i>Atalophlebia</i> ; Plecoptera <i>Dinotoperla</i> , <i>Austrocerca</i> ; Diptera <i>Austrosimulium</i>	Ephemeroptera <i>Koornonga</i> , <i>Atalophlebia</i> ; Plecoptera <i>Dinotoperla</i> , <i>Austrocerca</i> ; Diptera <i>Austrosimulium</i>	Ephemeroptera <i>Koornonga</i> , <i>Atalophlebia</i> ; Plecoptera <i>Dinotoperla</i> , <i>Austrocerca</i> ; Diptera <i>Austrosimulium</i>	Ephemeroptera <i>Atalophlebia</i>	None present

Attribute	Rating				
	Very Good	Good	Fair	Poor	Very Poor
<p>Attribute 4 Opportunistic or generalist taxa</p>	<p>Mollusca <i>Angrobia</i>, <i>Glyptophysa</i>; Ephemeroptera <i>Cloeon</i>, <i>Tasmanocoenis</i>; Trichoptera <i>Notalina</i>, <i>Oecetis</i>, <i>Triplectides</i>, <i>Hellyethira</i>, <i>Ecnomus</i>, <i>Lectrides</i>; Odonata <i>Coenagrionidae</i> (<i>Xanthagrion</i>, <i>Austroagrion</i>), <i>Austrolestes</i>, <i>Hemicordulia</i>, <i>Aeschnidae</i>, <i>Telephlebiidae</i>; Diptera <i>Dixidae</i>, <i>Chironomidae</i> (<i>Eukiefferiella</i>, <i>Thienemaniella</i>, <i>Rheotanytarsus</i>); Coleoptera <i>Limnoxenus</i></p>	<p>Mollusca <i>Angrobia</i>, <i>Glyptophysa</i>; Ephemeroptera <i>Cloeon</i>, <i>Tasmanocoenis</i>; Trichoptera <i>Notalina</i>, <i>Oecetis</i>, <i>Triplectides</i>, <i>Hellyethira</i>, <i>Ecnomus</i>, <i>Lectrides</i>; Odonata <i>Coenagrionidae</i> (<i>Xanthagrion</i>, <i>Austroagrion</i>), <i>Austrolestes</i>, <i>Hemicordulia</i>, <i>Aeschnidae</i>, <i>Telephlebiidae</i>; Diptera <i>Dixidae</i>, <i>Chironomidae</i> (<i>Eukiefferiella</i>, <i>Thienemaniella</i>, <i>Cladotanytarsus</i>, <i>Rheotanytarsus</i>); Coleoptera <i>Sternopriscus</i>, <i>Chostonestes</i>, <i>Limnoxenus</i>, <i>Macrogyrus</i>, <i>Aulonogyrus</i>, <i>Platynectes</i></p>	<p>Mollusca <i>Angrobia</i>, <i>Glyptophysa</i>; Ephemeroptera <i>Cloeon</i>, <i>Tasmanocoenis</i>; Trichoptera <i>Notalina</i>, <i>Oecetis</i>, <i>Triplectides</i>, <i>Hellyethira</i>, <i>Ecnomus</i>, <i>Lectrides</i>; Odonata <i>Austrolestes</i>, <i>Hemicordulia</i>; Diptera <i>Dixidae</i>, <i>Chironomidae</i> (<i>Eukiefferiella</i>, <i>Thienemaniella</i>, <i>Cladotanytarsus</i>, <i>Rheotanytarsus</i>); Coleoptera <i>Sternopriscus</i>, <i>Chostonestes</i>, <i>Limnoxenus</i>, <i>Macrogyrus</i>, <i>Aulonogyrus</i>, <i>Platynectes</i></p>	<p>Mollusca <i>Angrobia</i>, <i>Glyptophysa</i>; Ephemeroptera (in low numbers) <i>Cloeon</i>, <i>Tasmanocoenis</i>; Trichoptera <i>Triplectides</i>, <i>Hellyethira</i>; Odonata <i>Austrolestes</i>, <i>Hemicordulia</i>; Diptera <i>Chironomids</i> (<i>Tanytarsus</i>); Coleoptera <i>Sternopriscus</i>, <i>Necterosoma</i>, <i>Platynectes</i></p>	<p>Coleoptera <i>Necterosoma</i></p>

Attribute	Rating				
	Very Good	Good	Fair	Poor	Very Poor
Attribute 5 Tolerant taxa	Oligochaeta; Amphipoda <i>Austrochiltonia</i> ; Diptera <i>Simulium</i> ; Odonata <i>Ischnura</i>	Oligochaeta; Amphipoda <i>Austrochiltonia</i> ; Decapoda <i>Paratya, Cherax</i> ; Diptera <i>Simulium, Culicidae,</i> <i>Stratiomyidae,</i> <i>Ceratopogonidae,</i> <i>Cricotopus</i> ; Hemiptera <i>Micronecta</i> ; Odonata <i>Ischnura</i>	Turbellaria; Oligochaeta; Mollusca Hydrobiidae; Amphipoda <i>Austrochiltonia</i> ; Decapoda <i>Paratya,</i> <i>Cherax</i> ; Collembola; Diptera <i>Simulium,</i> <i>Culicidae, Cricotopus,</i> <i>Stratiomyidae; Hemiptera</i> <i>Micronecta, Sigara,</i> <i>Agraptocorixa, Anisops,</i> <i>Enithares</i> ; Odonata <i>Ischnura</i>	Turbellaria; Oligochaeta; Mollusca Hydrobiids; Amphipoda <i>Austrochiltonia</i> ; Decapoda <i>Paratya,</i> <i>Cherax</i> ; Collembola; Diptera <i>Simulium,</i> <i>Culicidae,</i> <i>Ceratopogonidae,</i> <i>Cricotopus,</i> <i>Stratiomyidae; Hemiptera</i> <i>Micronecta, Sigara,</i> <i>Agraptocorixa, Anisops,</i> <i>Enithares</i> ; Odonata <i>Ischnura</i>	Oligochaeta (often in large numbers); Amphipoda <i>Austrochiltonia</i> ; Collembola; Diptera <i>Procladius, Chironomus</i> (often in large numbers), <i>Culicidae,</i> <i>Ceratopogonidae,</i> <i>Stratiomyidae;</i> Hemiptera <i>Micronecta,</i> <i>Anisops</i>
Attribute 6 Non-endemic or introduced taxa	Mollusca <i>Physa,</i> <i>Potamopyrgus</i> in low numbers; Decapoda <i>Cherax tenuimanus</i>	Mollusca <i>Physa,</i> <i>Potamopyrgus</i> in low numbers; Decapoda <i>Cherax tenuimanus</i>	Mollusca <i>Physa,</i> <i>Potamopyrgus</i> ; Fish <i>Gambusia</i>	Mollusca <i>Physa,</i> <i>Potamopyrgus</i> ; Fish <i>Gambusia</i>	Mollusca <i>Physa</i> ; Fish <i>Gambusia</i> (rarely due to poor water quality)

Table 3 Condition ratings given by each panel member and final overall rating for each of the 72 sites monitored in the Adelaide and Mount Lofty Ranges NRM region during 2011

Notes								
Sites selection included:								
<ul style="list-style-type: none"> randomly selected sites shown by stream order (eg 1.1, 7.3 or 5.10). Site randomisation was determined by applying a tailored version of CatchmentSIM (Catchment Simulation Solutions Pty Ltd; <www.csse.com.au>). 5 best¹ condition sites based on prior knowledge of creeks and rivers in the AMLR NRM Region. Note that these are not necessarily the best condition sites that were assessed during 2011. 5 worst² condition sites based on prior knowledge of creeks and rivers in the AMLR NRM region. Note that these are not necessarily the worst condition sites that were assessed during 2011. WAP sites selected by the AMLR NRM as part of work designed to evaluate the Water Allocation Plan for the region. 								
Habitats ³ information shows if the site was dry, edge (E), and edge and riffle (ER) aquatic habitats sampled; autumn and spring periods separated by comma, so E,ER means edge present in autumn and both edge and riffle present in spring.								
Site codes relate to the stream order, best condition/worst condition or Water Allocation Planning.								
Refer to the EPA website < www.epa.sa.gov.au > for the site map coordinates and the site based aquatic ecosystem condition reports.								

Site code	Site name	Habitats ³	Very Good	Good	Fair	Poor	Very Poor	Final Grade
1.1	Tributary of the Torrens River, northwest from Mount Pleasant	Dry			1	3		Poor
1.2	Unnamed creek, 2.5 km southwest from Tunkalilla	Dry				4		Poor
1.3	Workanda Creek, Belair National Park	Dry		4				Good
1.4	Tributary of the Inman River, 3 km east from Inman Valley	Dry				4		Poor
1.5	Tributary of St Kitts Creek, north from Truro	Dry				4		Poor
1.6	Tributary of Brownhill Creek, west from Crafers West	Dry			4			Fair
1.8	Tributary of Kersbrook Creek, 2 km northeast from Kersbrook	Dry		4				Good
1.10	Tributary of Cox Creek, south from Uraidla	E,E			4			Fair
1.12	Tributary of Gomersal Creek, west from Tanunda	Dry					4	Very Poor
1.13	Unnamed creek, west from Myponga Beach	Dry				2	2	Very Poor

Site code	Site name	Habitats ³	Very Good	Good	Fair	Poor	Very Poor	Final Grade
2.3	Tributary of the Congeratinga River, Second Valley Forest	Dry			4			Fair
2.4	Tributary of the Congeratinga River, 1 km east from Second Valley	Dry					4	Very Poor
2.5	Tributary of Jacob Creek, 4 km south from Tanunda	Dry				4		Poor
2.7	Tributary of Blackfellows Creek, 1.5 km southwest from Mount Hayfield	Dry				2	2	Very Poor
2.8	Peter Creek, southwest from Kangarilla	E,ER		1	3			Fair
2.9	Tributary of the Torrens River, 2 km north from Forreston	E,E				4		Poor
2.10	Tributary of Waitpinga Creek, 13 km southwest from Encounter Bay	E,E				1	3	Very Poor
2.11	Tributary of Lyndoch Creek, 3 km southeast from Lyndoch	Dry			2	2		Poor
2.12	First Creek, flows to Tunkalilla Beach on the Fleurieu Peninsula	ER,ER	4					Very Good
2.13	Tributary of Waterfall Creek, near Roslyn Heights	Dry				4		Poor
3.1	Tributary of the Hindmarsh River, 2 km east from Hindmarsh Tiers	E,E			4			Fair
3.2	Tributary of Stockwell Creek, 3.5 km north from Nuriootpa	Dry					4	Very Poor
3.3	Tributary of Dry Creek, Banksia Park	E,E				4		Poor
3.5	Unnamed creek, flows into the northern part of Millbrook Reservoir	ER,E		1	3			Fair
3.8	Tributary of the Torrens River, 3 km southwest from Gumeracha	ER,E			4			Fair
3.9	Pine Creek, 8 km southeast from Tarlee	Dry					4	Very Poor
3.10	Tributary of the Gawler River, Bibaringa	Dry				4		Poor
3.11	North Para River, 4.5 km northwest from Eden Valley	E,E			1	3		Poor
3.12	Aldgate Creek, north from Heathfield	E, E (too shallow)			1	3		Poor
3.13	Tributary of the Torrens River, 3 km north from Mount Pleasant	Dry			2	2		Poor

Site code	Site name	Habitats ³	Very Good	Good	Fair	Poor	Very Poor	Final Grade
4.1	Cockatoo Creek, south from Sandy Creek	E,E			4			Fair
4.2	Tributary of the South Para River, west from Portuguese Bridge	E,E			4			Fair
4.3	Cockatoo Creek, south from Kalbeeba	ER,E			3	1		Fair
4.4	Tributary of Carrickalinga Creek, south from Myponga Reservoir	Dry				4		Poor
4.5	Adams Creek, Elizabeth Park	Dry					4	Very Poor
4.6	Tributary of Duck Ponds Creek, east from Moculta	Dry				3	1	Poor
4.7	Tributary of the Hindmarsh River, near Cloverdale	E,E			4			Fair
4.8	Tributary of Coolawang Creek, north from Koolah	E,E			3	1		Fair
4.9	Torrens River, 3.5 km northeast from Birdwood	ER,ER			4			Fair
4.13	Scott Creek, 1 km southwest from Scott Creek	E,E			4			Fair
5.1	Little Para River, Salisbury Downs	E,E				1	3	Very Poor
5.2	Torrens River, 1 km west from Birdwood	ER,ER			4			Fair
5.3	Onkaparinga River, Woodside	E,E			3	1		Fair
5.5	Wild Dog Creek, 5.5 km northeast from Yankalilla	E,E			4			Fair
5.6	North Para River, 4 km north from Angaston	ER,ER			4			Fair
5.8	Walkers Creek, 4.5 km southeast from Freeling	E,E				2	2	Very Poor
5.9	North Para River, Rowland Flat	ER,ER			4			Fair
5.10	Yankalilla River, 5 km south from Yankalilla	E,E		4				Good
5.11	Sixth Creek, near Montacute Heights	ER,ER		4				Good
5.12	Onkaparinga River, Oakbank	ER,ER			4			Fair
6.1	Onkaparinga River, west from Blewitt Springs	ER,ER		3	1			Good

Site code	Site name	Habitats ³	Very Good	Good	Fair	Poor	Very Poor	Final Grade
6.2	Inman River, 2 km upstream from Victor Harbor Golf Club	E,E				4		Poor
6.3	Light River, near Hamilton	ER,E				4		Poor
6.4	Onkaparinga River, south from Mylor	ER,ER			4			Fair
6.5	South Para River, south from Gawler	ER,ER		4				Good
6.6	Torrens River, Bonython Park	E,ER			1	3		Poor
6.7	Onkaparinga River, downstream from Mount Bold Reservoir	E,E			4			Fair
7.1	Light River, north from Freeling	ER,ER			1	3		Poor
7.2	Light River, west from Kapunda	E,E				4		Poor
7.4	Light River, upstream from Mingays Waterhole	E,E				4		Poor
3458 ¹	First Creek, Waterfall Gully	ER,ER		4				Good
3203 ¹	Scott Creek, Scott Bottom	E,E			4			Fair
3509 ¹	The Deep Creek, Deep Creek Conservation Park	ER,ER		4				Good
3324 ¹	Sixth Creek, near Castambul	ER,ER	1	3				Good
13033 ¹	Northern branch of Brownhill Creek, near Eagle on the Hill	ER,ER	1	3				Good
3445 ²	South Para River, south-east from Gawler	E,E			4			Fair
3352 ²	Sturt River, Bedford Park	E,E			4			Fair
3227 ²	Cox Creek, Piccadilly Valley	ER,ER				4		Poor
32662	Inverbrackie Creek, south from Woodside	E,E			1	3		Poor
32852	Hahndorf Creek, south from Verdun	E,E			1	3		Poor
WAP1	Torrens River, north from Mount Pleasant (WAP site 1)	E,E			3	1		Fair
WAP2	Torrens River, north from Mount Pleasant (WAP site 2)	E,E			4			Fair

Table 4 Condition ratings assigned to each stream order (SO), best and worst sites (from prior knowledge) and WAP sites in the Adelaide and Mount Lofty NRM region during 2011

Rating	SO 1	SO 2	SO 3	SO 4	SO 5	SO 6/7	Best 5	Worst 5	WAP sites	% sites
Very Good		1								1.4
Good	2				2	2	4			13.9
Fair	2	2	3	7	6	2	1	2	2	34.7
Poor	4	4	5	2		6		3		36.1
Very Poor	2	3	2	1	2					13.9

References

Catchment Simulations Solutions 2011, *Spatially balanced sampling site selection for streams in South Australia: Pilot project for Adelaide and Mount Lofty Ranges region*, unpublished report to the EPA, revision 2, May 2011.

Davies SP and SK Jackson 2006, 'The biological condition gradient: a descriptive model for interpreting change in aquatic ecosystems', *Ecological Applications*, Volume 16, pp 1251–66.

Stevens DL Jr and AR Olsen 2004, 'Spatially balanced sampling of natural resources', *Journal of the American Statistical Association*, Volume 99, pp 262–278.

Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

Further information

Legislation

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

Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet
Adelaide Service SA Centre
108 North Terrace
Adelaide SA 5000

Telephone: 13 23 24
Facsimile: (08) 8204 1909
Website: <shop.service.sa.gov.au>

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