"Your gorges are awesome". A method to improve chat-up lines, and the articulation of fluvial geomorphic values, based on types of information content.

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Key Points

- It is now common to value 'geosites', but systematic approaches to valuing geomorphic features are less developed
- Unique, intrinsic are almost impossible to define with confidence
- Consequential and emotional values are not directly related to geomorphology
- The information content of a geomorphic site is a transparent measure of its value
- A database of objective metadata containing information content values may be used for management and communication

Abstract

A site of fluvial geomorphic conservation value is often associated with aesthetic values or oddities, such as the biggest or longest example of that type. An ad hoc listing of oddities on discovery is likely to miss a significant proportion of values present. A strategic search for sites requires a more targeted approach around a set of clearly defined values. Using the Tasmanian Wilderness World Heritage Area as a test case, we have created a method to delineate fluvial geomorphic values based on their information content that can aid in prioritising conservation. The broad types of geomorphic value are reference, rarity, assemblage and information repository. The main value comes from the ability to use a site as a reference. This includes the best condition or most outstanding examples, equally a site may be included if representative of the population (despite not being a text-book example of type), or it may be a place that is well-documented. The value of rarity involves considering the population of the process or form. Rarity refers to a situation where the loss of one site will mean that the population variability can no longer be described. This may include losing a spatial outlier or a site that has features well outside the of the rest of the population. An assemblage value comes from combining a number of disparate sites to provide better understanding of a form or process. Finally, a repository is a site that has the potential to provide information on land forming processes. These values provide tools to geo-prospect for new sites and can also be used as basis for management decisions.

Keywords

Geomorphic value, Geosite, Rarity, Reference, World Heritage Area

Introduction

The landform section of the Tasmanian Wilderness World Heritage Area (TWWHA) nomination states 'The larger rivers have cut across mountain ranges creating some awesome gorges, particularly in the Franklin – Lower Gordon Wild Rivers National Park.' (UNESCO, 1989, p3). This statement, along with some of the other UNESCO listing criteria (Table 1), highlights some of the issues of valuing landforms, and more specifically fluvial geomorphology. In what way are the gorges awesome? Does this attribute provide a rationale for preserving this region in a World Heritage Area?

Value statements for both geomorphic features and processes need to be defined so that they are not ambiguous and enable classification. Emotional statements of 'awesomeness' do not easily fit these criteria. One person's awesome may be another's hideous. To distance values from just being their merit to humans it could be suggested that the gorges have 'intrinsic' value (Gray, 2013); however, that is almost impossible to either classify or justify. There is also the question of whether the gorges are more or less awesome than those in the next catchment? This suggests that there needs to be some level of spatial significance attached to value statements.

The past two decades has seen a rapid increase of interest in the assessment, recognition, and management of geoconservation sites (Bruno et al., 2014), and it is becoming an emerging research area in the geosciences (Pereira et al., 2015). Once a site is recognized as potentially being important, the majority of geosite literature focuses on the management of public access to these sites (Petrović et al., 2013; Prosser, 2013; Štrba et al., 2014; White and Wakelin-King, 2014). What is currently missing from the literature is an objective and transparent system of identifying a fluvial geomorphic value based on process or landform.

To value a geomorphic feature it must be judged against a predetermined set of value criteria. It is suggested these criteria should be developed by experts in the field of study (Sharples, 2003; White and Wakelin-King, 2014; Pereira et al., 2015). These general principles have been applied by the Tasmanian government who since 1996 have maintained a list of sites of geoconservation significance – the Tasmanian Geoconservation Database (DPIPWE, 2015). This database is used for a variety of planning and conservation purposes, and has been developed through a combination of spatial inventories and serendipitous site identification.

In 2014 a project was initiated to improve the methods for identifying and assessing fluvial geomorphic values in the Tasmania Wilderness World Heritage Area (TWWHA). This paper presents the result of this work by providing a system of classification for values associated with fluvial geomorphology, although the general approach is applicable to other geomorphic features. The method needed to be appropriate for sites discovered serendipitously, but allowing for sites to be systematically searched for (geo-prospecting). Whilst the judgment of value is always going to be an anthropogenic construct, it should be as transparent and logical as possible. The method should also be able to cope with a range of different landforms from large to small, relict to active or even transient, and, as is commonly the case, an incomplete knowledge of the population. The approach taken is to define what constitutes a fluvial geomorphic value from a scientific point of view, then a description of different value types and their significance. Finally, the application of values to management will be discussed.

Table 1. Comparison of WHA listing criterion (UNESCO, 2013) versus the values for fluvial geomorphology

World Heritage Area listing Criteria	Suggested fluvial geomorphic values
(vii) to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance	Rarity (Deviant, Geographical outlier, Threatened)
(viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological process in the development of landforms, or significant geomorphic or physiographic features	Reference (Outstanding, Well studied, Condition) Rarity (Threatened) Assemblage Information repository
(ix) to be outstanding examples representing significant on-going ecological and biological process in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	Reference (Outstanding, Representative, Well studied, Condition) Rarity (Threatened) Assemblage Information repository
(i) to represent a masterpiece of human creative genius	Reference (First studied)
(x) to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	Reference (Well studied, Condition) Rarity (Deviant, Geographical outlier, Threatened)

What are fluvial geomorphic values?

We suggest that geomorphic systems can have three types of value: service, consequential, and information values.

Service values. Geomorphic systems provide ecosystem (also called natural) services to humans. These are functions that are beneficial to humans that would need to be replaced by artificial methods if nature did not provide them. Gray (2011) identifies geosystem services as a distinct class of service.

Consequential values. Many geomorphic systems support other values. For example, deep pools in a river might be critical habitat for endangered fish species, or they might provide a popular swimming hole. Seminuk (1997) describes the link between geodiversity and biodiversity. Many of these values can be described as both ecosystem and geosystem services that would be expensive to replace if they were lost (Gray, 2011). Note that all of these services relate to the value of the thing or function that is dependent on the geomorphic feature. In this context, the pool in the river is important because the species that relies on it is considered important. Therefore, we would argue that these consequential values should be identified separately by the experts in the field best equipped to identify the value that is dependent on the geomorphology, rather than a geomorphologist.

Information values. A principle reason for identifying and preserving geosites is to recognise and protect the information that they contain or embody. They contain information that is of interest to a specific scientific community and discipline (in this case, mostly geomorphologists) and the information embodied in the feature or process. First, a feature can have discipline specific information that can relate to the feature itself (its form or processes). Second, the feature or system can have *repository value* because of what is contained in the deposit (e.g. bones, pollen) that can be used to understand form or process.

The focus of this paper is on the last of these three value classes: information values. In this paper we describe:

a) The characteristics of *geomorphic sites* to which values can be attached.
b) A process for identifying *values*
c) A process for allocating the *significance* of those values.

Defining geomorphic sites

The first step in identifying conservation values and their level of significance must be to clearly define what is being discussed. This allows for easier comparison between similar examples, more consistent assessments of values, and makes the results of assessments more easily applied in a management context. In this paper, a synonym for a fluvial geomorphological geosite is a 'site'. A site should have the following characteristics:

1. The site must be spatially defined (i.e. mappable).
2. The site must be produced at least in part by fluvial processes.
3. The site must be recognisable by experts in the field of study.
4. Fluvial features within the site may be: stable and actively maintained by ongoing processes, relict and no longer forming, or transitory on the landscape.

For example, a series of antidunes in a river represent a transient fluvial feature that might be recognised to have value. These features are incorporated within a river reach (which is the unit), and the reach is defined by the banks, and the up and downstream ends of the reach.

A process for identifying information values

Information values have been subdivided into four main categories based on the attributes they engender (Table 2). In this section each of the categories and any sub-categories will be presented. It is suggested that when using these values they should be written as Category (*Subcategory*), e.g. Reference (*Outstanding*).

It should be noted that the value of uniqueness (Brillha, 2016) has been excluded. Assessments of uniqueness require a definitive evaluation of the entire population within the region of interest. It can be difficult to prove the absence of a similar feature unless the type of feature within the region is extremely well studied. We propose that rarity is a better descriptor because it has a higher confidence and less risk of falsification.

Table 2. A description of geomorphic information content categories.

Attribute	Description
Reference	These values mean the site contains information that allows another site to be compared against it, allowing contextual information to be provided.
Rarity	Those sites that are special because of their relationship to the main population. The may provide extreme examples of a large population or contain the only examples of a very small population.
Assemblage	These are disparate sites that when combined together provide information that is different, or more effective, than when they are considered separately.
Information repository	A feature that is has the potential to contain useful information through an understanding of its formation. This may be dateable material or a sequence of deposition that allows process determination.

Reference Values

There are five subcategories of reference values that all allow some type of comparison. One application of these values is for condition assessments. Biological assessments like those of vegetation using Habitat Hectares (Parkes, Newell & Cheal, 2003), or invertebrates using AUSRIVAS (Hose, Turak & Waddell, 2004), compare an expected (E) sample with an observed (O) sample and in doing so provide an O/E score of condition. A similar process can be undertaken for geomorphological sites once the referential site has been identified and values assigned.

Outstanding

An outstanding site provides a very clear example of its type. Form and processes need to be clearly observable as if they are a textbook example. These sites allow comparisons to confirm type, or provide clarity of understanding, and so provide a clear reference. Of all the available sites, the one considered to be an outstanding reference should be within the 'normal' range rather than being an outlier of the population. An outlier would show the processes in an extreme or odd situation and so is unlikely to be an unambiguous reference for other sites. An outstanding site does not need to be easily accessible, but in some cases this may be very useful. It also does not need to be in perfect condition so long as the feature or process under consideration is still clearly illustrated.

Representative

A representative reference site provides information on how the form or process manifests most commonly, and so is an example of the mode of the population. To use an analogy - an outstanding reference is the catwalk model of fluvial geomorphology, showing clothes in the best possible way but not really showing how those clothes would look on the woman or man on the street. This may be useful when the most outstanding site is not in the region and a more local reference is needed.

First studied

First studied sites are locations where a geomorphic theory was originally developed and demonstrated. Knowing where, and how, a theory was established means that the site can be revisited to provide a better understanding of the relevant process or form. It also allows the sites to be re-evaluated in light of new techniques or theories.

Well studied

When a site has been well studied it has value as a reference tool for comparison with other sites because of clear documentation of theories and data. Where appropriate, such as in a landform that operates in a dynamic equilibrium, the data should not only be spatially detailed but also encompass variability over time. Often places where there are continual records of measurement fit into this category with researchers taking advantage of local stage, discharge or meteorological data to complement their own observations. Equally a carefully interpreted historic photo or map combined with a subsequent revisit, can elucidate how processes are operating and may allow this value to be attributed.

Condition

Sites in un-impacted condition are valued because they may provide a reference for impacted sites, and they are often also rare because other sites have been altered or destroyed through anthropogenic disturbance. These sites are different from outstanding sites, which must be clear in what they represent but not necessarily be in good condition. There can also be a representative site in a region, but several others that are in good condition. The TWWHA has, in part, been protected because of its undisturbed condition. The lack of disturbance means that it can be used to understand the relationship between natural drivers, processes and channel form, which is not possible in other large areas of south eastern Australia due to anthropogenic disturbance.

Table 3. Examples of different reference values

Reference types	Example description	Significance level
Outstanding	The Macquarie Graben Fluvial Geomorphic Systems are included in the TGD as they are a suite of tectonically-influenced peat-land fluvial landforms, including probably the most extensive and well-preserved flights of fluvial terraces in Australia, have developed on Tertiary sediments of the Macquarie Graben. These landforms have been described by Jerie et al. (2003).	Continental
Representative	Middle Gordon River Cross-strike Drainage is listed in the TGD because it is a very clear example of a river crossing erosion resistant strike ridges and forming the awesome gorges referenced in the title of this paper.	Continental
First studied	The Ringarooma River in N.E. Tasmania is an example of where sand slug propagation has been first studied in Tasmania by Knighton (1987,1989). This is a reference showing poor condition and may be valued for its ability to aid rehabilitation of other streams rather than conservation.	Regional
Well studied	The Gordon River below Lake Gordon has been extensively monitored as a result of the BassLink hydropower project. (http://www hydro.com.au/environment/gordon-river-monitoring)	Regional
Condition	The New River Catchment is listed in the TGD because its presently undeveloped nature and the presence of fire sensitive vegetation across the entire catchment suggest that this area has not been significantly impacted by human landuse for at least many hundreds and probably thousands of years. This is very unusual in the temperate climatic zone globally	Global

Rarity

Rare sites are valuable because when they are damaged, a significant proportion of an entire class of feature or process is lost, and that loss of diversity from our planet or region is perceived as a negative outcome. Their loss would mean that there are no longer enough sites to effectively describe the variability of that process or form. Rare sites may come from very small populations of similar features, or they may also be of the outliers from a population that are the extreme examples of processes operating in odd combinations or situations.

Threatened

A site may be considered rare because in removing/destroying it we lose the ability to effectively describe the variability within the sites class. This may be because the site comes from a population that is naturally small (low-frequency), or be due to the natural variation of the population having been lost as some sites are degraded. Once a population reaches this tipping point all the remaining sites may be classed as rare. This concept may aid in the prioritisation of site preservation.

Deviant

When there is a large population of sites of a particular type, the outliers of the group may be rare. System constraints, such as geology or previous geomorphic processes may mean that processes manifest in a different way, and can produce forms that are markedly different from the majority of the population. If these sites were lost they could no longer be described by the rest of the population. Unlike sites that are outstanding because they clearly show how a form or process manifests, rare deviant sites are not suitable reference sites. They only show the form or process in an exceptional combination of circumstances. This may lead to descriptors like the largest or deepest feature of that population.

Geographical outlier

A site may be spatially rare when most of the population is contained in one region but there is a disparate population found in another region. The number of features in the larger population, if the entire population was considered over its spatial extent, would not be considered rare. In effect the smaller secondary population should get assessed in the same way as an endangered one, even though there may be an extensive overall population.

An outlier can also be at the furthest geographical extent of that site. This could be in the x,y, or z ranges of latitude, longitude and height.

Table 4. Examples of different rarity values

Rarity types	Example description	Significance level
Threatened	Wombat Plain Fluvial and Floodplain Features are listed in the TGD because rivers in similar contexts (ie alluvial plains) are typically degraded in Tasmania (eg floodplain drained, riparian zone disturbed, channel incised, woody debris removed). The good condition of the main channel and the floodplain features, the natural variation in channel character between different vegetation types, and the *Sphagnum* bogs makes this section of river unusual in the state and highly significant	Regional
Deviant	Badger Creek Collapsed Gorge and Enclosed Basin is listed in the TGD because it is an excellent example of karst-like landforms, including underground drainage and a major surface depression, formed in non-carbonate conglomerate due to mass movement processes. This is one of the best developed examples of landforms of this type in Tasmania.	Regional
Geographical outlier	Mt Rufus Alpine Sandstone Weathering Forms are listed in the TGD because they provide a clear expression of classic sandstone weathering forms, but in an alpine environment where evidence for such chemical weathering tends to be overshadowed by the role of physical weathering by other processes.	Regional

Assemblage

An assemblage is a combination of sites that together provide information on how the system is currently operating or did operate. Individual sites within the assemblage are not required to have value in their own right, but may do so. Most frequently an assemblage would allow you to describe how a system functioned in previous climatic conditions, or how the landscape has evolved. Equally, there may be features or sites that are more valuable because they are close together. An example is the Three Parallel Rivers of Yunnan province in China. This is the only value that may be attributed across a number of catchments.

Table 5. An examples of an assemblage value

Assemblage	Example description	Significance level
Macquarie Graben Fluvial Geomorphic Systems	The terrace sequence along with the extensive peat soils and quartzite gravels mean that the contemporary river systems, terraces and peats in combination describe the development of the region subsequent to tectonic uplift.	Global

Information repository

Many landforms store information in their form or materials. For example, in sediment sequences, such as a varve, or a single event such as a flood deposit. They will frequently have the potential for the extraction of dateable material. Where this information can explain geomorphic process or form, or help reconstruct landscape history, then it has an information repository value. Note that data collection may have occurred to gather the information at the site, and this would probably make the site well studied at some significance level. However, it is possible to predict where significant information repositories may occur, and such sites can be considered valuable even in the absence of existing data.

Table 6. An example of an information repository value

Information repository	Example description	Significance level
Lake Fidler and Sulphide Pool	These meromictic lakes contain an extremely high resolution palynological record of the Holocene.	Regional

Allocating Significance levels

Once the values of the geomorphic site have been defined, then a level of significance can be allocated. The following scales of significance are suggested for sites.

Global: Phenomena that are rare in the world, and/or by the nature of their scale, state of preservation, or display, are comparable with excellent examples known internationally. They may be illustrative of processes occurring or having effects at an inter-continental or global scale, and are equivalent to a World Heritage value as defined by the Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO 1999).

Continental: Phenomena that are unusual or unique nationally, and/or by the nature of their scale, state of preservation or display are comparable with the best examples known within the continent. May be illustrative of processes occurring or having effects at a continental scale. For example significant relative to all rivers in Australasia.

Regional: Phenomena that are important within the context of a region. Regions may be arbitrarily defined on political or administrative boundaries, or on the grounds of characteristic geological, landform and/or soil features. May include phenomena that are amongst the best developed, expressed or preserved examples of the features that characterise the region. The local region for the TWWHA would be the island of Tasmania.

Sub-regional: Phenomena that are important within the context of a large drainage area, geologic type, or geomorphic process zone.

Sites can have more than one value associated with them, and these can be at varying levels of significance. The highest possible level of significance will be assigned for each value. It is suggested that sites be mapped into a database using a GIS system. This mapping is expected to be in the form of polygon features that encapsulate the extent of the site, although some sites may be points or lines. The information about the site can then be interrogated based on its metadata. These data should include a statement describing the site, its spatial extent, any dependencies, and significance levels for each of the types of value. There could also be a level of confidence for each value and information on who was responsible for the attribution.

Table 7. List of suggested values to assess the geographical significance of fluvial sites

Value	Confidence	How to value	Sub-regional	Regional	Continental	Global
Reference: Outstanding	Medium-High with higher confidence coming from better understanding of the form or process.	This site is an unambiguous example of the feature or process. It allows for other sites to be compared against it due to the clear nature of its portrayal of the feature. It is expected to be within the normal range of the population and not an outlier. There would need to be a strong justification to allow more than one outstanding reference at each spatial scale.	Of all the sites in this sub-region this is one that has the easiest access to the most unambiguous example of the feature or process.	Of all the sites in this region this is one that has the easiest access to the most unambiguous example of the feature or process.	Of all the sites in this continent this is one that has the easiest access to the most unambiguous example of the feature or process.	Of all the sites globally this is one that has the easiest access to the most unambiguous example of the feature or process.
Reference: Representative	High	1) The site is an example of the typical expression of the features or process in that region; 2) sites in good condition be selected over those in degraded condition; 3) sites where tenure provides some security of future condition selected over those without security; 4) the site is appropriately accessible; 5) only one site should be selected in each region.	Of the sites in this sub-region, this one is a clear example of the typical expression of the feature or process.	Of the sites in this region this one is a clear example of the typical expression of the feature or process.	Of all the sites in this continent this one is a clear example of the typical expression of the feature or process.	Of all the sites globally this one is a clear example of the typical expression of the feature or process.

Table 7. List of suggested values to assess the geographical significance of fluvial sites

Value	Confidence	How to value	Sub-regional	Regional	Continental	Global
Reference: First studied	High	Clear documentation of a site, reach or catchment where a theory was developed, or a process was first observed, that allowed for other research to be placed in context.	A theoretical development that has sub- regional implications	A theoretical development that has regional implications	A theoretical development that has continental implications	Major theoretical breakthrough that may have global implications.
Reference: Well studied	Medium-High Grey literature may be difficult to find but otherwise books and journals should be relatively easy to assess.	A combination of data and interpretation that allows for an understanding of the form or process	The information provided by the site has application to other sites in the sub-region, or is only available as data and is not published.	The information provided by the site has application only to sites in the region, or is only available as grey literature and data.	The information provided by the site has application to sites in the continent, or is available in peer reviewed literature and as data.	The information provided by the site has application to other sites across the globe, or is available in several peer reviewed journals and as a large dataset of intense measurements over a short period or measurements over a long time.
Reference: Condition	Medium It is difficult to be certain there has been no historic disturbance	The degree of anthropogenic disturbance for the population of sites needs to be assessed for the spatial area of the significance level. Of all the sites those that appear the least disturbed may be attributed this value.	The site is considered one of the least disturbed in the sub-region.	The site is considered one of the least disturbed in the region.	The site is considered one of the least disturbed on the continent.	The site is considered one of the least disturbed globally.

Table 7. List of suggested values to assess the geographical significance of fluvial sites

Value	Confidence	How to value	Sub-regional	Regional	Continental	Global
Rarity: Threatened	Low A complete census of fluvial geomorphic populations tends to be uncommon, so the ability to understand the consequences of losing a site tends to be low.	Consider the effect of the removal of a site. If the natural variability would be impacted by this loss then the whole remaining population is considered rare.	If a site were to be removed from the sub-regional population then the natural variability of the sub-regional population would be affected,	If a site were to be removed from the regional population then the natural variability of the regional population would be affected	If a site were to be removed from the continental population then the natural variability of the continental population would be affected	If a site were to be removed from the global population then the natural variability of the global population would be affected
Rarity: Deviant	Low	Assess the known population of the site. If the outliers can be determined, preferably statistically, then these should be classed as rare, but not necessarily the rest of the population.	This is an outlier of the population when assessed at a sub-regional scale.	This is an outlier of the population when assessed at a regional scale.	This is an outlier of the population when assessed at a continental scale.	This is an outlier of the population when assessed at a global scale.

Table 7. List of suggested values to assess the geographical significance of fluvial sites

Value	Confidence	How to value	Sub-regional	Regional	Continental	Global
Rarity: Geographical Outlier	Low	If a site were removed from a smaller outlying population the ability to describe variability would be lost. The smaller population would be classed as rare but probably not the larger main population. Alternatively, the site is at the extreme limit in latitude, longitude or altitude	The outlying population is the only one found in the sub-region. This is the extreme geographical limit of the feature in the sub-region.	The outlying population is the only one found in the region. This is the extreme geographical limit of the feature in the region.	The outlying population is the only one found on the continent. This is the extreme geographical limit of the feature in the continent.	The outlying population is the only one found on the globally. This is the extreme geographical limit of the feature globally.
Assemblage	Medium - High	A number of sites, reaches or catchments when used in combination provide evidence of functioning in past climates, or of landscape evolution. The assemblage might not be contiguous, and may include multiple themes, (e.g. glaciofluvio karst).	Contains features that help interpret processes or paleoclimate conditions important at a sub-regional level	Contains features that help interpret processes or paleoclimate conditions important at a regional level	Contains features that help interpret processes or paleoclimate conditions important at a continental level	Contains features that help interpret processes or paleoclimate conditions important at a global level

Table 7. List of suggested values to assess the geographical significance of fluvial sites

Value	Confidence	How to value	Sub-regional	Regional	Continental	Global
Information repository	Medium -High	A site may be predicted to contain useful information on process if there are already studies in the area that support this prediction, such as a dated flood deposit in a slackwater where there may be other potential flood deposits. There could also be a knowledge about how the landform development that supports this assumption, such as the infilling of an oxbow lake or accretion of a floodplain.	The site is predicted to contain features that help interpret processes or paleoclimate conditions important at a sub-regional level	The site is predicted to contain features that help interpret processes or paleoclimate conditions important at a regional level	The site is predicted to contain features that help interpret processes or paleoclimate conditions important at a continental level	The site is predicted to contain features that help interpret processes or paleoclimate conditions important at a global level

Conclusions

This paper presents a framework for clearly and consistently identifying fluvial geomorphic values, specifying why they are of value, and identifying the scale on which each value is significant. Sites that are serendipitously discovered may be attributed these values, however, it is now possible to actively search for new sites as well. This might be by identifying rarity of geographically outlying sites, or looking for the conditions where Rare (*Deviant*) sites might occur.

The commonly used values that define sites as unique or intrinsic are avoided as they lack confidence and rigour respectively. It may appear that geomorphic values based on information content miss the point of something that is often associated with aesthetics and the tourism this creates. Brilha (2016, p.127) describes a 'scenery' criteria that "represents the beauty of the geological elements that could stimulate students' interest for the site and thus increase it Educational Value". However, the approach described here does not exclude recognition of these values. Rather, it allows for their recognition as service values or consequential values, while allowing the information values to be teased out and recognised in a consistent and readily defensible manner. These justifiable values can still be aligned with UNESCO WHA listing criteria (Table 1) and so are seen as complimentary rather than different.

The determination of fluvial geomorphic information values allows for many end uses. In Tasmania, the existing geoconservation database is used for tracking the inventory of conservation values to meet the requirement of the International Union for Conservation of Nature (ICUN) to document the special values of the World Heritage area, and to assist in implementing the Tasmanian Nature Conservation Act 2002 which refers to conserving geological diversity. However, beyond these purposes, the database plays other important roles that include informing planning and land use decisions both within and outside the reserve estate. The information guides the real time response to extreme events such as the recent bushfires, and it is available as a resource for anyone with an interest in Tasmanian geodiversity.

In any jurisdiction, planning and land management decisions would benefit from an audit of all available information in a region so that sensitive sites, or those with a certain level of significance, can be given due consideration in development proposals. Outside of management objectives, researchers or environmental consultants often want to know where well studied sites are situated, or where they might find good condition reference sites to compare against. While the creation of a database of fluvial geomorphic values is a large and ongoing task, the framework presented here will assist by providing a systematic and transparent approach.

Acknowledgments

We would like to thank Mike Comfort and Jason Bradbury at DPIPWE as well as the Tasmanian Geoconservation Reference Group for their valuable input.

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