

# Sampling design and preparation

Version: February 2018

## Control and reference sites

### 1 Purpose and scope

'Control sites' and 'reference sites' are terms that are frequently used to describe sites that can be used to assess the impacts of a disturbance or pollution events. However, there is often considerable confusion between the two terms. This document describes the terms as used in a regulatory context under the *Environmental Protection Act 1994* and the Environmental Protection (Water) Policy 2009 (EPP Water).

### 2 Introduction

When assessing potential environmental impacts it is necessary to measure one or more indicators that will provide information (generally numerical quantities or qualitative ranks) about the environmental condition at the potentially impacted site, or test site, and compare these measurements against similar measurements collected in the absence of impact or disturbance.

Control sites can be described as '*monitoring sites that are identical in all respects to the site being assessed (sometimes called the test site) except for the disturbance*' (Section 3.1.4.1; ANZECC & ARMCANZ 2000). Control sites are usually upstream, off-stream or in another location in the vicinity of the proposed activity or wastewater release, and therefore, not impacted by the activity or wastewater release. Values for one or more indicators that may be considered controls could also include those data collected prior to an activity commencing, provided that an adequate quantity of data is available. The use of control sites is favoured for compliance and regulation assessment.

Reference sites, in contrast, are those that are considered to represent pristine environments. In practice, there are very few truly pristine environments in Queensland, so minimally disturbed and best available sites are often used as proxies for pristine condition. All attempts should be made to identify pristine sites before using minimally disturbed and best available sites as reference sites. Under the EPP Water, reference site data are used as the basis for the development of the *Queensland Water Quality Guidelines* (QWQG) (DEHP 2009) and *Scheduled Water Quality Objectives*<sup>1</sup>. Water Quality Objectives, in particular, are intended as a benchmark for improvement of water quality on a catchment scale, with the aim of returning a system to a more 'natural' condition.

### 3 Consideration in selecting control and reference sites

It is important to note that as control or reference sites are used for different purposes, a site that may be suitable as a control or reference site for one indicator may not be relevant for another. For example, a pristine site may be suitable for assessing the natural condition of macroinvertebrates or water quality in an area, but the existence of a major in-stream barrier downstream that prevents migration of fish, such as a dam, may mean that the site is not suitable as a fish reference site.

As flow conditions impact significantly on water quality, control and reference data need to be collected at an appropriate site and relate to the flow regime at the time of collection. Further, consideration must be given to the number of control or reference sites needed for adequate assessment (i.e. by using power analysis where possible).

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<sup>1</sup> Water Quality Objectives are *scheduled* pursuant to the provisions of the Environmental Protection (Water) Policy 2009, which is subordinate legislation under the Environmental Protection Act 1994. They are provided in Schedule 1 documents that list the Environmental Values and Water Quality Objectives for waters in Queensland (<https://www.des.qld.gov.au/water/policy/>).

## 4 Reference site criteria used for bioassessments

Protocols outlined in the River Bioassessment Manual (Davies 1994) describe the process for selecting reference and test sites. From this, the Queensland Department of Natural Resources and Mines (DNRM 2002) composed a set of ten selection criteria that should be used to determine whether or not a site is in reference condition for biological assessments. Each criterion relates to an anthropogenic activity that has the potential to modify the natural condition of the freshwater ecosystem. Where pristine sites are not available, minimally disturbed and best available sites must be used. By generating a numerical categorisation of sites, this approach ensures that reference sites are comparable across programs.

The criteria presented here have been modified slightly from DNRM (2002), resulting in the following 11 criteria:

1. Agriculture and forestry
2. Grazing intensity
3. Sand/gravel extraction
4. Upstream urban areas
5. Point source pollution
6. Barriers – impact on biota
7. Flow regime alteration
8. Riparian and valley flat vegetation
9. Weed species in riparian zone
10. Bankside erosion / deposition
11. Instream habitat alteration

These criteria are given a score between 1 and 5 representing the following categories:

1. Extreme impact
2. Major impact
3. Moderate impact
4. Minor impact
5. No impact

The ideal 'reference condition' site would score 5 in all 11 criteria (i.e. no impact). For a site to be classified as being of 'reference condition' it must score a 4 or 5 in each of the 11 criteria (i.e. minimally disturbed and/or best available site). If the impacts are unknown, the assessors must seek further information before scoring. Where a site receives a score of less than 5, comments must be provided to justify the score. As much information as possible should be provided. The reference site criteria used to develop guidelines for physico-chemical water quality indicators in the QWQG (DEHP 2009) use a modified version of the eleven reference site criteria and are discussed further in Section 5.

Diverse sources of information, including previous knowledge of the catchment and maps, can be used to determine a score for some of the criteria and select potential reference sites. If possible, before a sampling program commences, it is recommended that reconnaissance surveys be used to confirm the suitability of potential reference sites. Potential sites may be chosen by inspecting a large area prior to completing the reference criteria. Alternatively, assessment against the reference condition selection criteria can be completed upon arrival at a site prior to sampling - the assessors would need to conduct an inspection of the site (i.e. walk several hundred metres along the stream reach).

It is also recommended that the scores be reviewed again after sampling/surveying is completed, because the team members will have a better understanding of the site in question. This is particularly important when conducting riparian surveys where a much larger area is covered as part of the survey compared to the initial site inspection. The knowledge obtained from the survey may lead to an alteration of the scores.

Although the criteria are soundly based, in reality it may be difficult to find any sites that adequately meet these criteria. Because of this, flexibility may be required when applying the criteria in some situations. Seek expert advice to determine the extent (if any) to which the criteria may be relaxed in situations where ideal reference sites are lacking.

Scoring against the criteria is somewhat subjective. The variability in individual scores can be minimised if training is conducted by experienced staff and through the use of the example field sheets with descriptions of impact levels for each criterion. An example field sheet is presented in Appendix 1. To assist scoring, the field sheet includes examples of each of the five levels of impact for each criterion. Appendix 2 provides examples of

possible impacts for each of the selection criteria. More than one person must complete this form, and all assessors should be in agreement with the final scores.

A data-driven method for selecting reference sites for stream bio-assessments of freshwater fish are described by Rose et al. (2016) and may be used if suitable.

## 5 Reference site criteria used for physico-chemical water quality indicators

The QWQG (DEHP 2009) provide a different set of reference site criteria to those outlined above, and these are to be applied specifically for physico-chemical water quality indicators. The QWQG define a reference site as ‘a site whose condition is considered to be a suitable baseline or benchmark for assessment and management of sites in similar water bodies’. The criteria adopted to choose reference sites for physico-chemical indicators in the QWQG are shown in Table 1. The QWQG provide some flexibility in defining the reference condition. It states:

*‘The reference condition concept can also be applied to more disturbed systems. For example, in an urban situation it might be useful to use the least disturbed urban creek sites to derive reference values and guidelines to be applied to other urban creeks. This would provide a realistic expectation of quality in an urban situation whereas use of largely undisturbed reference sites for highly disturbed systems might create unachievable water quality expectations.’*

Through existing state government monitoring programs, a number of minimally disturbed reference sites have already been identified throughout Queensland. These are listed in Appendix F of the QWQG. Care should be taken when applying sites previously deemed as minimally disturbed reference sites as their status can easily change over time. Further assessment of these sites should be made using the criteria listed above.

**Table 1: Criteria for reference sites for physico-chemical indicators**

| Freshwaters |                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | No intensive agriculture within 20km upstream. Intensive agriculture is that which involves irrigation, widespread soil disturbance, use of agrochemicals and pine plantations. Dry-land grazing does not fall into this category. |
| 2           | No major extractive industry (current or historical) within 20km upstream. This includes mines, quarries and sand/gravel extraction.                                                                                               |
| 3           | No major urban area (>5000 population) within 20km upstream. If the urban area is small and the river large this criterion can be relaxed.                                                                                         |
| 4           | No significant point source wastewater discharge within 20km upstream. Exceptions can again be made for small discharges into large rivers.                                                                                        |
| 5           | No significant point source wastewater discharge within 20km upstream. Exceptions can again be made for small discharges into large rivers.                                                                                        |
| Estuaries   |                                                                                                                                                                                                                                    |
| 1           | No significant point source wastewater discharge within the estuary or within 20km upstream. Exceptions can again be made for small discharges into large rivers.                                                                  |
| 2           | No major urban area (>5000 population) within 20km upstream. If the urban area is small and the river large, this criterion can be relaxed.                                                                                        |

## 6 References and additional reading

Bailey, RC, Norris RH and Reynoldson, TB 2004, *Bioassessment of Freshwater Ecosystems: Using the Reference Condition Approach*. Springer Science + Business Media Inc. New York. USA.

Davies, PE 1994, *National River Processes and Management Program Monitoring River Health Initiative: River Bio-assessment Manual*, Commonwealth Environmental Protection Agency, Canberra.

DEHP 2009, *Queensland Water Quality Guidelines*, Version 3, ISBN 978-0-9806986-0-2, Department of Environment and Heritage Protection, Queensland Government, Brisbane, Available from <https://www.des.qld.gov.au/water/pdf/water-quality-guidelines.pdf>.

DNRM 2002, *Australia-Wide Assessment of River Health: Queensland AusRivAS Sampling and Processing Manual*, Monitoring River Health Initiative Technical Report Number 12, Environment Australia, Canberra.

Rose, PM, Kennard, MJ, Sheldon, F, Moffatt DB, and Butler GL 2016, 'A data-driven method for selecting candidate reference sites for stream bioassessment programs using generalised dissimilarity models', *Marine and Freshwater Research*, 67, 440-454.

## Appendix 1 Reference condition selection criteria field sheet

Project Name: \_\_\_\_\_ Project Code: \_\_\_\_\_ Run Number: \_\_\_\_\_ Photos taken (circle one): YES/NO Date: \_\_\_\_\_

Assessors: \_\_\_\_\_ Site Number: \_\_\_\_\_ Site Name: \_\_\_\_\_

| Possible Impacts                                                                      | 5                                                          | 4                                                    | 3                                                            | 2                                                                          | 1                                                               | Score |
|---------------------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------|-------|
|                                                                                       | (No Impact)                                                | (Minor Impact)                                       | (Moderate Impact)                                            | (Major Impact)                                                             | (Extreme Impact)                                                |       |
| <b>1. Agriculture and forestry*</b>                                                   | No impact                                                  | Present but level of impact is barely discernible    | Evident; however, not severe and/or widespread               | Obvious impact to stream; moderate and/or widespread                       | Severe and widespread; impact obvious                           |       |
| <b>2. Grazing intensity</b>                                                           | No impact                                                  | Present but level of impact is barely discernible    | Impacts evident; however, not severe and/or widespread       | Obvious impact to stream; moderate and/or widespread                       | Severe and widespread; impact obvious                           |       |
| <b>3. Sand/gravel extraction*</b>                                                     | No evidence or prior knowledge of extraction               | Small scale historical extraction                    | No current extraction; large historical extraction           | Current small scale/localised extraction                                   | Current and widespread extraction                               |       |
| <b>4. Upstream urban areas*</b>                                                       | No impacts from urbanisation                               | Possible impacts caused from urbanisation            | Definite impacts caused from urbanisation                    | High impacts caused from urbanisation                                      | Extreme impacts caused from urbanisation                        |       |
| <b>5. Point source pollution*</b>                                                     | Nil point source pollution                                 | Low volumes of point source pollution discharged     | Low to moderate volumes of point source pollution discharged | Moderate to high volumes of point source pollution discharged              | High to extreme volumes of point source pollution discharged    |       |
| <b>6. Barriers—impact on biota*</b>                                                   | No artificial barriers in basin which will affect the site | Few small upstream barriers; not within impoundment  | Many small barriers; site not within impoundment             | Multiple small barriers; large barriers upstream; within small impoundment | Large barriers upstream; within large impoundment               |       |
| <b>7. Flow regime alteration*</b>                                                     | Seasonal flow regime natural                               | Seasonal flow regime not obviously altered           | Flow regime altered                                          | Flow regime obviously altered                                              | Flow regime highly modified                                     |       |
| <b>8. Riparian and valley flat vegetation#</b>                                        | Streamside vegetation unaltered                            | Vegetation slightly modified                         | Obvious modification                                         | Highly modified vegetation                                                 | Severe modification                                             |       |
| <b>9. Weed species in riparian zone#</b>                                              | Weed species absent or insignificant                       | Few introduced species present; disturbance is minor | Some introduced species present; disturbance is moderate     | High percentage of introduced species; disturbance is high                 | Vegetation dominated by introduced species; extreme disturbance |       |
| <b>10. Bankside erosion / deposition#</b>                                             | No evidence of erosion beyond natural                      | Slightly more than natural levels of erosion         | Moderate levels of unnatural erosion                         | High levels of erosion                                                     | Extreme erosion                                                 |       |
| <b>11. Instream habitat alteration#</b>                                               | Instream habitats of natural appearance and diversity      | Barely discernible impacts                           | Moderate modifications to instream habitats                  | Highly modified modifications to instream habitats                         | Severe modification of instream habitats                        |       |
| <b>Total</b>                                                                          |                                                            |                                                      |                                                              |                                                                            |                                                                 |       |
| <b>Is site in reference condition i.e. all scores <math>\geq</math>4? (Yes or No)</b> |                                                            |                                                      |                                                              |                                                                            |                                                                 |       |

**Notes:**

\* the level of impact will generally decrease as the distance from the source of impact increases

# some of these variables will vary between and within catchments - compare with that which should be expected (i.e. natural).

If the impacts are unknown, seek further information before scoring.

More than one person must complete this form.

**Provide comments for all criteria scoring  $<$ 5 on the following page.**

**Selection criteria comments**

| <b>Selection Criteria</b> | <b>Comments</b> |
|---------------------------|-----------------|
| SC1                       |                 |
| SC2                       |                 |
| SC3                       |                 |
| SC4                       |                 |
| SC5                       |                 |
| SC6                       |                 |
| SC7                       |                 |
| SC8                       |                 |
| SC9                       |                 |
| SC10                      |                 |
| SC11                      |                 |

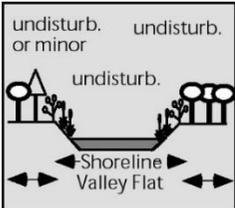
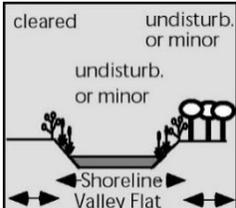
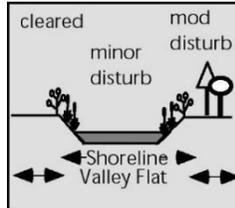
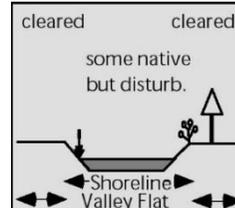
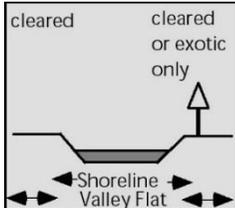
When filling in comments, provide as much information as possible, such as:

- identify desk based resources used in assessment
- details of type and source of impacts including approximate distances from those sources
- specific comments relating to assessments for each indicator, specifically when giving a score less than 5.

## Appendix 2 Example of possible impacts for each selection criteria

| Possible impacts and examples      | 5<br>(No impact)                                                                                                                                                                                                                                                                                                                         | 4<br>(Minor impact)                                                                                                                                                                              | 3<br>(Moderate impact)                                                                                                                                                                                                                                                                                           | 2<br>(Major impact)                                                                                                                                                                                                                                                                                                                         | 1<br>(Extreme impact)                                                                                                                                                    |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Agriculture and forestry</b> | <ul style="list-style-type: none"> <li>No agriculture and/or forestry</li> </ul>                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Dryland cropping and native species plantation with substantial vegetation buffer zones &gt;30m present</li> </ul>                                        | <ul style="list-style-type: none"> <li>Moderate dryland cropping and native species plantation with narrow/fragmented vegetation buffer zones &lt;30m</li> <li>Pine plantation and irrigated cropping with substantial vegetation buffer zone &gt;30m</li> </ul>                                                 | <ul style="list-style-type: none"> <li>Pine plantation and irrigated cropping with narrow/ fragmented vegetation buffer zones &lt;30m</li> <li>Dryland cropping and native species plantation with no vegetation buffer-zones present</li> </ul>                                                                                            | <ul style="list-style-type: none"> <li>Widespread soil disturbance extending to top of stream banks</li> <li>Extensive use of agrochemicals</li> </ul>                   |
| <b>2. Grazing intensity</b>        | <ul style="list-style-type: none"> <li>No grazing</li> </ul>                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>Light grazing in natural forest with limited and/or infrequent stock access to stream.</li> <li>Moderate grazing pasture.</li> </ul>                      | <ul style="list-style-type: none"> <li>Moderate grazing in natural forest with widespread and/or frequent stock access to river</li> <li>Moderate grazing pasture, with narrow or fragmented veg. buffer zones &lt;30m</li> <li>Heavy grazing, dairy, with substantial vegetation buffer-zone &gt;30m</li> </ul> | <ul style="list-style-type: none"> <li>Heavy grazing or dairy with narrow/ fragmented vegetation buffer zones &lt;30m</li> <li>Moderate grazing pasture with no vegetation buffer-zones present</li> </ul>                                                                                                                                  | <ul style="list-style-type: none"> <li>Heavy grazing, dairy, pine plantation and irrigated cropping with no vegetation buffer zones present</li> </ul>                   |
| <b>3. Sand/gravel extraction</b>   | <ul style="list-style-type: none"> <li>No knowledge of upstream and/or downstream extraction</li> </ul> <p><b>Note:</b> impacts <u>must</u> be present at site, rather than impacts that could be possibly occurring.</p>                                                                                                                | <ul style="list-style-type: none"> <li>Small scale historical extraction with impacts barely apparent</li> <li>Current small scale floodplain extraction</li> </ul>                              | <ul style="list-style-type: none"> <li>Historical instream extraction, with impacts still apparent</li> <li>Current large scale floodplain extraction</li> </ul>                                                                                                                                                 | <ul style="list-style-type: none"> <li>Current small scale instream extraction</li> </ul>                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Current widespread extraction</li> </ul>                                                                                          |
| <b>4. Upstream urban areas</b>     | <ul style="list-style-type: none"> <li>No urbanisation upstream</li> </ul>                                                                                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>Small town on large stream; few upstream towns</li> </ul>                                                                                                 | <ul style="list-style-type: none"> <li>Medium town (pop 3000 to 10,000) on small stream (width&lt;30m), &gt;10km upstream; few upstream towns</li> <li>Small town on large stream, &lt;10km upstream; many upstream towns</li> </ul>                                                                             | <ul style="list-style-type: none"> <li>Medium town on small stream, &lt;10km downstream; many upstream towns</li> <li>Stream &gt;10km from large town (pop&gt;10,000)</li> </ul>                                                                                                                                                            | <ul style="list-style-type: none"> <li>Stream &lt;10km from large town</li> </ul>                                                                                        |
| <b>5. Point source pollution</b>   | <ul style="list-style-type: none"> <li>Nil point source pollution upstream</li> </ul> <p><b>Note:</b> score will vary significantly depending upon the type of pollutant discharged. Examples include sewage, road drainage, industrial waste, thermal pollution, etc. When applicable, write down the type of pollutant discharged.</p> | <ul style="list-style-type: none"> <li>Low volumes of effluent into large (width &gt;30m) permanently flowing stream</li> </ul>                                                                  | <ul style="list-style-type: none"> <li>Low volumes of effluent into small (width &lt;30m) permanently flowing streams</li> <li>Moderate volumes of effluent into large permanently flowing stream</li> </ul>                                                                                                     | <ul style="list-style-type: none"> <li>High volumes of effluent into large permanently flowing stream</li> <li>Moderate volumes of effluent into small permanently flowing stream</li> <li>Low volumes of effluent into temporary stream during flowing periods</li> </ul>                                                                  | <ul style="list-style-type: none"> <li>High volumes of effluent into permanently flowing stream</li> <li>Discharge into temporary stream during no/low flow</li> </ul>   |
| <b>6. Barriers-impact on biota</b> | <ul style="list-style-type: none"> <li>No barriers upstream or within 10km downstream from site</li> </ul> <p><b>Note:</b> barriers can be artificial such as dams/weirs but should also include road crossings and other obstructions to the passage of biota.</p>                                                                      | <ul style="list-style-type: none"> <li>Few small (&lt;2m high) barriers upstream from site</li> <li>Site not within impoundment</li> <li>No barriers within 10km downstream from site</li> </ul> | <ul style="list-style-type: none"> <li>Many small barriers upstream from site</li> <li>Flow regime obviously altered</li> <li>Site not within impoundment</li> </ul>                                                                                                                                             | <ul style="list-style-type: none"> <li>Large dam/weir or artificial barriers &gt;10km upstream</li> <li>Multiple upstream small dams/weirs or artificial barriers</li> <li>Instream habitat obviously altered (e.g. artificial riffles created, dried out or drowned)</li> <li>Within small impoundment with stable water levels</li> </ul> | <ul style="list-style-type: none"> <li>Large dam/weir &lt;10km upstream from site</li> <li>Within impoundment with no flow or highly fluctuating water levels</li> </ul> |

Control and reference sites

| Possible impacts and examples                        | 5<br>(No impact)                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4<br>(Minor impact)                                                                                                                                                                                                                                                                                                                                                                             | 3<br>(Moderate impact)                                                                                                                                                                                                                                                                                                                                                              | 2<br>(Major impact)                                                                                                                                                                                                                                                                                                                                                     | 1<br>(Extreme impact)                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>7. Flow regime alteration</b></p>              | <ul style="list-style-type: none"> <li>No flow alteration due to abstraction, impoundments or water releases</li> <li>Or “No knowledge” of any such effects</li> </ul>                                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Some abstraction from large stream</li> <li>Base flow stopped or decreased</li> </ul>                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Occasional releases supplement base flow</li> <li>Abstraction high relative to stream size decreasing or stopping flow</li> <li>Low abstraction during low/no flow periods</li> <li>Base flow stopped</li> </ul>                                                                                                                             | <ul style="list-style-type: none"> <li>Frequent releases supplement base flows</li> <li>Large abstraction from a permanent small stream obviously reducing/stopping flow and water level</li> <li>Moderate abstraction during low/no flow periods</li> <li>Base or medium flow stopped or reduced</li> </ul>                                                            | <ul style="list-style-type: none"> <li>Seasonality of flow regime reversed by dams/weirs stopping flood flows and frequently/continuously</li> <li>Releasing supplemental base flows, site severely affected by abstraction or regulation</li> <li>Large abstraction during low/no flow periods</li> </ul>                                                                                                                                    |
| <p><b>8. Riparian and valley flat vegetation</b></p> | <p><b>Valley flat vegetation</b>—native vegetation present on BOTH sides of the river with a virtually intact canopy.</p> <p><b>Shoreline vegetation</b>—native vegetation on BOTH sides of the river is generally in good condition. Any disturbance is minor.</p>                                                                                                                        | <p><b>Valley flat vegetation</b>—agricultural land and/or cleared on ONE side; native vegetation on the other in reasonably undisturbed state.</p> <p><b>Shoreline vegetation</b>—native vegetation on BOTH sides with canopy intact or with native species widespread and common in the shoreline zone.</p>  | <p><b>Valley flat vegetation</b>—agricultural land and/or cleared on ONE side; native vegetation on the other clearly disturbed.</p> <p><b>Shoreline vegetation</b>—bank vegetation moderately disturbed though native species remain.</p>                                                       | <p><b>Valley flat vegetation</b>—agriculture and/or cleared land BOTH sides.</p> <p><b>Shoreline vegetation</b>—native vegetation present, but it is modified on BOTH sides.</p>                                                                                                     | <p><b>Valley flat vegetation</b>—agriculture and/or cleared land BOTH sides.</p> <p><b>Shoreline vegetation</b>—absent or severely reduced. Vegetation present is extremely disturbed.</p>                                                                                                                                                                 |
| <p><b>9. Weed species in riparian zone</b></p>       | <ul style="list-style-type: none"> <li>Weed species absent (0%)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>Weed species &lt;20%</li> <li>Disturbances from presence of weeds is minor</li> </ul>                                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Obvious presence of exotic species (20-40%)</li> </ul>                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>High percentage of exotic species in riparian zone (40-60%)</li> </ul>                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>Riparian zone dominated by exotic vegetation (&gt;60%)</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
| <p><b>10. Bankside erosion and deposition</b></p>    | <ul style="list-style-type: none"> <li>Riparian zone and stream banks in natural condition</li> <li>No unnatural erosion</li> </ul>                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>Riparian zone and stream banks with barely discernible erosion impacts</li> <li>Infrequent, small areas (&lt;20%) of unnatural erosion</li> </ul>                                                                                                                                                                                                        | <ul style="list-style-type: none"> <li>Riparian zone and stream banks with erosion impacts</li> <li>Moderate sized areas (20-40%) of unnatural erosion</li> </ul>                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Riparian zone and stream banks with obvious erosion impacts</li> <li>Extensive areas (40-60%) of unnatural erosion</li> </ul>                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>Riparian zone and stream banks with severe erosion impacts</li> <li>Majority (&gt;60%) of area unnaturally eroded</li> </ul>                                                                                                                                                                                                                                                                           |
| <p><b>11. Instream habitat alteration</b></p>        | <ul style="list-style-type: none"> <li>Diverse number of naturally occurring instream habitats in natural condition (e.g. some macrophyte growth, little algal growth, abundant coarse woody debris)</li> <li>No evidence of stream bed aggregation or degradation</li> </ul> <p><b>Note:</b> Degraded symptoms include: bed shallowing or deepening; bed erosion; steepening/undercutting banks; exposure of bridge bases; headcut or nickpoint; steep/mobile riffles.</p> | <ul style="list-style-type: none"> <li>Partial loss of some instream habitats and alteration to condition (e.g. increased macrophyte growth, algal growth, some loss of woody debris)</li> <li>If present then only slight degradation or aggregation</li> <li>Exhibits few of the degraded symptoms</li> </ul>                                                                                 | <ul style="list-style-type: none"> <li>Limited loss of some instream habitats (from drying, drowning, silting, scouring etc.) and alteration to conditions</li> <li>Moderate algal and/or macrophyte growth may extensively cover some areas of reach</li> <li>Some coarse woody debris removal</li> <li>Exhibits more than a few symptoms</li> <li>Moderate degradation</li> </ul> | <ul style="list-style-type: none"> <li>Widespread loss of instream habitats (from drying, drowning, silting, scouring etc.) and alteration to conditions</li> <li>Extensive algal and/or macrophyte growth smothering areas of reach</li> <li>Coarse woody debris removed</li> <li>Exhibits more than a few symptoms</li> <li>Moderate to severe degradation</li> </ul> | <ul style="list-style-type: none"> <li>Dominated by only one habitat (due to drying, drowning, filling or scouring), conditions highly modified</li> <li>Extensive macrophyte and algal growth chokes whole reach</li> <li>No woody debris</li> <li>Substrate smothered with deep layer of rotting vegetation (such as in Para grass choked streams)</li> <li>Exhibits many of the degradation symptoms listed. Severe degradation</li> </ul> |

