ENGINEERS AUSTRALIA

Engineering Heritage Australia

An Engineer's Guide to the Conservation of Australia's Engineering Heritage

Prepared by
Engineering Heritage Australia

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Note:

The concept of this document was initiated by Peter Spratt and was further developed by a sub-committee of Engineering Heritage Australia led by Bruce Cole.

Other members were Neil Hogg, Dick Baird, Richard Muncey and Tony Moodie.

This document replaces “Engineering Heritage & Conservation Guidelines 2009”.

Image captions:

Cover page (top to bottom):

100-year-old Abt Railway locomotive restored and back in service for the West Coast Wilderness Railway, Tasmania. *Source: West Coast Wilderness Railway.*

Callington Flour Mill built in Oatlands, Tasmania in 1837, restored in 2010 from a burnt-out tower to a working mill producing high quality flour. *Source: Steven French.*

Luna Park (Melbourne) Carousel 1913, refurbished 1999-2001. *Source: Luna Park Melbourne.*

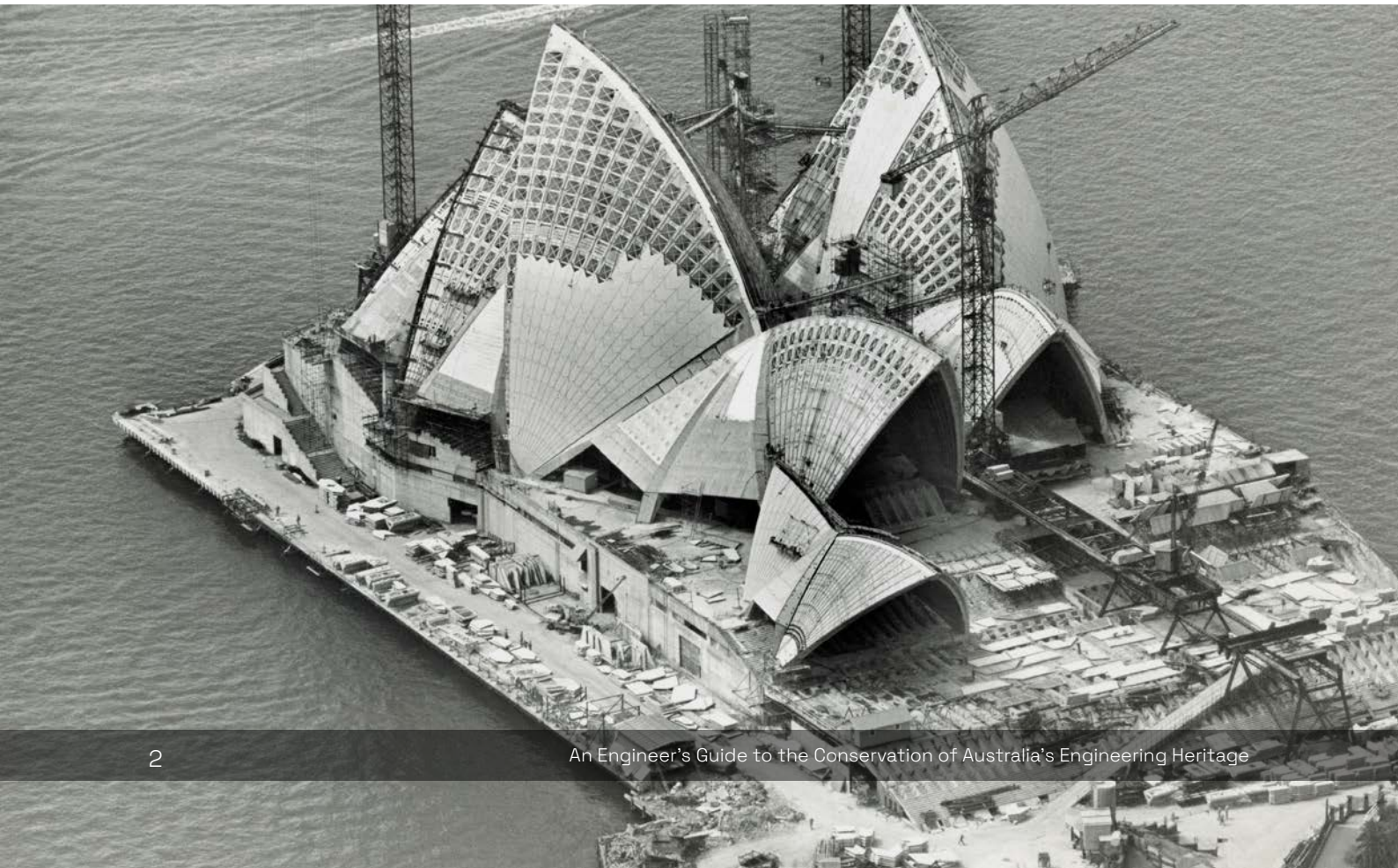
Back page (top to bottom):

Tiger Moth aeroplane rebuilt to modern standards. *Source: Neil Hogg.*

Waddamana A Power Station Museum. It was the Hydro-Electric Department’s first power station commissioned in 1916, the start of Tasmania’s statewide hydro-electic system. It was retained as a museum when the Great Lake water was diverted northwards to Poatina. *Source: Hydro Tasmania.*

Steamer John Oxley built in 1927, totally restored in 2022. *Source: Sydney Heritage Fleet.*

Sydney Opera house under construction in the 1960s. *Source: Australian Air Photos*



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PART 1: Introduction

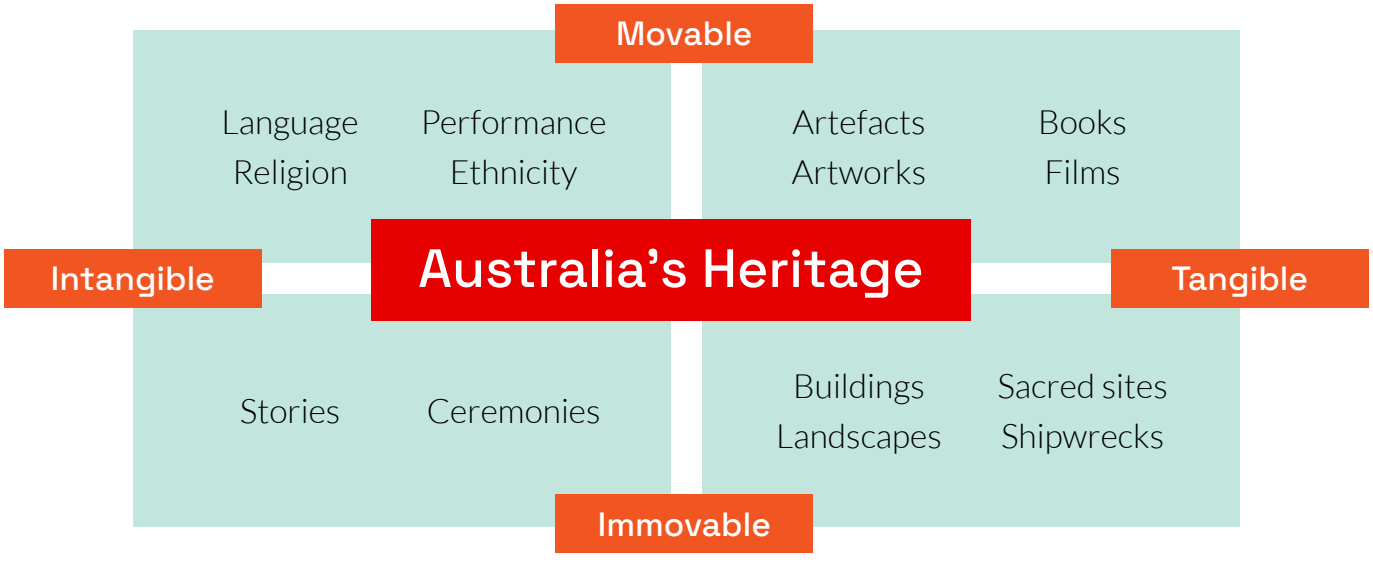
1.1 Preamble

The Australian Heritage Strategy (AHS) states:

"Heritage can be simply defined as the special places or things that tell important stories about us and our world. Heritage is present everywhere – it is in household objects, in machinery and technology, and in buildings and landscapes. It is what we value from the past and wish to pass on to future generations."

(AHS Draft of April 14th 2014)

It further describes the many facets of heritage:



Examples of Engineering Heritage

Type of Heritage	General Types	Specific Examples	Engineering Types	Australian Engineering Examples
Immovable and Tangible	Places Structures Monuments Landscape	Taj Mahal Great Barrier Reef Machu Picchu	Bridges, Dams Roads Buildings	Sydney Harbour Bridge Snowy Mountains Scheme
Movable and Tangible	Works of Art, natural specimens, private and public possessions, documents	Mona Lisa Magna Carta Fossils Ned Kelly's armour	Machinery Instruments, Archive Manuals	Steam engines Blueprints and Photos Digital images and records
Movable and Intangible	"How to" knowledge: re Cultivation, building, animal husbandry, song, dance, language, ritual and cuisine Religion Philosophy	Speaking French Traditional folk music, songs and dance Making of Pizza Rituals The meaning attached to a religious icon or relic	How to design, build, operate tangible items Engineering "language" (drawings, ideas, symbols, algorithms)	CSIRO Wi-Fi Build a road Calculate a beam deflection Operate a boiler Trade skills Assess and implement remediation
Immovable and Intangible	Engenders feeling, meaning or identity in a person	Mecca Gallipoli Uluru	Historical events associated with significant sites or structures	Rockbolting test site in Cooma The opening of the Sydney Harbour Bridge

1.2 The role of engineers

Over time a number of "Charters" have been developed to guide assessment and management of different types of *significant* heritage *items. (Note: Words in italics are defined in Appendix B).* The Burra Charter, developed by Australia International Committee on Monuments and Sites (Australia ICOMOS), has defined a process for objectively evaluating the *significance* of heritage places and has been widely adopted in Australia and is acclaimed internationally. At this stage there is no universally agreed Charter which can be applied to all types of heritage.

Engineering Heritage Australia (EHA) is the body within Engineers Australia (EA) responsible for Engineering Heritage and has prepared this Guide to provide guidance to engineers working on all types of heritage individually or with other heritage professionals and *custodians*. While it respects the various principles and processes used by different heritage sectors (e.g. buildings and structures, museums and *operating* heritage) it acknowledges the special interest engineers have in *preserving* engineering and industrial knowledge.

Engineers have responsibilities in two primary fields:

- To identify, assess and recognise Engineering Heritage - that is those items of universal cultural heritage that owe their existence to the theory and practice of engineering.
- To apply engineering knowledge, skills and techniques to the conservation of all items of cultural significance where engineering is involved. This is the practice of Heritage Engineering.

It is the aim of EA, through EHA,

- to educate all engineers in a broad understanding of the principles and practices of *Heritage Engineering* and its application to all types of heritage,
- to foster *Heritage Engineering* as a specialist skill within the profession, with diverse applications across a wide range of situations,
- to equip engineers to take a leadership role within the heritage community,
- to identify and *conserve items* of engineering, technological and industrial heritage.
- to promote engineering heritage to the community

Richmond Bridge, the oldest masonry bridge in Australia, still in service. *Source: Peter Spratt.*

1.3 Examples of intangible heritage

Preserving the knowledge of hot rivetting steel.

Source: Maitland Steam Antique Machinery Association.

The idea of firmly anchoring the concrete deck to the steel beams below made a much stronger composite beam.

Source: PWD, Tasmania

PART 2: An Engineers Guide

2.1 The aim of the Guide

To assist engineers, when working on a built *item* or its *intangible heritage*, in assessing the *significance* of the *item* and its components and devising a course of action to achieve the *conservation* of the *significance* of the *item*.

The following principles, methodology and criteria form a practical approach to the challenge.

2.2 Apply the principles

Principle 1: State Heritage Agencies' Guidelines, the Australian ICOMOS Burra Charter for places and structures, and other charters and guidelines have rigorous processes for the assessment of the *significance* of all types of heritage. When these documents are important as the primary guide to assessment and for the further steps in a heritage project, engineers must respect them. The "Key References" in Part 1 of this Guide are those internationally recognised Charters and Guides that may take precedence in certain jurisdictions and circumstances dictated by the *item* in hand.

The Heritage Assessment Criteria set out below are specifically intended as an alternative or adjunct to these broader assessment processes when working with the engineering, technological and industrial elements of a heritage project.

Principle 2: Proposals and planning for the management of *significance* should be guided by the formal assessment of *significance* and the application of appropriate engineering skills. Planning should include consultation with other *conservation* professionals (e.g.. archaeologists, historians, architects and conservators) and the wider community. Proposals should consider the minimum intervention necessary to achieve long term *conservation* and safety. *Adaptive re-use* can be considered as part of a management plan.

Principle 3: Engineering knowledge and engineered *items* are created to perform a function. *Conservation* of *significance* and *interpretation* is best achieved by *maintaining* continuity of *use*, and/or by demonstrating the function as well as the object.

Pyrmont Bridge, Darling Harbour, Sydney was scheduled for demolition but lobbying achieved restoration, and its opening span is rotated every Sunday.

Source: Bruce Cole

Principle 4: Current regulations should be considered in both *conservation* of *fabric*, and also in any *re-use* or ongoing *operation* of an item. Consideration of health and safety, environmental and other regulatory requirements should include pragmatic risk evaluation and consideration of all options to avoid or minimize any loss of heritage *significance*. You are encouraged to employ robust risk assessment processes and innovative solutions to achieve the best overall solution.

Principle 5: Knowledge is important and should be *preserved* in some form where possible, even a "mundane" concept may be of *significance* if it represents the basic concept in a design. When an artefact resulting from such knowledge cannot be retained or is no longer available, a documentary or virtual record may be appropriate. The "context" of relevant knowledge – its position in the development of technology and its relationship to other technologies at the time - is also important to consider.

Mercury Arc rectifiers in Russell Place substation formerly produced direct current for trams from the AC transformer at left.

Source: Yuyang Richard Lee 2010.

Principle 6: Engineers becoming involved in a heritage project should have appropriate expertise in the areas in which they provide advice. Where inexpert or unsure they should seek advice from those of their peers possessed of the appropriate experience.

Note 1: Engineers must understand the development of engineering theory and practice over time, and its relevance in decision-making for engineering interventions and their impact on the heritage *significance* of the project.

Note 2: Engineers should take every opportunity for education and training in current heritage philosophy, legislation, materials, *conservation*, *preservation* and *maintenance/repair* techniques.

2.3 Find out all you can about it (investigate)

2.3.1 Write a description of the *item:*

- describe location, *ownership* and other legal considerations,
- describe its engineering aspects,
- describe its physical condition,
- identify and conduct any testing required.

2.3.2 Research technical and historical documents relating to the heritage *significance,* particularly the *engineering heritage, significance* of the item.

2.3.4 Research the people involved in designing, constructing, *using, operating* and benefiting from the *item*.

2.3.5 Involve other heritage professionals, *custodians* and community members if necessary.

2.3.6 Record the knowledge, ideas and innovations employed in producing and using the *item.*

2.3.7 Determine where it sits in the timeline of development, the alternative options available at the time and the likely reasons for choosing the option adopted.

2.3.8 Determine if there are any advances in technology demonstrated by the *item*.

2.3.9 Find out if there are any other similar *items* already *conserved*.

2.3.10 Assess its heritage significance against the seven criteria immediately below.

Kangaroo Island Lighthouse

Source: www.dreamtime.com

2.4 Assess significance

The following criteria form a good basis to assess *items* of *engineering heritage* considering always that an *item* may be intangible, in whole or in part, and *significance* can lie in aspects such as inventions, ideas, oral history and concepts, which have led to major advances, technical skills, manufacturing practices and trade skills.

In the context of engineering, *significance* can be represented by tangible items, such as built *works*, machinery, *movable* objects (cars, trains, aircraft), communication systems, power systems and the like. It can be argued that all tangible *items* result from the intangible ideas and knowledge used to conceive them and that engineering knowledge is the accumulation of developments and knowledge over time.

Psyche Bend pumping engine 1891 at Mildura supplied water for irrigation. Recommissioned 1995 for display purposes.

Source: Peter Stone.

An *item* or knowledge is *significant* if it meets at least one of these criteria.

a. **Historical significance**: An *item* is important in the course, or pattern of history and, in particular, engineering history.

b. **Historical individual or group**: An *item* has strong or special association with the life or works of a person, or group of persons of particular importance in engineering history.

c. **Creative or technical achievement**: An *item* is important if it demonstrates a high degree of creative or technical achievement.

d. **Social**: An *item* has strong or special association with the engineering community, or a particular community group that has been affected by it.

e. **Research Potential**: An *item* has potential to yield information that will contribute to an understanding of history, particularly engineering history.

f. **Rarity**: An *item* exhibits uncommon, rare or endangered aspects of creative and technical achievement important to history, particularly engineering history

g. **Representativeness**: An *item* is important in demonstrating the principal characteristics of a class of technology or industry.

2.5 Prepare a statement of *significance* AND level of *significance*

The Statement of *Significance* is important because it summarises the essential information derived from the assessment of heritage *significance*. Apart from describing the *item* itself, it must clearly answer the basic questions –

- "Why is the *item significant*?"- based on the criteria of section 2.4
- "*Significant* to whom?" - the community, a group or an individual

Note: Some components of an *item* may be more *significant* than others. These should be identified and described. Refer to Appendix A for more information.

The Statement is to justify the most desirable outcome. It should not be a repetition of the assessment criteria, or merely a recital of the history of the *item*. It is important that all the elements of the *item* contributing to its *significance* are identified so that the Statement can inform initiate and inform *conservation* activity.

Port Arthur convict settlement Tasmania. Under-fired brick subject to salt attack causing deterioration.

Source: PA Management Authority

2.6 Determine the likely future of the *item*

Note 1: *Items* of heritage *significance* are, more often than not, *owned* by individuals or corporate entities whose intentions and finances must be seriously considered in any project. What may be practical for an *owner* might not coincide with the desires of heritage professionals who may be involved, or the community.

There are a range of options available to the *custodians* of the *item*, these should be examined, and proposals canvassed in line with the following:

a. Retain in current condition – this is the status applied in most museums.

b. Do nothing and allow gradual deterioration.

c. Return to and *maintain* in *operating* condition – *operation* may range from, limited time and/ or loading, to full-time/ full load as part of modern infrastructure or production.

d. Retain the *item* through *adaptive re-use.*

e. Resolve what the owner would like to do with it and any applicable limit to expenditure.

Note 2: *Operating* the *item* will, inevitably, lead to wear and other degradation of its *fabric.*

2.7 Choose the appropriate method of *conservation*

Methods are most often documented in a Conservation Management Plan the aim of which is to provide an understanding of the *significance* of the *item* and to set out management policies to *conserve* that *significance* while still providing for the continuing evolution and use of the *item*.

Note: Where practical, retain the *item* in its original position and context. In all cases the *item* should be retained in a place where it is appreciated and *maintained* by the surrounding community.

2.7.1 On static display in a museum

The aim is to prevent any further deterioration.

The *conservation* management is simple. Museums will apply their own *conservation* standards which usually means they *maintain* it only so far as to retain the same condition as on arrival adding only appropriate *interpretation*.

2.7.2 Able to perform its original role in its original form.

The aim is to achieve an *operating* item whilst retaining as much original *fabric* and function as possible. All removed original components should be catalogued and stored safely. See also 2.8(g) and 2.8(h).

You may need to:

a. review test results

b. consider the condition of individual materials, components and the overall condition of the *item*.

c. carry out analysis (structural, mechanical, hydraulic, electrical),

d. assess residual strength or capacity, including assessing non-compliance with current standards and methods of mitigating non-compliance.

e. consider safety, durability and compliance with codes.

f. identify potential *repair*, *conservation*, *preservation and restoration* methods.

g. consider access to specialist skills,

h. consider the hierarchy of *significance* for the *item* (i.e. some components or aspects may be more *significant* than others)

i. consider the potential impact of *works* on *significance*,

j. consider the benefits of works to *significance*,

k. report on findings with recommendations for actions, taking into account the heritage *significance* factors,

l. consider the engineering requirements associated with an *interpretation* strategy.

m. consider the views of other heritage professionals, *custodians* and community members,

n. prepare a short-term and long-term *conservation* plan,

o. if modern codes cannot be complied with without compromising significance, consider the intended objective and devise and propose an alternative method to achieve the same objective,

p. if modifications are required, minimise their impact on appearance (conceal if possible) or performance of the item,

q. prepare *operating* procedures and training of personnel,

r. prepare a long-term *maintenance* plan.

Dunmore Bridge in Woodville NSW is the most significant timber truss bridge in NSW; it is heritage listed and well maintained.

Source: NSW Roads & Maritime Services.

2.7.3 Adaptive re-use.

In conjunction with the following particulars, the considerations listed in the previous section are applicable to *adaptive re-use*.

a. Investigate the potential functions for which *re-use* of the *item* could be adapted.

b. The impacts of the potential functions on heritage *significance* must be assessed in each case.

c. The impact of any prospective *re-use* on the heritage *significance* of the *item* must be kept to a minimum.

d. Any impact on the *significance* of the *item* must be assessed against the potential benefit(s).

2.8 Implement the Conservation Plan

a. Define actions (including what is not to be affected)

b. Engage suitable resources.

c. Define responsibilities.

d. Ensure adequate direction and supervision.

e. Establish a log and keep records.

f. Provide guidance on interpretation and responsibility for maintaining interpretive installations and signs, including the long-term.

g. Consider retaining removed *fabric* as an aid to *interpretation*.

h. Provide guidance on the retention, storage and display of significant *fabric* which has been removed or replaced.

Bucket Dredger 21 extracted overburden and brown coal from the Morwell Open Cut 1955-92 in Victoria.

Source: Neil Hogg

2.9 Manage *operation*

a. Ensure statutory requirements for *operation* are complied with.

b. Consider movement, cleaning and lubrication.

c. Secure access to replacement parts and specialist services.

d. *Maintain* documentation and keep *operational* records.

e. Manage the environmental impacts – weather, pollution, people, storage, pests etc.

f. Ensure the health and safety of operators and visitors.

g. Prepare an emergency plan – fire, flood, security

Note: These aspects may involve an agreement with and handover to the *owner* or client. The agreement should state who is responsible for long term *maintenance*.

2.10 Prepare a report on the whole process

The report should carry the reader through the process, detailing the information gathered, explaining the decisions which you have made, how you reached them and recording the outcomes.

A nomination under the EHA's Engineering Heritage Recognition Program (EHRP), which recognises engineering and industrial works of heritage significance, should be considered as part of any activity on a work of engineering, technological or industrial heritage.

The EHRP Guide is at: https://www.engineersaustralia.org.au/sites/default/files/resource-files/2017-08/HRP.Guide%202017.FINAL%20APPROVED.V19.15%20July%202017.pdf

Note:

It is intended to supplement the Guide with examples of a conservation management plan, an item on static display, an item able to operate in its original role in its original form, and an item adapted for re-use. This task will be tackled in 2022.

Built in 1863-69, The Zig Zag Railway overcame an otherwise insurmountable ascent and descent on the western side of the Blue Mountains in NSW. Now operated as a heritage railway.
Credit Dennis Rittson.

APPENDIX A

Levels of *significance*

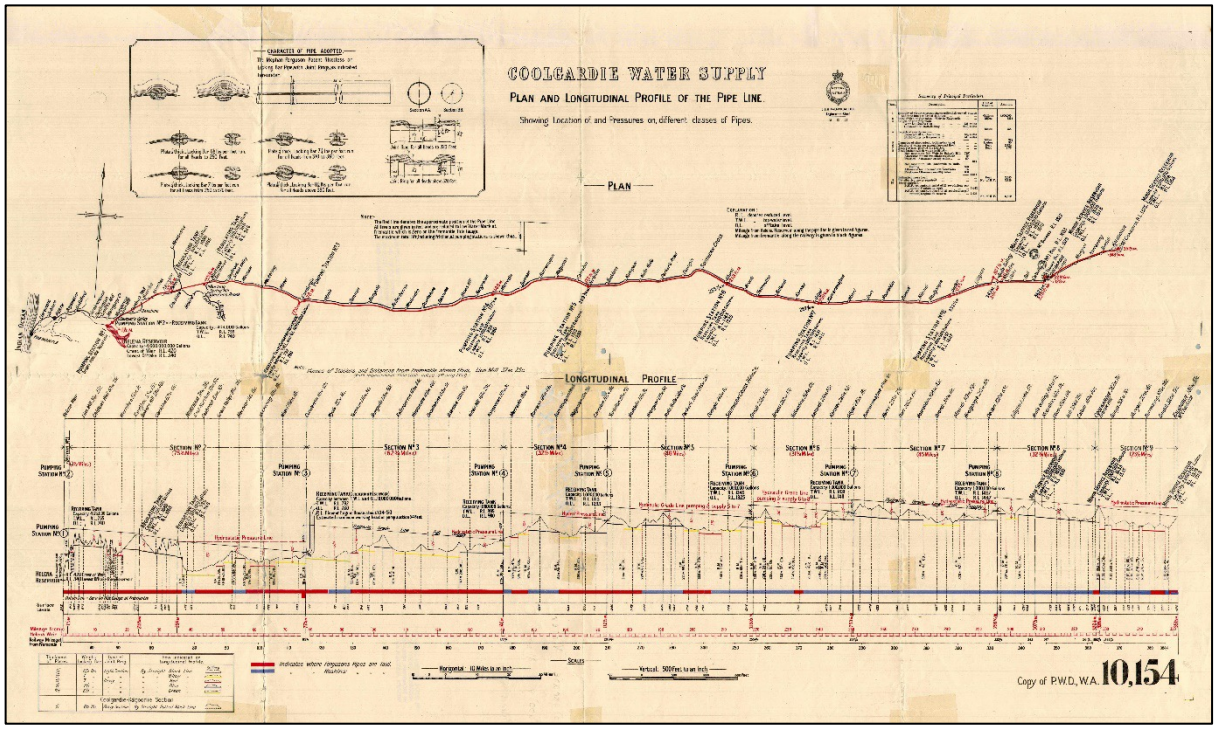
Most state heritage bodies categorise heritage as being of World, National, State or Local *significance*. It should be noted that these distinctions do not define the "quality" or "importance" of the *item*, merely to how many people regard it as *significant*.

The majority of heritage projects will not require you to determine world, national, state or local *significance*, however it can be useful in guiding future management to identify *items* which are more or less *significant* than others.

Five levels of significance are suggested in the literature (NSW State Heritage Office):

- Exceptional = rare or outstanding *item* or element contributing to *significance*.
- High = High degree of original fabric, demonstrates a key element of the *item's* significance.
- Moderate = Altered or modified elements. Elements with little heritage value but which, together, contribute to overall heritage *significance*.
- Little = Alterations detract from *significance*. Difficult to interpret.
- Intrusive = Damaging to the *item's significance*.

Map of the Perth to Kalgoorlie pipeline opened in 1903. It carried water 530km using 8 steam pumping stations. *Source: Royal Western Historical Society*



APPENDIX B
Definitions

Adaptation: Altering an *item* to suit a new *use*, or to achieve safety compliance.

Adaptive re-use: Alterations to suit a different function.

Conservation: The process of retaining the *significance* of an *item* (includes *preservation*, protection, *maintenance*, *restoration* and *adaptation)*.

Custodian: The person responsible for the care of the *item*.

Engineering Heritage: See Part 1 Clause 1.2

Fabric: All the physical material of the *item*, including components, fixtures, contents and objects.

Heritage Engineering: See Part 1 Clause 1.2. Note: The term "Conservation and Heritage Engineering" is sometimes used in other contexts)

Immovable: Cannot be moved without serious impact on its significance.

Interpretation: All the ways of presenting the cultural significance of the *item*.

Intangible heritage: An idea, knowledge, practice, skill or organisation. For engineers, intangible heritage includes the specialist accumulated knowledge (taught and learned by engineers through experience over time) that allows them to create objects for the use of individuals and society.

Item: A made object (tangible heritage).

Maintenance: The continuing care of the *item;* excludes *repair*, *adaptation*, and *restoration*.

Movable: Can be relocated without impact on its significance and *restoration*.

Operation: An *item* with moving parts carrying out its intended function.

Owner: The legal owner or the person whose approval is required before any *conservation* can be carried out.

Preservation: *Conservation* without change

Reconstruction: *Restoration* incorporating new material

Repair: Making good defects which adversely impact *conservation*. May incorporate *restoration*, *reconstruction* and *adaptation*.

Significance: The important values and meanings that *items* and collections have for people and communities.

Restoration: Returning an *item* to an earlier state, or to its original condition:

Use: The function of the *item*.

Work: Same as built *item* or artefact.

APPENDIX C

Key references

- Australia ICOMOS Burra Charter, 2013
- The Illustrated Burra Charter. Australia ICOMOS, 2004
- State Agency Heritage Guidelines (e.g. NSW Department of Planning Industry and Environment)
- The Conservation Plan by James Semple Kerr, The National Trust of Australia
- British Standard BS 7913: 2013, Guide to the conservation of historic buildings
- Association of British transport and Engineering Museums (ABTEM) Guidelines for Operating Heritage Machinery
- UNESCO Intangible Heritage Domains (from 2003 Convention)
- Significance 2.0 for museums and collections
- 2017 Guide to Engineering Heritage Recognition Program

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