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# REGISTER OF STATE GEOHERITAGE SITES, WESTERN AUSTRALIA: NOMINATION AND REGISTRATION PROCESS

SK Martin





Government of **Western Australia**  
Department of **Mines, Industry Regulation  
and Safety**

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SK Martin

PERTH 2023



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Western Australia**

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**Cover image:** Episodic tides discharge sediments along a rocky shoreline at Cable Beach, Broome. Photo by Robin Bower

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# Register of State Geoheritage Sites, Western Australia: nomination and registration process

SK Martin

## Abstract

Geoheritage in Western Australia is managed by the Geological Survey of Western Australia, primarily through the Register of State Geoheritage Sites, a formal although non-statutory listing of sites of geoconservation significance within the State. This Record outlines the process of nominating, assessing and adding sites to the Register, and provides background for the concepts of geoheritage, geodiversity and geoconservation against which potential sites are assessed. It is intended for this process to allow any organization or individual to nominate sites for assessment and potential registration on the Register.

**KEYWORDS:** geoconservation, geodiversity, geoheritage, nomination process, policy, Register of State Geoheritage Sites

## Introduction

Geoheritage and geoconservation have received increased global attention in recent years, with more countries and regions attempting to identify and conserve significant features within their borders, and numerous publications proposing new and expanded geoheritage processes for assessment. As an example of this growing area of research, a chapter discussing natural heritage in the International Union for Conservation of Nature's *Protected Area Governance and Management* book (Worboys et al., 2015) gives geodiversity equal weighting to biodiversity, despite public perceptions being substantially skewed towards biological conservation. In Australia, there is a similarly increasing urgency to catalogue our own geological and geomorphological treasures; however, geoheritage and geoconservation are generally managed at a state (rather than national) level, with interest varying between states. Geoconservation efforts are regularly eclipsed by more intense management and public focus on biological and cultural heritage (e.g. Cresswell, 2019). Although there are avenues for national and international protection of unique and highly significant geological sites (the National Heritage and World Heritage Lists, respectively), geological heritage is arguably under-represented on the National Heritage List at present, and World Heritage listing is reserved for only the most iconic or critical sites.

In Western Australia, geological heritage is currently under-represented and underappreciated when compared to other forms of State heritage, when all three aspects — abiotic, biotic and cultural heritage — are deeply linked, and should be equally valued and supported. Despite general perceptions that rocks and landforms are robust and therefore do not require protection, this is rarely true. A wide range of human activities — agriculture, mining, weeds and introduced pests, urban expansion, infrastructure construction, modification of waterways, and tourism — can adversely alter outcrops, landscapes and soils, whether through increased exposure, abrasion, modification, excavation or extraction. Natural

influences such as rain, wind and tides can also alter and diminish significant geology, although geoconservation aims to 'maintain natural rates and magnitudes of change in those features and processes' (Sharples, 2002, p. 2), as elimination of natural processes is both beyond the control of government or conservationists and counterintuitive for dynamic natural systems.

## Geoheritage in Western Australia

The role of the Geological Survey of Western Australia (GSWA) is to document the geology of Western Australia, collect and interpret regional geoscientific data and provide related policy information systems on land use planning and State development by acquiring, enhancing, archiving and disseminating data to promote the mineral and petroleum prospectivity of Western Australia. As GSWA sits within the Department of Mines, Industry Regulation and Safety (DMIRS), geoheritage falls within GSWA's responsibilities as the primary custodian of geological research and information within Western Australia. GSWA bases its methods of identifying, managing and maintaining sites of geological significance (i.e. State Geoheritage Sites and State Geoheritage Reserves) on current best practice within Australia, working within the constraints of present State legislation and processes.

In Western Australia, sites of geological significance may include different aspects of geology and geomorphology, such as a fossil locality, a type section, a landform or other geological features. Other terms used to describe sites of geological significance include 'geological monument' (now obsolete), 'geosite' and 'geoheritage site'; the latter is the preferred term in Western Australia. The Executive Director, Geological Survey of Western Australia (herein, Executive Director GSWA) manages sites of geological significance on behalf of the State through the maintenance of the Register of State Geoheritage Sites, which was formally established in 2003, although in preparation since the late 1980s.

A spatial version of this Register (Fig. 1) is publicly available via the DMIRS online data portal, GeoVIEW.WA at <www.dmirs.wa.gov.au/GeoView>. The Register provides recognition for geological heritage in Western Australia, and facilitates the appropriate management of activities that may influence the value and integrity of sites of geological significance. However, although formalized, there is no State legislation that deals directly with geoh heritage, and the Register is therefore non-statutory in nature.

State sites of geological significance as listed on the Register fall into two categories, based on their level of management and protection.

1. State Geoh heritage Reserves are Crown Reserves created under Section 41 of the Western Australian *Land Administration Act 1997* through a Management Order that vests them with the Minister for Mines and Petroleum, for management by the Executive Director GSWA. Access and sampling of these locations is strictly controlled by GSWA (Grey et al., 2010).
2. State Geoh heritage Sites are entered onto the Register without any change to their land tenure. The location and condition of these sites is monitored, although they have no legal definition. GSWA undertakes management of these sites through education and mediation with local communities, shires and landowners, and by influencing other land use processes, such as mining and exploration approvals (under the *Mining Act 1978*). Several State Geoh heritage Sites

fall within other types of Crown Reserves, such as bioconservation (e.g. National Parks), timber or water reserves, or National or World Heritage Sites, and are therefore governed primarily under the auspices of the relevant State and national government departments.

Localities are generally registered initially as State Geoh heritage Sites, with only the most vulnerable and critical sites taken through the lengthy process required to become a State Geoh heritage Reserve.

A key part of managing geoh heritage within Western Australia is being able to nominate and formally assess new sites of geological significance, as a way to ensure State geodiversity is properly recognized, represented and conserved. Although GSWA intends to conduct systematic regional assessments to identify potential State Geoh heritage Sites in the near future, it was considered advantageous to also provide a mechanism by which any organization or individual could nominate sites they consider should be added to the Register. Such a mechanism has never been established previously for the Register of State Geoh heritage Sites, and as a result the Register has remained static for many years.

The intention of this Record is to describe both the concepts underpinning the Register of State Geoh heritage Sites and the process undertaken by GSWA to establish a new State Geoh heritage Site once a nomination is received. It is hoped that this information will foster community awareness of geoh heritage as a whole, and guide those who wish to propose a site for inclusion on the Register.

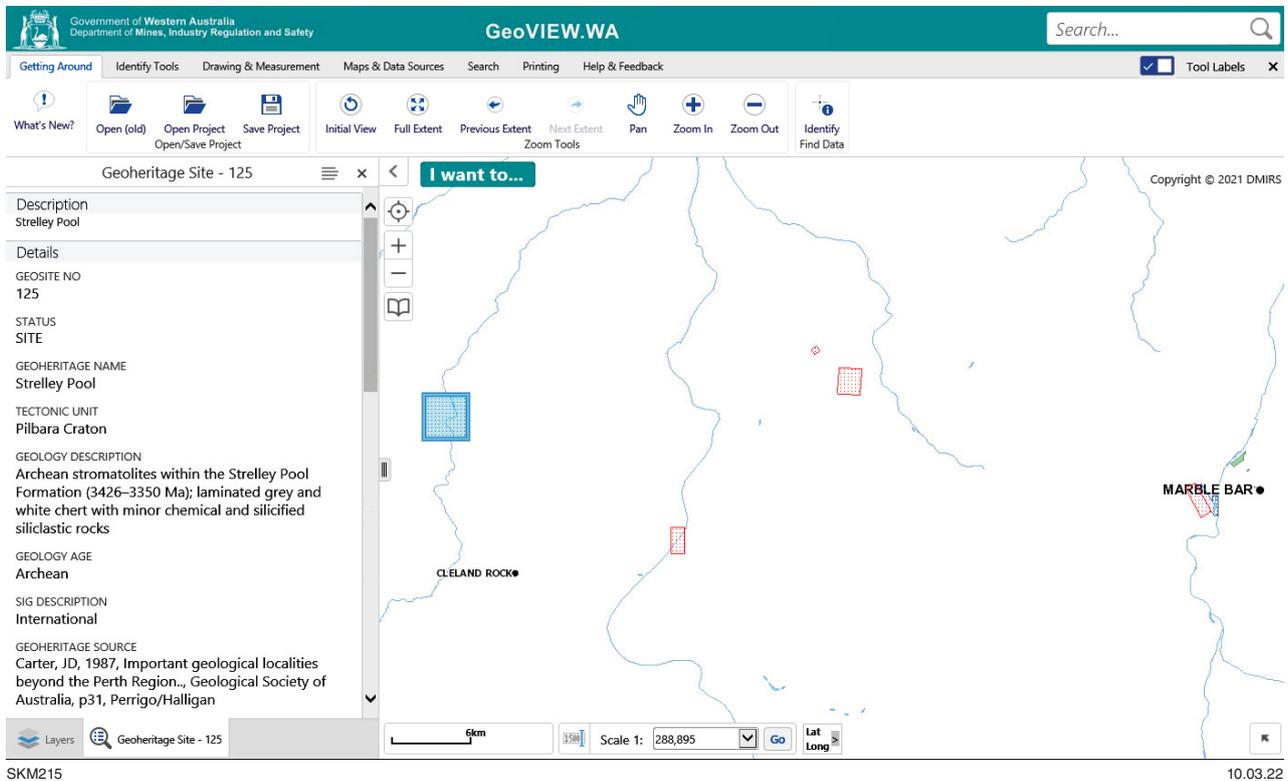


Figure 1. Screenshot showing spatial search of the Register of State Geoh heritage Sites as seen through the GeoVIEW.WA portal. On this layer, State Geoh heritage Reserves are mapped in red and State Geoh heritage Sites in blue; information relating to Geosite 125, Strelley Pool, can be seen in the left-hand panel

## Conceptual framework

The geoheritage definitions, processes and assessment framework used within Western Australia are based on an amalgam of practices already in use within Australia, especially those with strong research or legislative support. The main two schemes incorporated are:

- the Australian National Heritage List assessment process (Australian Heritage Council, 2009)
- the Geoheritage Tool-kit approach championed by the Geological Society of Australia, and published as a set of research papers by Brocx (2008) and Brocx and Semeniuk (2007, 2019, 2020, among others).

Other approaches, such as Sharples (1995, 2002), were also considered and concepts integrated as appropriate based on previous iterations of the Register (Roberts and Freeman, 2008; Grey et al., 2010) and the current Western Australian legislative landscape.

## Key geoheritage concepts

Geodiversity, geoheritage and geoconservation are closely interlinked ideas ascribing heritage concepts to natural abiotic features and landscapes.

### Geoheritage

The most widely used definition of 'geoheritage' currently in use within Australia was established by Brocx and Semeniuk (2007, p. 62), and is as follows:

*Globally, nationally, state-wide, to local features of geology, such as its igneous, metamorphic, sedimentary, stratigraphic, structural, geochemical, mineralogic, palaeontologic, geomorphic, pedologic, and hydrologic attributes, at all scales, that are intrinsically important sites, or culturally important sites, that offer information or insights into the formation or evolution of the Earth, or into the history of science, or that can be used for research, teaching or reference*

Here, the suffix 'heritage' is intended in its broadest sense, encompassing aspects of human-centric, ecological and intrinsic value, somewhat contrary to Sharples' (2002) suggestion that the word 'heritage' be used to imply value to humans, rather than value to natural ecosystem processes, or value for its own sake.

### Geodiversity

There is some debate surrounding the use and scope of the term 'geodiversity' (e.g. Joyce, 1997; Brocx and Semeniuk, 2007, 2020; Gray and Gordon, 2020), specifically whether geodiversity is global or regionally specific. In a practical sense, the Register of State Geoheritage Sites already places a geographic constraint (the State of Western Australia) on its assessment of geodiversity, so the definition provided by Brocx and Semeniuk (2007, p. 63) is preferred here:

*the natural variety of geological, geomorphological, pedological, hydrological features of a given area, from the purely static features (i.e. products such as shorelines, sandy spits, or limestone pinnacles, or*

*river canyons) at one extreme, to the assemblage of products, and at the other, their formative processes (e.g. active parabolic dunes forming under a given wind regime)*

Although often misused to indicate worth, 'diversity' is a descriptive term, not a value judgement; that is, high diversity regions are not better than low diversity areas, unless that is the natural state for that area. Therefore, the concept of geodiversity is best considered a tool for evaluating the natural range of geological features and their interacting assemblages and processes within a site or region (e.g. Brocx and Semeniuk, 2020, fig. 2), and a guide towards the maintenance of a full range of features characteristic of an area.

### Geoconservation

The final term in the set, 'geoconservation', has had various definitions since its establishment in the 1990s (see Brocx and Semeniuk, 2007 for historical uses of the term) although the brief definition given in Sharples (2002, p. 57) is fairly representative:

*The identification and conservation of geological, geomorphological and soil features, assemblages, systems and processes (geodiversity) for their intrinsic, ecological or (geo)heritage values*

Thus, geoconservation can best be thought of as the act of maintaining geodiversity through the identification of geoheritage. This interconnectivity was best summarized by Eberhard (1997, p. v):

*The relationship between 'geodiversity', 'geoheritage' and 'geoconservation' can be summarised thus: geodiversity is an objective quality of the natural environment; geoheritage is made up of examples of aspects of geodiversity that have been identified as having conservation significance; and geoconservation is the endeavour of trying to conserve geodiversity*

In this way, geodiversity, geoheritage and geoconservation can be equated to biodiversity, biological heritage and bioconservation (the latter often colloquially termed 'conservation', although intended to conserve biota specifically), and to culture, cultural heritage, and cultural conservation, although care must be taken to acknowledge differences in the application of these concepts as applied to the different types of heritage. Summaries of these concepts and their application are provided by Brocx and Semeniuk (2007), Brocx (2008) and Sharples (2002) and numerous other texts.

## Defining Western Australian sites of geological significance

For a site to be included on the Register of State Geoheritage Sites, it must meet the following definition:

*Geological features of state-wide to international significance, being either outstanding (unique, uncommon or rare) or representative (of a feature, association or process) examples of geodiversity, of scientific and/or other value to the State of Western Australia*

This definition indicates that sites of geological significance must display either: 1) features of prime use for geological research, reference and education; or 2) features critical to the function of, or evidence for, natural geological and environmental processes of the State. As significant features, these locations are thereby deemed to be worthy of management, protection and preservation by both the geological community and the Western Australian community at large.

The State Geoheritage Site definition provided here is revised from the previous definition (see Grey et al., 2010), which had focused on unique and iconic landforms. However, modern geoheritage practice, as seen in the scientific literature, also considers maintenance of regional systems or processes as a critical part of geoconservation, and a decision was made to revise the Western Australian geoheritage site definition accordingly. As a result, the new definition is more closely aligned with local biological conservation and cultural heritage practices, as well as national and international geoheritage practice.

## Assessment criteria

Under the new definition, a place can be considered to qualify as a State Geoheritage Site if it meets one or more of the criteria prescribed below. These criteria are based on those used to assess places nominated for the [Australian National Heritage List](#). Similar criteria are used in Western Australia to assess significant cultural heritage, and in New South Wales and South Australia to assess State Heritage Places (natural or cultural); therefore, the aim is to align Western Australian geoheritage assessments with similar processes nationwide.

The criteria are:

1. **Events and processes:** The place has outstanding geoheritage value to the State because of the place's importance in the evolution or pattern of Western Australia's geological history.
2. **Rarity:** The place has outstanding geoheritage value to the State because of the place's possession of unique, uncommon or rare aspects of Western Australia's geology or geomorphology.
3. **Research potential:** The place has outstanding geoheritage value to the State because of the place's contribution, or potential to contribute, to an understanding of Western Australia's geological history.
4. **Representativeness:** The place has outstanding geoheritage value to the State because of the place's importance in demonstrating the principal characteristics of:
  - 4.1. a specific feature, or association of features, of Western Australia's geology or geomorphology; or
  - 4.2. a natural process important to understanding Western Australia's geological past or present geography.
5. **Geologically historical sites:** The place has outstanding geoheritage value to the State because of the place's cultural importance by:

- 5.1. exhibiting particular aesthetic characteristics valued by a community or cultural group; or
- 5.2. being closely linked with historically significant scientific events or people that have furthered our understanding of Western Australia's geology and geomorphology (or both).

Although the criteria above are primarily framed in reference to 'value to the State of Western Australia' and 'understanding Western Australia's geology', the wording is intended as a jurisdictional limit and a **minimum** level of significance for consideration. Sites of international value within Western Australia will also be of value to the State, and understanding Western Australian geology can be valuable in a global context. Other guidance on the application of these criteria is provided below.

## Criterion definitions and examples

The following section provides discussion on how each of the criteria are intended to be applied, with an example from the current Western Australian Register of State Geoheritage Sites provided for context. The criterion definitions are modified after the National Heritage List guidelines (Australian Heritage Council, 2009).

### *Criterion 1: events and processes*

*The place has outstanding geoheritage value to the State because of the place's importance in the evolution or pattern of Western Australia's geological history.*

This criterion applies to natural places that contain outstanding evidence or products of past or continuing geological or geomorphological processes at the relevant level of significance. It must make an important contribution to understanding the evolution of the Australian continent (structure, landscapes and biota), at the regional (such as tectonic unit), state, national or international level. This would include modern landscapes and settings, and geohistorical sites.

**Example: Trendall Reserve (R50149).** Trendall Reserve (Fig. 2a) is a site of international significance, preserving some of the clearest evidence of early life within an assemblage of Paleoarchean stromatolites preserved within the Strelley Pool Formation (Hickman et al., 2011). The Strelley Pool stromatolites are considered the world's oldest microfossils consistently interpreted as biogenic; older forms, such as those seen at the nearby Buick Reserve (R44710), are controversial regarding their origin and interpretation. At the Trendall site, there are a wide variety of microbialite forms with excellent in-situ preservation, hosted in only lightly deformed and metamorphosed rocks. These features provide a clear window into the early establishment of life, and the environmental conditions that supported their development.

This site also qualifies for Criteria 2, 3 and 4, as well-preserved Paleoarchean stromatolites are extremely uncommon and represent an intense research interest to numerous scientists worldwide, with the Trendall site often used as the most comprehensive and iconic example of early Archean stromatolites.



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Figure 2. Examples of localities listed on the Register of State Geoheritage Sites: a) Trendall Reserve (R50149), an example of Criterion 1: events and processes (image: A Hickman); b) Dalgarranga Reserve (R28497), representing Criterion 2: rarity; c) Jack Hills (Geosite 59), an example of Criterion 3: research potential (image: S Wyche); d) Lake Cowan Causeways (Geosite 69), representing Criterion 4: representativeness (image: T Ivanic); e) Coal Seam Park (Geosite 26), as an example of Criterion 5: geologically historic sites (image: T Lenane)

### **Criterion 2: rarity**

*The place has outstanding geoheritage value to the State because of the place's possession of unique, uncommon or rare aspects of Western Australia's geology or geomorphology.*

This criterion relates to natural places containing geological or geomorphological features, associations or processes that are unusual or uncommon within its class or type of feature and at the relevant level of significance. It must be clear from the assessment that the feature is both unusual at the regional, state, national or international level, and considered worthy of conservation due to this rarity. This criterion would cover 'monuments' or iconic features or landscapes.

**Example: Dalgarranga Reserve (R28497).** Dalgarranga (Fig. 2b) is a small impact crater. Dalgarranga has a set of features that make it highly unusual at the national and international level (Haines, 2005; Hamacher and O'Neill, 2013) as it is:

- one of only 190 confirmed craters worldwide
- the third smallest confirmed crater on the international list
- the smallest single crater in Australia
- one of only three proven impact craters in Western Australia
- the only crater in Australia formed by a mesosiderite bolide. Mesosiderite is a rare type of stony-iron meteorite, with very few impact craters worldwide formed by this class of meteorite.

The site also qualifies for Criteria 3 and 5. As one of the smallest proven impact craters, and one formed by an unusual bolide type, it is likely to be of research interest in the future. The site is also historically significant due to its long history of investigation (it was first noted in the scientific literature in the 1920s), and its status as one of the oldest sites in Western Australia to be conserved specifically for its geological features, being designated a State C class reserve for the 'protection of a geological monument' in 1967.

### **Criterion 3: research potential**

*The place has outstanding geoheritage value to the State because of the place's contribution, or potential to contribute, to an understanding of Western Australia's geological history.*

This criterion relates to natural places considered critical for ongoing or future geological or geomorphological research, or places that were the focus of past geological or geomorphological research and may continue to be used similarly in the future. Evidence or proven use of the site is required to invoke 'a potential for research contribution'; this statement does not cover an unspecified possibility for use. This criterion could include type localities (stratigraphic, mineralogical or paleontological), modern landscapes and settings, and geohistorical sites; Criterion 3 differs from Criterion 1 in the specific application to research and the scientific community, as opposed to contributions to geological understanding and knowledge as a whole.

**Example: Jack Hills (Geosite 59).** Jack Hills (also known as Erawondoo Hill; Fig. 2c) is an internationally significant locality preserving the oldest terrigenous materials currently known on Earth (Cavosie et al., 2007). The zircon crystals extracted from metasedimentary rocks at this location have been intensively studied, providing extensive information on the form and processes active in the Hadean, such as whether the crust was fully solidified, whether plate tectonic processes were active and whether liquid water existed at the surface. The site is of ongoing research interest, and it is in the scientific community's interest to ensure the locality remains accessible in the future.

The site also qualifies for Criterion 1, with the zircons representing outstanding evidence of early Earth environments and processes.

### **Criterion 4: representativeness**

*The place has outstanding geoheritage value to the State because of the place's importance in demonstrating the principal characteristics of:*

- a specific feature, or association of features, of Western Australia's geology or geomorphology; or
- a natural process important to understanding Western Australia's geological past or present geography.

This criterion relates to natural places that illustrate all of the critical aspects of an important type of geological or geomorphological feature, or geological or geomorphological process. The key to meeting this criterion is that the place is representative of specific lithology, mineralogy, structure, age, formational environment or paleobiota; however, if a feature/process is known to be diverse or varied in form or function, multiple sites can be identified under this same criterion. Sites identified under this criterion would likely be of use for education and research due to their typical form and nature, and could include type localities and modern landscapes and settings.

**Example: Lake Cowan Causeways (Geosite 69).** The Lake Cowan Causeways site (Fig. 2d) preserves outcrops of the Jimberlana mafic layered intrusion. Jimberlana is generally considered an excellent analogue — albeit at a smaller scale (Hallberg, 1986; Campbell, 1991) — of the Great Dyke of Zimbabwe, the classic example used to illustrate this class of intrusions internationally. The Lake Cowan site, along with associated outcrops at Bronzite Ridge and Mount Norcott, preserves all of the features characteristic of this style of layered intrusion, and their excellent exposure and good condition makes the sites of particular use to researchers and students attempting to understand these complex and unusual structures. Although there are other layered intrusions known within Western Australia, Jimberlana is arguably the best studied and most typical example.

### **Criterion 5: geologically historical sites**

*The place has outstanding geoheritage value to the State because of the place's cultural importance by:*

- exhibiting particular aesthetic characteristics valued by a community or cultural group; or

- *being closely linked with historically significant scientific events and/or people which have furthered our understanding of Western Australia's geology and geomorphology.*

This criterion relates to natural places closely linked to culture and to the history of geological research within Western Australia. It requires clear evidence that the site/feature inspired, or was the focus of, a critical piece of research or hypothesis related to a regional, state, national or international understanding of geology. Alternatively, the site might be intimately linked to the research output considered critical to the development of geological science at either a regional, state, national or international level. This criterion would also include sites of outstanding societal or scenic value, such as iconic sites of primarily touristic or aesthetic value.

**Example: Coal Seam Park (Geosite 26).** The outcrops along the northern branch of the Irwin River, within what is now Coalseam Conservation Park (Fig. 2e), were critical to the description and study of lower Permian sedimentary rocks within Western Australia. The Gregory brothers' examination of the site in 1846 is the first record of coal within Western Australia, and sites along the river, particularly Fossil Hill, are some of the State's earliest comprehensively studied fossil localities (Clarke et al., 1951; Mory and Haig, 2011).

The site also meets the requirements of Criteria 3 and 4 as it contains three type sections, and the excellent outcrop exposure and ease of interpretation make it a useful site for education and research (Mory and Haig, 2011).

### Site classification qualifiers

To aid comparison of the nominated site with similar features worldwide, and therefore assess which, if any, of the assessment criteria are met, the site and its features should first be categorized using several key classification qualifiers:

- conceptual categories
- significance scale
- significance level
- significance themes.

The first three qualifiers are adapted directly from the Geoheritage Tool-kit established by the [Geological Heritage Committee of the Geological Society of Australia \(GSA\)](#); the fourth qualifier allows better comparison of sites to similar locations based on the types of geology preserved.

Sites are rarely simple and may contain multiple significant features with various categories, scales, significance levels or themes. To allow comprehensive comparison and assessment, it is critical that all relevant qualifiers are identified for a site.

#### Conceptual categories

Conceptual categories indicate what type of geoheritage the site represents. These categories are:

- **Type example, reference site or location** – type stratigraphic, fossil or mineralogical locations; locations where rare or important mineral assemblages, soil,

geomorphological features, or lithologies can be observed

- **Culturally or historically significant site** – aesthetic sites (monuments), sites where geological principles were first explained, or sites linked with historically important people
- **Geohistorical site (ancient sequences)** – classic localities where earth processes or history can be inferred
- **Modern landscapes and settings** – locations where dynamic processes are operating, which provide reference models for ancient processes or features.

Identifying conceptual categories helps to identify which aspects of the site require the most focus and attention by permitting easier identification of similar sites for comparison. Conceptual categories can also help guide the management methods used at the locality and identify any potential education or touristic opportunities.

#### Significance scale

Geological features exist at a range of scales, and identifying the relative size of each significant aspect at a site will ensure the application of suitable management controls (Table 1).

Very large sites are likely to be extremely difficult to manage, although are still worthy of nomination and assessment.

Table 1. Definition of significance scales used to characterize sites on the Register of State Geoheritage Sites

Scale	Relative size	Measurable units
Very large	region/basin/terrane	tens of kilometres or more
Large	landscape feature	kilometres
Medium	outcrop	tens or hundreds of metres
Small	bed	metres
Very small	crystal/grain/fossil	centimetres or less

#### Significance levels

Features relevant to each assessment criterion identified in a site should be assigned one of the following significance levels, which is determined by considering the feature in comparison to equivalent examples. The definitions for each of the significance levels used here are based on those of Brocx (2008).

- **International:** only one, or one of a few, of a given feature occurring globally; hence it is globally unique, rare or uncommon; or performs a function in an international network
- **National:** although it may be present elsewhere globally, only one, or one of a few, of a given feature occurs within Australia, hence it is nationally unique, rare or uncommon; or performs a function in a national network
- **State:** although it may be present elsewhere internationally or nationally, only one, or one of a few, of a given feature occurs within Western Australia, hence it is unique, rare or uncommon within the State; or performs a function in a statewide network

- **Regional:** although occurring elsewhere globally, nationally or statewide, only one, or one of a few, of a given feature occurs within a specified geological region; or performs a function in a regional network
- **Local:** the geological or geomorphological feature is important only to the local community.

Where there are multiple features under consideration for a particular criterion, the highest significance level from all features will be used to represent the significance level for that criterion; the highest significance level from all criteria will be adopted as the significance level for the site as a whole.

### **Significance themes**

Significance themes identify the type(s) of geoscience research to which the site significance is closely linked; these can be considered equivalent to the assessment themes used in geoheritage processes in other parts of the world, or within World Heritage assessments (McKeever and Narbonne, 2021). One or more of these themes must be identified for each assessment criterion identified as relevant to a nominated site; the same theme might be applicable to multiple assessment criteria within a single site. The themes used in Western Australia are:

- Mineralogy
- Paleontology
- Geomorphology
- Hydrogeology, Hydrology
- Regolith geology, Pedology
- Sedimentary geology
- Igneous geology
- Metamorphic geology
- Stratigraphy
- Structural geology, Tectonics
- Impact structures
- Historical geology, Mining history

Within each of these themes, a set of sub-themes are identified to help in site assessment, particularly when selecting similar or equivalent features or sites for comparison (Appendix 1).

### **Significance thresholds**

Each of the assessment criteria specifies 'outstanding geoheritage value to the State', which is the significance threshold that must be surpassed for a site to be listed under that criterion. Sites identified as significant at the **state, national** or **international** level, for any one or multiple assessment criteria, would automatically meet the threshold of 'outstanding value to the State', unless there are mitigating factors, such as poor site integrity or condition. However, threshold placement, and therefore whether a site or feature is considered outstanding or not, may differ between criterion and the types of geological feature under consideration. For example, very common

geological features, which might otherwise be considered of **regional** or **local** significance, might be considered for registration alongside more remote or inaccessible exemplars if more accessible, adequately preserved, and fairly comprehensive, and therefore more likely to be regularly visited or researched. Otherwise, sites identified as significant at these lower significance levels would be better protected at a community or local council level, rather than through statewide geoheritage mechanisms.

Site assessments will use all available information and expertise at the time of nomination; however, significance values and thresholds can change over time as sites degrade, are enhanced, are further investigated, as new localities are found, or as societal values change (Dixon, 1996). For this reason, sites should be reassessed regularly to ensure they still meet the requirements of a State Geoheritage Site, and to identify any new or enhanced significance or vulnerabilities that might require additional management. The process for reassessing listed sites is described towards the end of this Record.

### **Value**

Each of the assessment criteria requires the nominated site to represent outstanding value to the State. Although it should be acknowledged that there is no single 'correct' list of values with which to assign significance to geoheritage sites, it is important that any value is fully described to ensure process transparency and consistency.

There have been numerous criteria proposed to assess value. Sharples (2002) identified three main types of value – intrinsic (rarity and representativeness), ecological, and anthropocentric (scientific, educational, recreational, touristic and cultural) – although noted that these three categories are partly overlapping. In comparison, other authors such as García-Cortés et al. (2019), use two sets of values – intrinsic or scientific values (representativeness, rarity, type locality / reference, degree of knowledge, geological diversity, state of preservation) and potential-for-use values (educational, economic, recreational/touristic, cultural).

Assessments made regarding Western Australia's Register of State Geoheritage Sites are more similar to that of García-Cortés et al. (2019), with the greatest emphasis placed on the geoscientific/intrinsic value, and less focus on potential-for-use value. Ecological, cultural and recreation/tourism value are likely already factored into conservation under other State legislation (e.g. *Heritage Act 2018*, *Conservation and Land Management Act 1984*), although there might be disparity in application based on the individual wording or focus of these other systems. For example, the *Heritage Act 2018* is designed to conserve cultural heritage value, but can only be applied to human-built environments and structures, so any natural site related to the history of geological research and mining in Western Australia is better considered under geoheritage processes. Therefore, although these other (non-scientific) values may not be the prime focus for geoheritage assessments, maintenance of the State's geodiversity will inevitably provide support to the maintenance of biological and cultural heritage (whether indirectly or otherwise), and will also aid potential-for-use interests, such as education or tourism.

The criteria used to assess Western Australian geoheritage are designed to be flexible and cover the widest range of significant geology; however, site assessments (such as part of the nomination process) will need to be specific about which criteria, scale and significance level are used for decision making. This delineation of site value and significance thresholds should also be transparent to encourage open dialogue on community concepts of value.

## A note on site duplication

The Register of State Geoheritage Sites currently (as of early 2022) includes many sites conserving very similar or strongly linked features, seemingly in spite of the previous geoheritage site definition's emphasis on uniqueness. An example of these seemingly duplicated sites are the four listed State Geoheritage Sites on Rottnest Island, which preserve elevated platforms of similar age. Although it could be argued that each of these sites is unique at a granular level, by that argument every outcrop in the State would also be considered unique. By pivoting the focus of the Register of State Geoheritage Sites in Western Australia from protecting monuments to maintaining regional geodiversity, as indicated in this Record, the emphasis on uniqueness is greatly reduced, becoming part of the assessment criteria rather than the primary driver. Adding the classification qualifiers can also better constrain and clarify the level of rarity indicated (i.e. uncommon or rare at the international, national or state level) and is recommended when questions of uniqueness arise. Therefore, the new definition and assessment criteria presented here allow for multiple sites of similar theme or type to be co-registered, providing they meet the minimum value requirements.

From a practical management perspective, it is considered preferable to conserve multiple ideal examples of a feature, particularly if those examples are in geographically distinct areas (e.g. Sharples, 2002). Even conserving duplicates or very similar sites within the same region is prudent to ward against unexpected degradation of conserved features, to capture the widest range of variation within a type or group of features, and to maintain local levels of geodiversity (Sharples, 1995, 2002). Therefore, replication should not be considered a dilution of individual site value, but a desired feature of a robust geoheritage inventory.

Similarly, some sites nominated for inclusion on the Register of State Geoheritage Sites may already be recognized on other heritage listings, such as the World Heritage, Australian National Heritage or Western Australian State Heritage Lists; however, this is not considered a conflict or duplication, as the Register of State Geoheritage Sites has a specific purpose and scope (being confined to geological or geomorphological significance, and to Western Australia, respectively) distinct from the other listings. Geoheritage site management processes may be deferred if protections afforded by another listing are more stringent than those available to Western Australian geoheritage sites. This approach is compatible with geoheritage legislation in other states, such as in South Australia, where sites can be listed on both the State Heritage Register and National Heritage List (Lewis, 2019). Some locations on the Register of State Geoheritage Sites are already registered on multiple conservation lists: for example, both Shark Bay and Purnululu are within National Parks, and are listed on both the National Heritage and World Heritage Lists.

## Site management

Inclusion of a site on the Register of State Geoheritage Sites does not automatically indicate a need for direct management or a specific type of protection. For a state the size of Western Australia, significant resources would be needed to maintain all sites on the Register to the same level, which might be unnecessary effort if a site is fairly robust, infrequently visited or already under the management of another government agency. Therefore, once a site is confirmed as significant and ascribed to the Register, GSWA will conduct an assessment of the site's sensitivity and vulnerability to determine the required level and type of care. This ranking process only applies to State Geoheritage Sites, as State Geoheritage Reserves will automatically receive protections to the level prescribed in the relevant management plan. For State Geoheritage Sites, local community or relevant interest groups may be solicited to protect sites of lower priority, when State resources are overtaxed, or when protections are difficult to implement.

Although this Record does not focus on site management, it is critical to recognize that not all geoheritage sites should be considered for, or developed as, touristic or educational sites (Brocx and Semeniuk, 2019). Therefore, GSWA must be consulted if tourist operators are planning to establish experiences, such as geotrails, within a site of geological significance. The State will not support the development of such ventures in landscapes assessed as hazardous to travellers, or vulnerable to damage by increased traffic.

## Registration process

The registration of State Geoheritage Sites follows a multi-step process (Fig. 3):

1. Nomination
2. Registration of the nomination
3. Appraisal
4. Assessment
5. Advisory committee recommendation
6. Decision by Executive Director GSWA
7. Interim listing and objection period
8. Registration of Site of Geological Significance (State Geoheritage Site).

## Nomination

Nominations for a site of geological significance can be lodged by any organization or member of the public. Nominations must adhere to the following:

- a nomination must be in writing by completing the GSWA Nomination Form (Appendix 2), provided on the *Geoheritage* page of the [DMIRS website](#)
- a person or organization must submit the nomination form and all attached maps and photos to the geoheritage email address ([geoheritage@dmirs.wa.gov.au](mailto:geoheritage@dmirs.wa.gov.au)), attention Executive Director GSWA (note that an FTP link can be provided if maps and images are too large to email)

- all sections of the Nomination Form must be completed, describing the location and boundaries of the site, a description of its geological features, its geological importance or contribution to the advancement of geoscience in Western Australia, and references (if available).

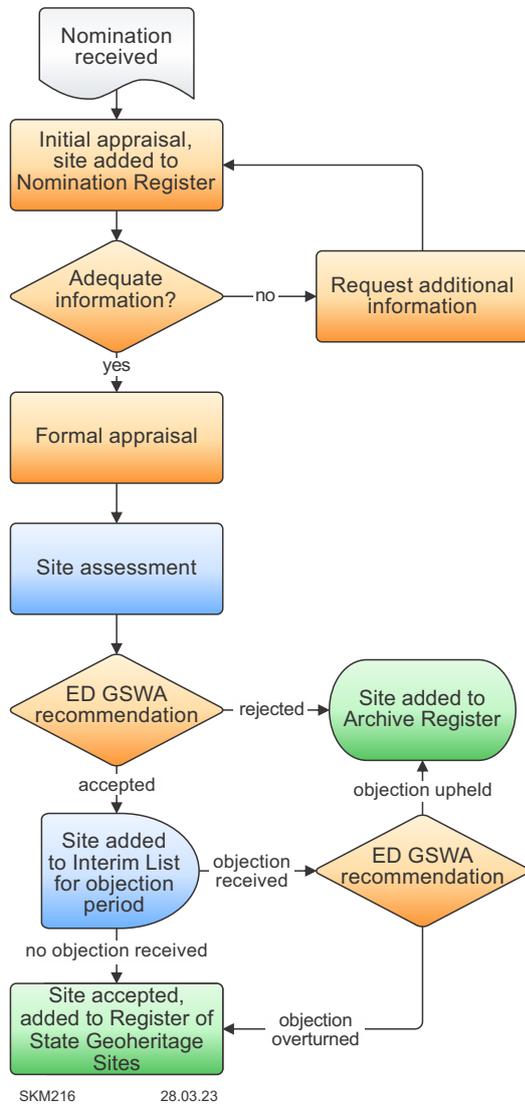


Figure 3. Flow chart illustrating the registration process for sites of geological significance in Western Australia. Abbreviation: ED GSWA, Executive Director Geological Survey of Western Australia

## Registration of the nomination

The function of the Nomination Register is to acknowledge that a nomination has been received and is the first part of the registration process.

This process involves GSWA geoheritage staff:

- entering data into the Nomination Register
- presenting the location and extent of the nominated geoheritage site on the publicly accessible online DMIRS Interactive Geological Map (GeoVIEW.WA). If the site location is deemed sensitive, the location and extent

will be censored in such a way that allows the site to be identified as relevant to particular land development assessments without exposing the precise location of key features.

## Appraisal

The appraisal is a check whether sufficient information has been provided by the nominator for assessment to proceed.

### Initial appraisal

As part of the initial appraisal, GSWA geoheritage staff (or a person nominated by the Executive Director GSWA) will check:

- that the location and extent (with clearly defined boundaries) of the nominated site are precisely described
- that the attributes of the site are adequately described
- if the site is on another register, such as the National Heritage List
- if the site has been previously nominated for registration.

If there is insufficient information to make an assessment, the Executive Director GSWA can request additional details before proceeding to the formal appraisal stage.

### Formal appraisal

Once the nomination has passed the initial appraisal stage, formal appraisal will be carried out by GSWA staff with experience in geoheritage matters, with the aid of a reference group composed of senior geologists within GSWA. The reference group should consist of at least three (3) staff with relevant experience or expertise in the geology and location of the site under assessment; this might include the GSWA Leadership Team, branch managers or specialist staff.

The GSWA reference group will derive the following additional information needed for site assessment and consultation with stakeholders:

- land tenure(s) underpinning the site
- native title or any Indigenous Land Use Agreements (ILUAs) in the area
- existing mining or petroleum tenure
- safety issues (e.g. quarries, minerals such as uranium, asbestos)
- if the proposal is within an area of State Agreement
- identification of likely site classification qualifiers (conceptual categories, significance scale, significance level, significance themes) for use during the site assessment
- priority ranking for assessment (if more than one site is received, or other sites are under assessment).

At this stage, key stakeholders in the area under consideration – such as tenement holders, freehold land owners, shires, pastoralists and native title holders – will be informed of the nomination and advised of the process and its implications to encourage open dialogue on potential land access and geoheritage issues relating to the proposed site.

## Geoheritage site assessment

An assessment of whether the site is geologically significant, and therefore worthy of inclusion on the Register, is conducted by an advisory committee who compares the site against the standard set of criteria (see 'Assessment criteria', above), and to other similar sites worldwide, based on scientific literature.

### Advisory committee

The advisory committee must consist of no less than three (3) geoscientists, and may include representation from Curtin University (including the Western Australian School of Mines), University of Western Australia, Geological Society of Australia, Western Australian Museum, GSWA, and other Australian or international universities or geological organizations as appropriate. GSWA will also provide a secretariat to coordinate the advisory committee. As for the appraisal reference group, the composition of the advisory committee will depend on the geology and location of the site under assessment.

On commencement, the advisory committee follows a three-step process to assess the nomination:

1. **Individual appraisal:** each member completes an assessor's report (Appendix 3) identifying their view of the site's significance using all current knowledge and research. Copies of the Geoheritage Tool-kit will also be provided to the advisory committee members during the assessment period for context and to aid comparison with similar sites both within Western Australia and across the world.
2. **Discussion:** once assessments from each of the committee members have been received, GSWA geoheritage staff will convene a round table of all advisory committee members, where the site's significance will be discussed and a recommendation formulated.
3. **Final decision:** the advisory committee's recommendation statement and individual assessment reports will then be passed on to the Executive Director GSWA for a formal decision. Information on site significance identified during the assessment process will form the basis of data entered into the Register of State Geoheritage Sites if the nomination is later ratified.

## Executive Director GSWA decision

The Executive Director GSWA will accept or reject the nominated site using the recommendation of the advisory committee. Where there are unreconcilable differences of opinion within the advisory committee and a consensus cannot be reached, the Executive Director GSWA may ask for additional assessments.

The Executive Director's decision determines whether the site is placed on the Interim List for the Register of State Geoheritage Sites or the Archive Register.

### Nominated site accepted

If the Executive Director GSWA accepts a recommendation that the site is geologically significant, the site is entered onto the Interim List of the Register of State Geoheritage Sites.

Information added to the Interim List includes:

- the outcome of the assessment and the date the assessment was made
- the administrative file that contains all information related to the assessment, such as nomination information, additional information provided as part of the assessment process, and any management strategy developed to preserve the site and actions performed on the site
- ratings of site vulnerability, susceptibility to degradation and risk of degradation
- indication of whether the site is confidential or not
- location and extent of the site.

If a site is deemed confidential, information will be censored in such a way that allows the site to be represented in the land development process without exposing the true location of key features.

GSWA will advertise proposed additions to the Interim List for the Register of State Geoheritage Sites on the DMIRS website *Geoheritage* page, on department social media accounts, and in *FieldNotes* (a GSWA publication); these advertisements will be linked back to GeoVIEW.WA, where the proposed locations will be mapped as 'interim' sites on the *Geoheritage Site* layer for spatial reference. Key stakeholders will also be directly informed of the decision.

### Nominated site rejected

If the Executive Director GSWA considers that the site does not presently meet the significance threshold for inclusion on the Register of State Geoheritage Sites, then it is entered into the Archive Register and key stakeholders advised accordingly.

Rejection of a nomination should not be interpreted as a statement that the nominated site has no value, geological or otherwise. Therefore, a rejection should not be used to disqualify the site for other types of heritage assessments, for future State geoheritage assessments, or for geoheritage assessments at a different level of significance (such as regional or local government). In some cases, the assessment process might recognize a potential for significance that cannot be confirmed based on current knowledge of the locality or its features; in this case, the site should be flagged for reappraisal once further research has been completed.

The Archive Register contains a list of all previously nominated geological sites, and provides background information if a site is reassessed at a later stage.

The Archive Register will record the:

- date of the assessment
- administrative file that contains nomination information and additional information provided as part of the assessment process
- location and extent of the site.

As for accepted sites, if a site is deemed confidential, information will be censored in such a way that allows the site to be represented in the land development process without exposing the true location of key features.

## Interim listing and objection period

Once a site is entered into the Interim List of the Register of State Geoheritage Sites and advertised, there is a minimum period of three (3) months in which objections to its entry can be made in writing to the Executive Director GSWA.

### No objections received

If there are no objections, then the site is entered into the Register of State Geoheritage Sites and its status confirmed as 'accepted' in the formal *Geoheritage Site* layer on GeoView.WA.

### Objections received

Objections to placing a site on the Register of State Geoheritage Sites will be referred to the Executive Director GSWA.

When appropriate, the Executive Director GSWA should seek advice from the advisory committee (and legal services if necessary) before making a decision on whether the objection will be upheld or rejected. Once the Executive Director GSWA has made a recommendation, the objector will not be able to make further submissions about the nomination in question.

If the Executive Director GSWA recommends that the site should be removed from the Interim List of the Register of State Geoheritage Sites, the site is placed on the Archive Register. If the Executive Director GSWA recommends that the objection be overruled, the site is placed on the Register of State Geoheritage Sites. In both cases, the following details are recorded on the relevant register:

- who lodged the objection
- the date the objection was received
- the outcome of the objection
- the identity of the administrative file that contains the objection details.

Objectors will be informed of the outcome, whether the objection is upheld or overruled.

## Site review and reassessments

As site significance can change over time, it is intended that localities on the Register of State Geoheritage Sites be periodically reviewed regarding condition and significance, including comparisons to other sites with similar features.

This process should be initiated by GSWA geoheritage staff who will conduct a desktop assessment of site significance, assisted by recent literature and site visits. How often desktop reviews are conducted should be determined according to site vulnerability and the amount of research in the geological region. A desktop assessment might also be triggered after a major review or paper in the geological region or of the particular class of site represented.

If a desktop assessment suggests that a site no longer meets the required significance or value criteria, it should be referred to an assessment advisory committee and a process similar to that of site nomination followed, specifically:

- geoheritage site assessment
- Executive Director GSWA recommendations
- objection period.

If, after reassessment, the advisory committee confirms that a site no longer meets the criteria for acceptance as a geoheritage site, and this advice is accepted by the Executive Director GSWA, the site will be delisted and its information shifted to the Archive Register following the process listed above for when a nominated site is rejected.

However, any archived site, whether delisted or a failed nomination, can be reassessed through the nomination and assessment process listed above on receipt of a written request, no less than six (6) months after site archival. In both cases, the new advisory committee should be appraised of previous objections and assessments, and must make their recommendation based primarily on the state of knowledge at the time of reassessment. The Executive Director GSWA should then make their recommendation by considering all available information, both current and historical.

## References

- Australian Heritage Council 2009, *Guidelines for the assessment of places for the National Heritage List: Department of the Environment, Water, Heritage and the Arts, Canberra, Australian Capital Territory*, 154p.
- Brocx, M 2008, *Geoheritage from global perspectives to local principles for conservation and planning: Western Australian Museum, Perth*, 175p.
- Brocx, M and Semeniuk, V 2007, *Geoheritage and geoconservation – history, definition, scope and scale: Journal of the Royal Society of Western Australia*, v. 90, p. 53–87.
- Brocx, M and Semeniuk, V 2019, *The '8Gs'—a blueprint for Geoheritage, Geoconservation, Geo-education and Geotourism: Australian Journal of Earth Sciences*, v. 66, p. 803–821.
- Brocx, M and Semeniuk, V 2020, *Geodiversity and the '8Gs': a response to Gray & Gordon (2020): Australian Journal of Earth Sciences*, v. 67, p. 445–451.
- Campbell, IH 1991, Chapter 2: *The Jemberlana Intrusion, in Mafic-ultramafic complexes of Western Australia, Guidebook for the post-symposium field excursion of the Sixth International platinum symposium edited by SJ Barnes and RET Hill: Geological Society of Australia (Western Australian Division) Excursion Guidebook 3*, p. 15–18.
- Cavosie, AJ, Valley, JW and Wilde, SA 2007, *The oldest terrestrial mineral record: A review of 4400 Ma to 4000 Ma detrital zircons from Jack Hills, Western Australia, in Earth's oldest rocks edited by MJ Van Kranendonk, VC Bennett and RH Smithies: Elsevier B.V., Burlington, Massachusetts, USA, Developments in Precambrian Geology 15*, p. 91–111.

- Clarke, EdeC, Prendergast, KL, Teichert, C and Fairbridge, RW 1951, Permian succession and structure in the northern part of the Irwin Basin, Western Australia: *Journal of the Royal Society of Western Australia*, v. 35, p. 31–84.
- Cresswell, ID 2019, Geoheritage and geoconservation in Australia: *Australian Journal of Earth Sciences*, v. 66, p. 753–766.
- Dixon, G 1996, Geoconservation: an international review and strategy for Tasmania: Parks and Wildlife Service Tasmania Occasional Paper 35, 101p.
- Eberhard, R (editor) 1997, *Pattern and Process: Towards a Regional Approach to National Estate Assessment of Geodiversity*: Australian Heritage Commission & Environment Forest Taskforce, Environment Australia Technical Series No. 2, Canberra, 102p.
- García-Cortés, Á, Vegas, J, Carcavilla, L and Díaz-Martínez, E 2019, Conceptual base and methodology of the Spanish inventory of sites of geological interest (IELIG): Instituto Geológico y Minero de España, Madrid, Spain, 102p.
- Gray, M and Gordon, JE 2020, Geodiversity and the '8Gs': a response to Brocx and Semeniuk (2019): *Australian Journal of Earth Sciences*, v. 67, p. 437–444.
- Grey, K, Roberts, FI, Freeman, MJ, Hickman, AH, Van Kranendonk, MJ and Bevan, AWR 2010, Management Plan for State Geoheritage Reserves: Geological Survey of Western Australia, Record 2010/13, 23p.
- Haines, PW 2005, Impact cratering and distal ejecta: the Australian record: *Australian Journal of Earth Sciences*, v. 52, p. 481–507.
- Hallberg, JA 1986, Postcratonization mafic and ultramafic dykes of the Yilgarn Block: *Australian Journal of Earth Sciences*, v. 34, p. 135–149.
- Hamacher, DW and O'Neill, C 2013, The discovery and history of the Dalgara meteorite crater, Western Australia: *Australian Journal of Earth Sciences*, v. 60, p. 637–646.
- Hickman, AH, Van Kranendonk, MJ and Grey, K 2011, State Geoheritage Reserve R50149 (Trendall Reserve), North Pole, Pilbara Craton, Western Australia – geology and evidence for early Archean life: Geological Survey of Western Australia, Record 2011/10, 32p.
- Joyce, B 1997, Assessing geological heritage, in *Pattern and process: towards a regional approach to national estate assessment of geodiversity* edited by R Eberhard: Australian Heritage Commission & Environment Forest Taskforce, Environment Australia Technical Series No. 2, Canberra, p. 35–40.
- Lewis, ID 2019, South Australian geology and the State Heritage Register: an example of geoconservation of the Naracoorte Caves complex and karst environment: *Australian Journal of Earth Sciences*, v. 66, p. 785–792.
- McKeever, PJ and Narbonne, GM 2021, Geological World Heritage: a revised global framework for the application of criterion (viii) of the World Heritage Convention: International Union for Conservation of Nature, Gland, Switzerland, 118p.
- Mory, AJ and Haig, DW 2011, Permian–Carboniferous geology of the northern Perth and Southern Carnarvon Basins, Western Australia – a field guide: Geological Survey of Western Australia, Record 2011/14, 65p.
- Roberts, FI and Freeman, MJ 2008, Western Australian Register of Geoheritage Sites, in *Conference proceedings of the Inaugural Global Geotourism Conference* edited by R Dowling and D Newsome, 17–20 August 2008, Fremantle, Western Australia, p. 301.
- Sharples, C 1995, Geoconservation in forest management-principles and procedures: *Tasforests*, v. 7, p. 37–50.
- Sharples, C 2002, *Concepts and principles of geoconservation*: Tasmanian Parks and Wildlife Service, Hobart, 82p.
- Worboys, GL, Lockwood, M, Kothari, A, Feary, S and Pulsford, I (editors) 2015, *Protected area governance and management*: ANU Press, Canberra, 966p.

## Appendix 1. List of significance themes and subthemes

### 1. Mineralogy

- 1.1. Mineraloid or pseudo-mineral species or assemblage (amber, coal, oil, natural gas, opal)
- 1.2. Silicate mineral species or assemblages
- 1.3. Oxide or hydroxide mineral species or assemblages
- 1.4. Sulfide or sulfate species or assemblages
- 1.5. Other (phosphate, halide, carbonate, native element) mineral species or assemblages

### 2. Paleontology

- 2.1. Plants and fungi
  - 2.1.1. Macrofloral (including mesofloral) fossils
  - 2.1.2. Microfloral fossils
  - 2.1.3. Root casts, rhizoliths
- 2.2. Invertebrates
  - 2.2.1. Invertebrate macrofossils
  - 2.2.2. Invertebrate microfossils
- 2.3. Vertebrates
  - 2.3.1. Vertebrate macrofossils
  - 2.3.2. Vertebrate microfossils
- 2.4. Microbialites
  - 2.4.1. Stromatolites
  - 2.4.2. Thrombolites
  - 2.4.3. Dendrolites and Leiolites
  - 2.4.4. MISS and other microbially mediated features
- 2.5. Protists and miscellaneous microfossils
- 2.6. Lagerstätten and exceptional preservation features
  - 2.6.1. Konservat-Lagerstätten (conservation Lagerstätten)
  - 2.6.2. Konzentrat-Lagerstätten (concentration Lagerstätten)
- 2.7 Trace fossils and biogenic forms
  - 2.7.1. Dwelling traces
  - 2.7.2. Feeding or grazing traces
  - 2.7.3. Locomotive traces
  - 2.7.4. Resting traces
  - 2.7.5. Escaping traces
  - 2.7.6. Other or multipurpose traces
  - 2.7.7. Biogenic forms (fossil reefs, bioherms, biostromes, phytoherms)

### 3. Geomorphology

- 3.1. Tectonic processes and forms
  - 3.1.1. Faulting and seismic features and landforms (including neotectonic fault scarps)
  - 3.1.2. Folding and ductile features and landforms
  - 3.1.3. Other tectonic or structural features and landforms
- 3.2. Volcanic processes and forms
  - 3.2.1. Constructional features and landforms
  - 3.2.2. Destructional features and landforms
- 3.3. Mass-wasting processes and forms
  - 3.3.1. Slope features and landforms
  - 3.3.2. Mass-wasting features and landforms (talus, colluvium)
- 3.4. Weathering and erosional processes and forms
  - 3.4.1. Resistant features and landforms (including inverted topography)
  - 3.4.2. Erosional features and landforms
- 3.5. Rivers and valley processes and forms
  - 3.5.1. Flood plains and alluvial features
  - 3.5.2. Stream or channel features and landforms
  - 3.5.3. Fluvial erosion features and landforms
  - 3.5.4. Deltaic features and landforms
- 3.6. Lacustrine processes and landforms
- 3.7. Aeolian and arid processes and forms
  - 3.7.1. Coastal dunes
  - 3.7.2. Inland dunes

- 3.7.3. Erosion features and landforms (deflation basins, desert pavements)
    - 3.7.4. Other desert deposition features and landforms (loess etc.)
  - 3.8. Solution processes and forms
    - 3.8.1. Karst
    - 3.8.2. Other chemical weathering features and landforms
  - 3.9. Coastal processes and forms
    - 3.9.1. Beach features and landforms
    - 3.9.2. Coastal cliffs
    - 3.9.3. Mangroves and tidal flats
    - 3.9.4. Emergent features (terraces, wave-cut platforms, relict coastlines etc.)
  - 3.10. Marine processes and forms
    - 3.10.1. Organic or carbonate barrier features (reefs, seagrass banks or meadows)
    - 3.10.2. Clastic barrier features (spits, bars and barriers)
    - 3.10.3. Marine canyons
    - 3.10.4. Other marine features
  - 3.11. Glacial and periglacial processes and forms
    - 3.11.1. Ice and meltwater erosion features and landforms
    - 3.11.2. Ice and meltwater depositional features and landforms
    - 3.11.3. Frost, ice or snow features and landforms
- 4. Hydrogeology, Hydrology
  - 4.1. Fluvial
    - 4.1.1. Perennial rivers
    - 4.1.2. Ephemeral streams
  - 4.2. Lacustrine
    - 4.2.1. Perennial lake
    - 4.2.2. Playa and salt lakes
    - 4.2.3. Wetlands, swamps
  - 4.3. Lagoons, estuaries
  - 4.4. Springs, seeps
  - 4.5. Hydrothermal or geothermal water bodies
  - 4.6. Aquifers
- 5. Regolith geology, Pedology
  - 5.1. Desiccation and evaporation features
  - 5.2. Surface soil
  - 5.3. Buried soil, paleosols
  - 5.4. Soil or regolith component
    - 5.4.1. Duricrust
    - 5.4.2. Saprolite
    - 5.4.3. Caliche, calcrete
    - 5.4.4. Concretions and nodules
  - 5.5. Other weathering and erosion products
- 6. Sedimentary geology
  - 6.1. Fluvial products or environments
    - 6.1.1. Paleo drainage
  - 6.2. Lacustrine products or environments
  - 6.3. Deltaic products or environments
  - 6.4. Aeolian products or environments
  - 6.5. Marginal marine products or environments
    - 6.5.1. Subtidal products or environments
    - 6.5.2. Littoral or peritidal products or environments
    - 6.5.3. Supratidal products or environments
    - 6.5.4. Estuarine products or environments
  - 6.6. Offshore marine products or environments
    - 6.6.1. Turbidites or mass flows
    - 6.6.2. Detrital products or environments
    - 6.6.3. Non-detrital (oozes, precipitations, nodules) products or environments
    - 6.6.4. Organic products or environments
  - 6.7. Glacial products or environments
  - 6.8. Products of uncertain origin (e.g. banded iron-formations)
  - 6.9. Diagenetic features (dewatering structures, soft-sediment deformation)

- 7. Igneous geology
  - 7.1. Extrusive rocks
  - 7.2. Igneous extrusion features, structures or textures (pillows, spinifex texture)
  - 7.3. Igneous extrusion by-products (e.g. pyroclastics, autoclásticos, hyaloclastics, epiclastics and tuffs)
  - 7.4. Intrusive rocks
    - 7.4.1. Layered complex
  - 7.5. Igneous intrusion features, structures or textures (magmatic fraction, xenolith, enclave)
- 8. Metamorphic geology
  - 8.1. Metasedimentary rocks
  - 8.2. Meta-igneous rocks
  - 8.3. Metasomatic rocks
  - 8.4. Contact metamorphic rocks or features (e.g. hornfels)
  - 8.5. Anatexis or partial melting rocks or features
  - 8.6. Impact metamorphic features
  - 8.7. Other metamorphic textures
  - 8.8. Metamorphic mineral assemblages
- 9. Stratigraphy
  - 9.1. Type section (outcrop only)
  - 9.2. Type area
  - 9.3. Unconformity or disconformity
  - 9.4. Relation between elevated marine features and present sea level
  - 9.5. Cross-cutting relationships
- 10. Structural geology, Tectonics
  - 10.1. Brittle deformation
    - 10.1.1. Faults
    - 10.1.2. Fractures
    - 10.1.3. Other brittle features
  - 10.2. Ductile deformation
    - 10.2.1. Folds
    - 10.2.2. Shear zones
    - 10.2.3. Other ductile features
  - 10.3. Tectonic form or process
    - 10.3.1. Divergent, spreading processes
    - 10.3.2. Convergent, collision processes
    - 10.3.3. Convergent, subduction processes
    - 10.3.4. Slip, transform processes
    - 10.3.5. Other tectonic processes
- 11. Impact structures
  - 11.1. Impact craters
  - 11.2. Impact products
    - 11.2.1. Breccias
    - 11.2.2. Shatter cones, shocked quartz
    - 11.2.3. Melted rocks, spherulites and tektites
    - 11.2.4. In-situ meteorites
- 12. Historical geology, Mining history
  - 12.1. Historical mines and mineralization sites (not including built features)
  - 12.2. Iconic landscapes, including aesthetic sites
  - 12.3. Historical sites relating to geological research
  - 12.4. Historical collections (ex-situ geoheritage)
  - 12.5. Other features of anthropogenic origin

## Appendix 2. State geoheritage nomination form

Form also available through the [DMIRS website](#).



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# Nomination form for a new State Geoheritage Site

This document is the nomination form for a new State geoheritage site in Western Australia. Nomination of a site can be made by any member of the public or organisation. For a site to be included on the Register of Western Australian Sites of Geological Significance, the Executive Director Geological Survey of Western Australia uses the following definition:

***“Geological features of state-wide to international significance, being either outstanding (unique, uncommon or rare) or representative (of a feature, association or process) examples of geodiversity, of scientific and/or other value to the State of Western Australia”***

Details for where the form should be submitted are given at the end of this document. All sections must be completed.

### Contact

Name of person nominating the site: \_\_\_\_\_

Email address: \_\_\_\_\_

Contact number(s) (include country and area codes if applicable): \_\_\_\_\_ M: \_\_\_\_\_

Mailing address: \_\_\_\_\_

Organisation (if appropriate): \_\_\_\_\_

### Site details

Has this been proposed before? Y  N  When? \_\_\_\_\_

Proposed name for site (Geographical and geological): \_\_\_\_\_  
*(e.g. Alkimos Dune System; Dalgara impact crater)*

General location and description:  
*(e.g. Archean-aged dacitic cryptodome. 23 km northeast of Kalgoorlie in the Eastern Goldfields, Yilgarn Craton. The site is an example of a submarine debris avalanche deposit formed during the collapse of a dacitic dome wall. Also contains examples of coeval felsic and ultramafic volcanism and stromatolites)*

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Coordinates (in GDA 94, Lat/Long [degree minutes seconds e.g. 32° 30 25S, 118° 30 20E])

Centroid of site: Lat: \_\_\_\_\_ Long: \_\_\_\_\_

Northeast corner Lat: \_\_\_\_\_ Long: \_\_\_\_\_

Southwest corner Lat: \_\_\_\_\_ Long: \_\_\_\_\_

If the area is not square/rectangular, please list the site centroid here and provide a shapefile or map showing the suggested site extent.



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Department of Mines, Industry Regulation and Safety

# Nomination form for a new State Geoheritage Site

Access description with map\* (describe in words how to get to the nominated site from the nearest inhabited town):

.....  
.....  
.....

Tick to confirm map attached

Provide a satellite image of the area to be nominated with boundary outlined (e.g. use aerial photography, or Google Earth).  
Provide grid coordinates on the image if possible.

Tick to confirm image attached

Provide high resolution photographs of the site (e.g. jpeg, or tiff. If the nomination is successful the images may be used for public distribution, assessing potential degradation of a site and/or educational purposes)

Tick to confirm high-resolution photos attached

Are any of the photographs likely to show sensitive cultural features or landmarks? Yes  No

If yes, please explain:

.....  
.....  
.....

\* Maps can be produced using DMIRS' interactive geological map (GeoView.WA) located at : <www.dmirs.wa.gov.au/geoview>

Is this site already within a reserve, conservation or national park, or on any other protection register?

Australian Heritage Database: Y  N  Name on register: .....

National Park: Y  N  Name of Park: .....

Reserve: Y  N  No# (eg. R 12345): .....

Conservation covenant: Y  N

Other: .....

## Geological significance

### Conceptual categories

Type example, reference site or location  Culturally or historically significant site

Geohistorical site (ancient sequences)  Modern landscape and settings

(continued over...)



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# Nomination form for a new State Geoheritage Site

### Significance scale

- Very large: region/terrane/basin sized (tens of kilometres or more)
- Large: landscape feature sized (kilometres)
- Medium: outcrop sized (tens or hundreds of metres)
- Small: bed sized (metres)
- Very small: crystal/grain/fossil sized (centimetres or less)

### Significance level

- International
- National
- State
- Regional
- Local

### Significance themes

- |  |  |
|--|--|
| Mineralogy <input type="radio"/>                 | Igneous geology <input type="radio"/>                    |
| Paleontology <input type="radio"/>               | Metamorphic geology <input type="radio"/>                |
| Geomorphology <input type="radio"/>              | Stratigraphy <input type="radio"/>                       |
| Hydrogeology, Hydrology <input type="radio"/>    | Structural geology, Tectonics <input type="radio"/>      |
| Regolith geology, Pedology <input type="radio"/> | Impact structures <input type="radio"/>                  |
| Sedimentary geology <input type="radio"/>        | Historical geology, Mining history <input type="radio"/> |

### Criteria

1. Events and processes: the place has outstanding geoheritage value to the State because of the place's importance in the evolution or pattern of Western Australia's geological history;
2. Rarity: the place has outstanding geoheritage value to the State because of the place's possession of unique, uncommon or rare aspects of Western Australia's geology or geomorphology;
3. Research potential: the place has outstanding geoheritage value to the State because of the place's contribution, or potential to contribute, to an understanding of Western Australia's geological history;
4. Representativeness: the place has outstanding geoheritage value to the State because of the place's importance in demonstrating the principal characteristics of:
  - 4.1. a specific feature, or association of features, of Western Australia's geology or geomorphology; or
  - 4.2. a natural process important to understanding Western Australia's geological past or present geography;
5. Geologically historical sites: the place has outstanding geoheritage value to the State because of the place's cultural importance by:
  - 5.1. exhibiting particular aesthetic characteristics valued by a community or cultural group; or
  - 5.2. being closely linked with historically significant scientific events and/or people which have furthered our understanding of Western Australia's geology and geomorphology.

### Geological value:

Describe why this site is outstanding. Features for consideration in your description could include geological age, stratigraphic relationships, unconformities, palaeogeography, type section, structural features, rock type, mineralogy and paleontology. (e.g. *Site contains excellent exposure of contemporaneous felsic and ultramafic volcanism interpreted to be a submarine sea floor setting, where basalt erupted producing pillow basalts and the subsequent growth of dacitic cryptodome. The pillows are up to 1 metre in size and clearly show a younging direction to the east (photo 2.jpg)... Komatiitic lava is identified by olivine spinifex textured (photo 3.jpg)... Dacitic breccia is characterized by... A small area (123°45'67"E, 20°59'11"S) comprises a chert with columnar stromatolites*)

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NB: Additional pages may be attached for completion of description



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# Nomination form for a new State Geoheritage Site

List any related papers or publications

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List any potential threats to preservation

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## Submission

Check list:

- All sections answered
- Attached map with location and position to nearest inhabited town
- Attached an aerial photo or satellite image of the proposed site
- Attached all high-resolution photographs (jpeg or tiff)
- Attached any relevant publications (*optional*)

Send to: Executive Director  
Geological Survey of Western Australia  
Department of Mines, Industry Regulation and Safety  
100 Plain Street, East Perth WA 6004  
Australia

Electronic delivery: email application form and all relevant documents to [geoheritage@dmirs.wa.gov.au](mailto:geoheritage@dmirs.wa.gov.au)  
An FTP link can be provided on request for application packages greater than 5 Mb

For any queries, please contact: [geoheritage@dmirs.wa.gov.au](mailto:geoheritage@dmirs.wa.gov.au)



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## Appendix 3. Assessor’s report form



### Assessors report for Geoheritage site nomination

Title and name of Assessor:	
Position:	
Institution:	
Date of assessment:	

Office use only	
Name of nominated site	
Name of Nominee	
Date of Nomination	
Reference file no.	
Related Sites/Reserves	

Once completed, please return this form and any additional pages to [geoheritage@dmirs.wa.gov.au](mailto:geoheritage@dmirs.wa.gov.au), marked 'Confidential, attn: Executive Director, Geological Survey of Western Australia'





### *Guidelines for the assessment process*

Assess the site against **each of the following criteria**, indicating whether the criterion is relevant and, if so, provide a discussion of how the criterion applies to the locality.

Each criterion should be assessed separately, with the understanding that some features might relate to multiple criteria. The **primary value** for the assessment of Western Australian geoheritage sites is **scientific**, with lesser focus to be placed on educational, cultural, aesthetic, recreational, touristic or ecological values. Also consider the site in terms of **comparable or equivalent features** at the Local, Regional, State, National and International level. For example: how many equivalent sites are known at that level of significance? Is this site more or less representative than other examples? Is it better accessible, or in better condition? Are there other features which set it apart from comparators? Are there complementary non-scientific values that enhance its significance? Please ensure all statements of significance are amply referenced and clearly described.

The assessment should be based on information provided in the application, and any relevant scientific literature. **Please provide full references** to any cited research towards the end of this report.

For each criterion considered applicable to the site, also provide the **significance themes and sub-themes** (can be multiple), **significance level** (singular) and **significance scales** (can be multiple) most relevant to the criteria under discussion. For the case where there are multiple features under consideration for a particular criterion, **choose the highest significance level** from all features to represent the significance level for that criterion; the highest significance level from all criteria will be adopted as the significance level for the site as a whole. Definitions for all site classification qualifiers are provided at the end of this document.

If additional pages are required to complete your comments on any particular criterion, attach these as separate sheets at the end of the document; clearly indicating which criterion the discussion relates to at the top of each sheet or document.

It is recommended that assessors refer to the [Geoheritage Tool-kit](#) and Geological Survey of Western Australia Record 2023/3, *Register of State Geoheritage Sites, Western Australia: nomination and registration process* for guidance on the application of the various concepts referred to herein. Also consider significance statements for similar / comparable sites already on the Register of State Geoheritage Sites. Some relevant sites are listed on the front page of this Assessor's Report.





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Resource and Environmental Regulation

GSWA has identified the site as falling within the following geological region(s) in Western Australia:

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**Are there any Western Australian geological regions that this site might be comparable to, which are not listed above? Or listed regions not relevant?**

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GSWA has identified the following geological region(s) outside Western Australia as suitable for comparison to this site:

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**Are there any Australian or global geological regions that might provide useful comparisons for this site which have not been identified above? Or listed regions not relevant?**

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**Resource and Environmental Regulation**

## Section 2: Assessment criteria

1. Events and processes: the place has outstanding geoheritage value to the State because of the place's importance in the evolution or pattern of Western Australia's geological history

Significance themes:	
Significance level:	
Significance scale:	



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**Resource and Environmental Regulation**

2. **Rarity:** the place has outstanding geoheritage value to the State because of the place's possession of unique, uncommon or rare aspects of Western Australia's geology or geomorphology

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Significance themes:	
Significance level:	
Significance scale:	



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3. Research potential: the place has outstanding geoheritage value to the State because of the place's contribution, or potential to contribute, to an understanding of Western Australia's geological history

Significance themes:	
Significance level:	
Significance scale:	



4. Representativeness: the place has outstanding geoheritage value to the State because of the place's importance in demonstrating the principal characteristics of:

- 4.1) a specific feature, or association of features, of Western Australia's geology or geomorphology; or
- 4.2) a natural process important to understanding Western Australia's geological past or present geography

Significance themes:	
Significance level:	
Significance scale:	



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5. Geologically historical sites: the place has outstanding geoheritage value to the State because of the place’s cultural importance by:

- 5.1) exhibiting particular aesthetic characteristics valued by a community or cultural group; or
- 5.2) being closely linked with historically significant scientific events and/or people which have furthered our understanding of Western Australia’s geology and geomorphology (or both)

Significance themes:	
Significance level:	
Significance scale:	



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### Section 3: Summary

**Are there any additional features or values not listed above that should be considered supportive of or complementary to the site's status as significant? Yes/No**

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**Should the exact location of the site be regarded as confidential? Yes/No**

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**Do you consider the site meets the significance threshold required to be listed on the Register of State Geoheritage Sites? Yes/No**

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Signed:

Date:





## Definitions

### Conceptual categories

- **Type example, reference site or location** – type stratigraphic, fossil or mineralogical locations; locations where rare or important mineral assemblages, soil, geomorphological features, or lithologies can be observed
- **Culturally or historically significant site** – aesthetic sites (monuments), sites where geological principles were first explained, or sites linked with historically important people
- **Geohistorical site (ancient sequences)** – classic localities where earth processes or history can be inferred
- **Modern landscapes and settings** – locations where dynamic processes are operating, which provide reference models for ancient processes or features.

### Significance scale

- Very large: region/terrane/basin sized (tens of kilometres or more)
- Large: landscape feature sized (kilometres)
- Medium: outcrop sized (tens or hundreds of metres)
- Small: bed sized (metres)
- Very small: crystal/grain/fossil sized (centimetres or less)

### Significance levels

- **International** — only one, or one of a few, of a given feature occurring globally; hence it is globally unique, rare or uncommon; or performs a function in an international network
- **National** — although it may be present elsewhere globally, only one, or one of a few, of a given feature occurs within Australia, hence it is nationally unique, rare, or uncommon; or performs a function in a national network
- **State** — although it may be present elsewhere internationally or nationally, only one, or one of a few, of a given feature occurs within Western Australia, hence it is unique, rare, or uncommon within the State; or performs a function in a statewide network
- **Regional** — although occurring elsewhere globally, nationally or statewide, only one, or one of a few, of a given feature occurs within a specified geological region; or performs a function in a regional network
- **Local** — the geological or geomorphological feature is important only to the local community

RECORD 2023/3

# REGISTER OF STATE GEOHERITAGE SITES, WESTERN AUSTRALIA: NOMINATION AND REGISTRATION PROCESS

SK Martin

## Access GSWA products



### All products

All GSWA products are free to download as PDFs from the DMIRS eBookshop <[www.dmirs.wa.gov.au/ebookshop](http://www.dmirs.wa.gov.au/ebookshop)>. View other geoscience information on our website <[www.dmirs.wa.gov.au/gswa](http://www.dmirs.wa.gov.au/gswa)>.



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### Fieldnotes

Fieldnotes is a free digital-only quarterly newsletter which provides regular updates to the State's exploration industry and geoscientists about GSWA's latest programs, products and services. Access by subscribing to the GSWA eNewsletter <[www.dmirs.wa.gov.au/gswaenewsletter](http://www.dmirs.wa.gov.au/gswaenewsletter)> or downloading the free PDF from the DMIRS eBookshop <[www.dmirs.wa.gov.au/ebookshop](http://www.dmirs.wa.gov.au/ebookshop)>.



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