Sydney WATER

Appendix Q
World Heritage Assessment

Upper South Creek Advanced Water Recycling Centre

Greater Blue Mountains World Heritage Area Heritage Impact Assessment

Prepared for Sydney Water
September 2021

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Upper South Creek Advanced Water Recycling Centre

Greater Blue Mountains World Heritage Area Heritage Impact Assessment

Report Number

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Sydney Water

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24 September 2021

Executive Summary

Sydney Water is planning to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas. The proposed development will include a wastewater treatment plant in Western Sydney, known as the Upper South Creek Advanced Water Recycling Centre (AWRC), and associated pipelines, collectively known as the 'project'.

The project has been declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) with World Heritage Properties and National Heritage Places listed as controlling provisions (EPBC 2020/8816). The project was deemed to have potential to impact on the World Heritage Listed Greater Blue Mountains World Heritage Areas (GBMWHA), which is also identified on the National Heritage List as holding natural heritage values.

The interaction between the project and the GBMWHA is confined to a small portion of the Blue Mountains National Park. There are two release points for treated water from the AWRC; into the Warragamba River downstream (north-east) of the Warragamba Dam wall and into Nepean River upstream of its confluence with the Warragamba River. Both these locations are outside of the GBMWHA. The Warragamba River runs for approximately 1 kilometre (km) from the Warragamba River release point before reaching the boundary of the GBMWHA, while the release point into the Nepean River is approximately 1.5 km from the GBMWHA boundary. Flows of treated water, mixed with the waters of the Nepean River, would flow through the GBMWHA for approximately 13 km prior to the Nepean River exiting the GBMWHA. This Heritage Impact Assessment (HIA) has focused on the 13 km stretch within the GBMWHA, identifying and assessing the impacts to the World and National heritage values. The HIA has looked beyond the listed natural values to encompass the Indigenous and historical heritage values ascribed by the broader Australian community, but not yet acknowledged within the formal National Heritage Listing.

The Nepean River sits within a confined channel bed within the bedrock, which has been assessed as being in good geomorphic condition. The river bed consists of bedrock overlaid with gravel, cobbles and boulders and there are a number of in-channel bars and benches. The existing terrestrial environment is made up of five Plant Community Types: 835 - Forest Red Gum – Rough-barked Apple grassy woodland, PCT 1078 - Prickly Tea-tree – sedge wet heath, PCT 1181 - Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest, PCT 1284 - Turpentine - Smooth-barked Apple moist shrubby forest and PCT 1292 - Water Gum – Coachwood riparian scrub. The area provides habitat for Platypus (*Ornithorhynchus anatinus*), Echidna (*Tachyglossus aculeatus*) and a range of birds, mammals and reptiles. The aquatic environment has been identified as habitat for the endangered Macquarie Perch (*Macquaria australasica*). Aquatic plants consist of both native and exotic species and the macroinvertebrate community structure indicates low family richness, probably as a result of water quality.

No Indigenous archaeological or art sites have been identified within the immediate proximity of the waters edge. The eastern bank of the Nepean River is listed on the Penrith LEP as Table Rock Lookout with aesthetic and historical significance. The historical significance relates to both Indigenous and historical activities. No built or historical heritage sites have been identified within the immediate proximity of the waters edge. Preliminary consultation with local Aboriginal communities has not identified particular sites or points of connection within the study area, but Aboriginal communities view rivers, including the Nepean River, as sources of both spiritual and practical nourishment. Caring for country is a deeply held obligation.

Hydrological modelling of project impacts has identified that a rise in water level of up to 5 cm at 50 M/L day and 10 cm at 100 M/L day is anticipated. The wetted perimeter could increase by up to 2 m, although this would impact on in-channel bars and benches, with no additional overbank flow as the Nepean River is contained within a channel within the bedrock. Changes to water velocity would be <0.01 m/s, which is considered negligible. Water quality modelling indicates that there would be a slight improvement in quality.

The impacts associated with these alterations would be:

- imperceivable alteration to views or landscape setting within the GBMWHA, including at Table Rock Lookout;
- no increase in erosion and therefore no impact on the geodiversity or geomorphology of the GBMWHA;
- improved water quality, resulting in slightly beneficial outcomes for aquatic ecology;
- inundation frequencies of individual trees within an additional area of 0.19 of a hectare;
- no impact to Indigenous archaeological or art sites; and
- no alteration in Indigenous community connections – visitation would not be altered and as the impacts of the project are slight, the country is being cared for.

In summary, the assessment indicating the impact will range from slight (biodiversity), through none (geodiversity and geomorphology and Indigenous or historical heritage sites) to slightly beneficial (water quality and aquatic ecology). As Indigenous connections is based on consideration of caring for the whole of environment, on balance it is likely that the project would be considered as caring for country, with community consultation ongoing.

The specialist studies from which the information in this HIA has been drawn contain mitigation measures. A review of these measures indicates they are satisfactory to address the slight to negligible impacts identified to the heritage values of the GBMWHA.

The following management and mitigation measures are recommended in relation to the World and National Heritage values of the GBMWHA:

- Biosis (2021) have identified a number of mitigation measures design to mitigate impacts of the project on biodiversity values. This includes ensuring the quality of water released into the Nepean River, monitoring of biodiversity offsets that cover the potential loss of vegetation for the project as a whole, including the indirect impacts within the GBMWHA. These measures should be adopted;
- CT Environmental (2021) and Aurecon Arup (2021) have both recommended on-going water quality and aquatic ecology monitoring. This measure should be adopted; and
- The Aboriginal Cultural Values Study should be reviewed once complete and relevant recommendations considered for implementation in relation to the Indigenous connections to the GBMWHA section of the Nepean River.

Table of Contents

Appendices

Tables

Figures

Plates

1 Introduction

1.1 Project description

Sydney Water is planning to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas. The proposed development will include a wastewater treatment plant in Western Sydney, known as the Upper South Creek Advanced Water Recycling Centre. Together, this Water Recycling Centre and the associated treated water and brine pipelines, will be known as the 'project'. Further details of each component of the project are provided below and illustrated in Plate 1.1.

- Advanced Water Recycling Centre
    - a wastewater treatment plant with the capacity to treat up to 50 megalitres (ML) of wastewater per day, with ultimate capacity of up to 100 ML/day.
    - the Advanced Water Recycling Centre will produce:
        - high-quality treated water suitable for a range of uses including recycling and environmental flows;
        - renewable energy, including through the capturing of heat for cogeneration;
        - biosolids suitable for beneficial reuse; and
        - brine, as a by-product of reverse osmosis treatment.
- Treated water pipelines
    - a pipeline about 17 kilometres (km) long will be constructed from the Advanced Water Recycling Centre to the Nepean River at Wallacia Weir, for the release of treated water;
    - infrastructure from the Advanced Water Recycling Centre to South Creek to release excess treated water and wet weather flows during operation;
    - a pipeline, about five km long, from the main treated water pipeline at Wallacia to a location between the Warragamba Dam and Warragamba Weir, to release high-quality treated water to the Warragamba River as environmental flows. The release point is approximately 1 km from the closest point of the GBMWHA boundary. The Warragamba River meets the Nepean River approximately 3 km from the release point;
- Brine pipeline
    - A pipeline, about 24 km long, that transfers brine from the Advanced Water Recycling Centre to Lansdowne, in south-west Sydney, where it connects to Sydney Water's existing Malabar wastewater network;

Sydney Water is planning to deliver the project in stages, with Stage 1 comprising:

- building and operating the Advanced Water Recycling Centre to treat an average dry weather flow of up to 50 ML per day; and

- building all pipelines to their ultimate capacity, but only operating them to transport and release volumes produced by the Stage 1 Advanced Water Recycling Centre.

The timing and scale of future stages will be phased to respond to drivers including population growth rate and the most efficient way for Sydney Water to optimise its wastewater systems. This HIA assesses Stage 1, but also makes comment on Stage 2, which would allow for an average dry weather flow of up to 100 ML per day.

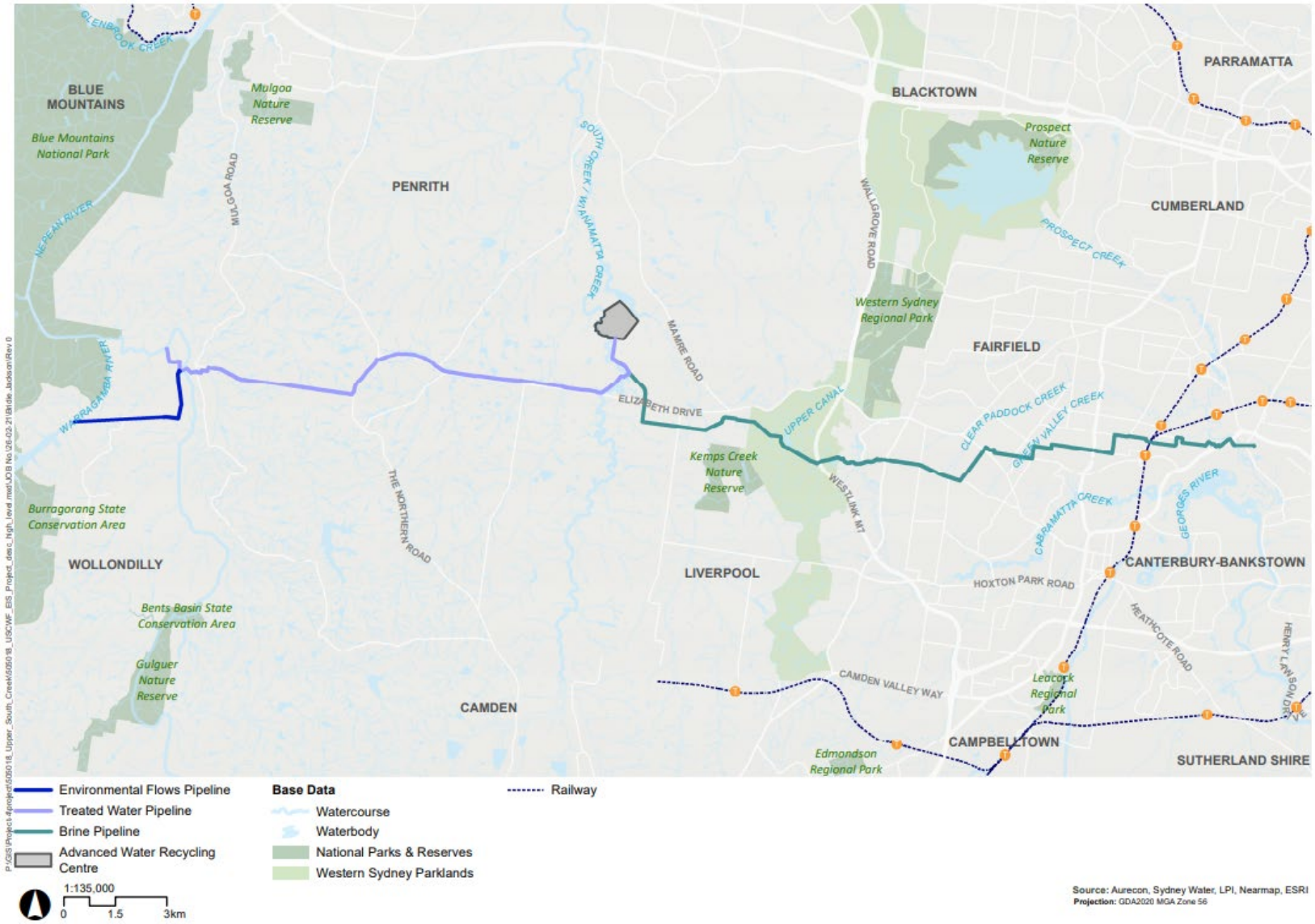


Plate 1.1 Upper South Creek Advanced Wastewater Recycling Centre project

1.2 Greater Blue Mountains World Heritage Area background

The project has been declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) with World Heritage Properties and National Heritage Places listed as controlling provisions (EPBC 2020/8816). The project was deemed to have potential to impact on the World Heritage Listed Greater Blue Mountains World Heritage Area (GBMWHA), which is also identified on the National Heritage List as holding heritage values. For the sake of simplicity, GBMWHA also refers to the National heritage values throughout this HIA.

The GBMWHA comprises 10,000 square kilometres of bushland, covering seven National Parks (Wollemi, Yengo, Gardens of Stone, Blue Mountains, Kanangra-Boyd, Nattai and Thirlmere Lakes) and the Jenolan Karst Conservation Reserve (Figure 1.1). The Outstanding Universal Values (OUV) identified in the World Heritage List relate to the natural heritage values. The National Parks and Conservation Reserve are managed by the NSW National Parks and Wildlife Service (NPWS).

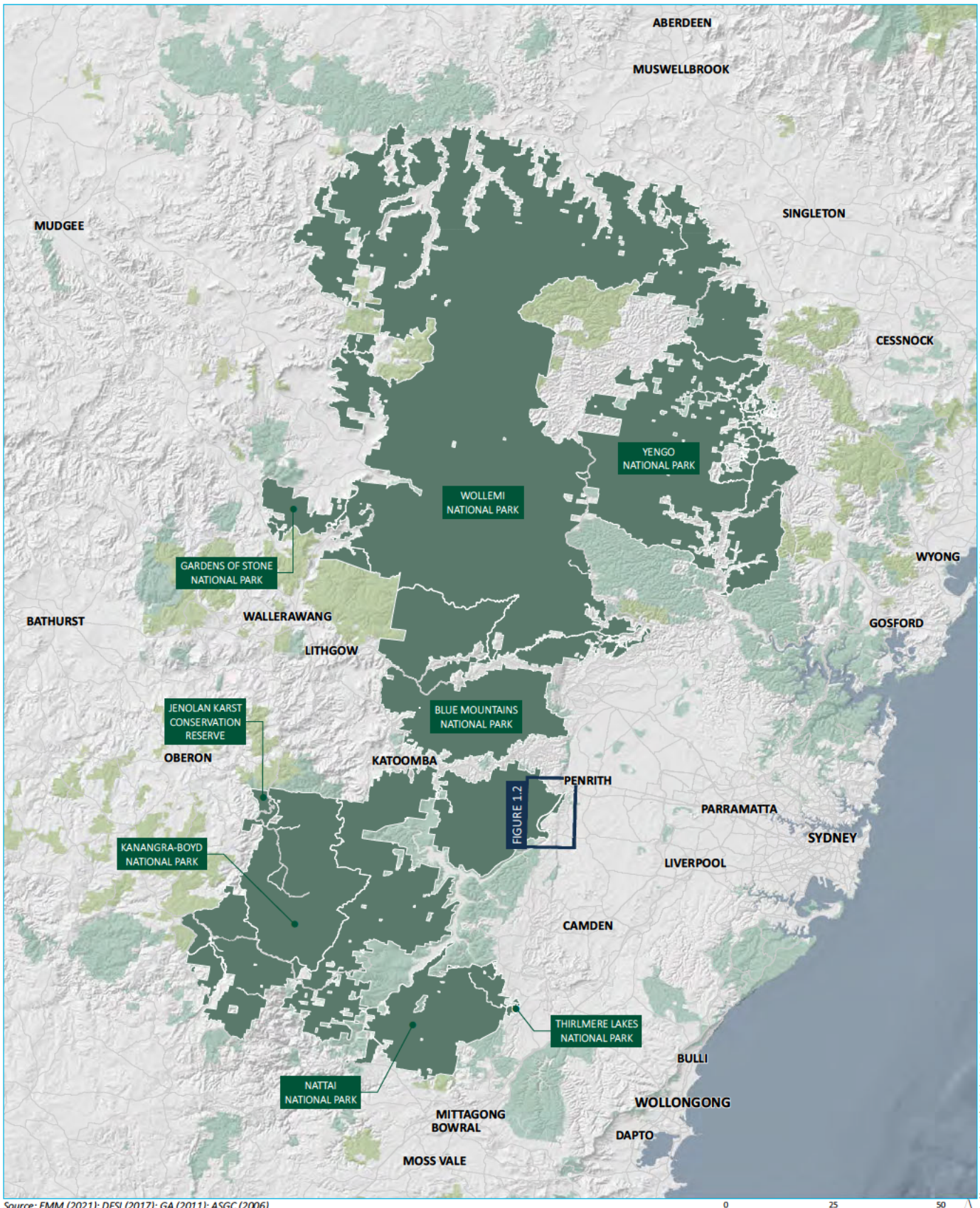
The Secretary's Environmental Assessment Requirements (SEARs) were issued by the NSW Department of Planning, Industry and Environment (DPIE), with inputs from the Commonwealth Department of Agriculture, Water and the Environment (DAWE), on 28 January 2021. The requirements relating to World and National Heritage are outlined in Attachment 1 of the SEARs. The project will require the preparation of a Heritage Impact Assessment (HIA), which must address the SEARs.

The interaction between the project and the GBMWHA is confined to indirect impacts associated with the proposed water releases through a small portion of the Blue Mountains National Park. No infrastructure is proposed for construction within GBMWHA, with the AWRC being located near South Creek over 5 km from the GBMWHA boundary and the release points are located:

- downstream (north-east) of the Warragamba Dam wall, outside of the GBMWHA, on the southern side of the Warragamba River. The River stretches approximately 1 km before reaching the boundary of the GBMWHA at the intersection of the Warragamba River and the Nepean River; and

- adjacent to the Wallacia Weir, located on the Nepean River outside of the GBMWHA (Figure 1.2).

Flows of treated water, mixed with the waters of the Nepean River, would flow through the GBMWHA for approximately 13 km prior to the River exiting the GBMWHA (Figure 1.2). This HIA is focused on the 13 km stretch within the GBMWHA through which the treated water will flow, using a 300 metre (m) site boundary, centred on the middle of the Nepean River (the study area). It is not anticipated that impacts will extend to this boundary, but rather this boundary is used to define a study area for the HIA that is sufficient to capture direct and indirect impacts. As noted above, this HIA assesses Stage 1, but also makes comment on Stage 2, which would allow for an average dry weather flow of up to 100 ML per day.



Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006)

0 25 50 km

GDA 1994 MGA Zone 56

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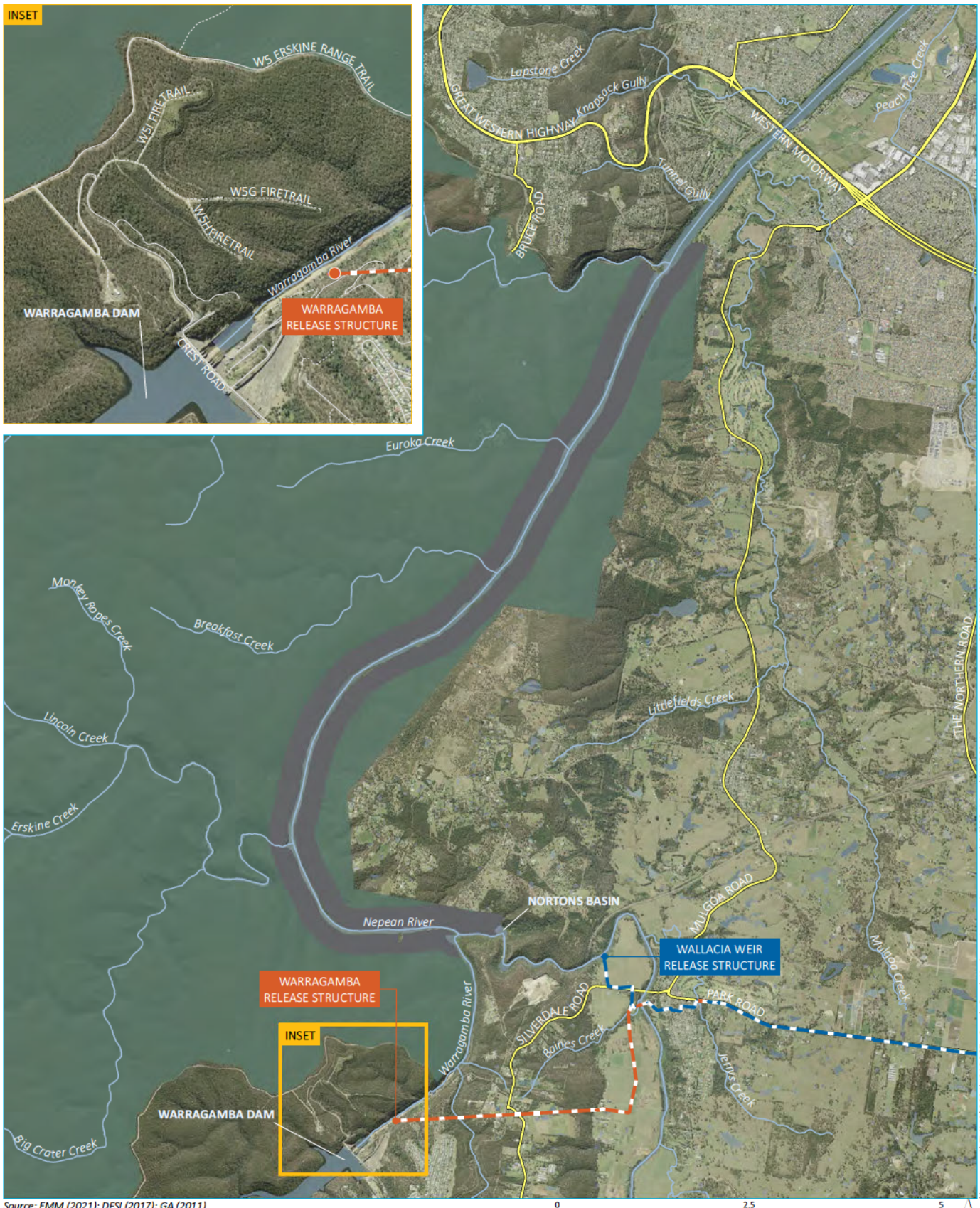
KEY

- Greater Blue Mountains World and National Heritage Area
- Major road
- NPWS reserve
- State forest

Greater Blue Mountains World Heritage Area curtilage

Upper South Creek Advanced Water Recycling Centre
Heritage impact assessment
Figure 1.1

EMM
creating opportunities



Source: EMM (2021); DFSI (2017); GA (2011)

0 2.5 5 km

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KEY

- Study area
- Greater Blue Mountains World and National Heritage Area
- Treated water pipeline
- Environmental flows pipeline
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Named waterbody

Area of interaction between the Greater Blue Mountains World Heritage Area and the Upper South Creek Advanced Water Recycling Centre (study area)

Upper South Creek Advanced
Heritage impact assessment
Figure 1.2

EMM
creating opportunities

1.3 Secretary's Environmental Assessment Requirements

The project will be assessed as State Significant Infrastructure (SSI) under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This HIA has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 28 January 2021, as well as relevant government assessment requirements, guidelines and policies, and in consultation with the relevant government agencies. To inform preparation of the SEARs, the DPIE invited relevant government agencies to advise on matters to be addressed in the Environmental Impact Statement (EIS), including the DAWE in relation to the World and National heritage listings. These matters were taken into account by the Secretary of DPIE when preparing the SEARs.

The matters relevant to this assessment, and where they are addressed in this report, are listed in Table 1.1 below.

Table 1.1 Relevant matters raised in SEARs Attachment 1

Requirement	Section addressed
9. The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including: i. a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long term relevant impacts; ii. a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible; iii. analysis of the significance of the relevant impacts; and iv. any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	Section 6
10. For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including: i. a description, and an assessment of the expected or predicted effectiveness of the mitigation measures, ii. any statutory policy basis for the mitigation measures; iii. the cost of the mitigation measures; iv. an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing; v. the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.	Section 6.10
11. Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	No significant residual adverse impact is likely. Refer to Section 6
12. For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any: i. conservation advice or recovery plan for the species or community, ii. relevant threat abatement plan for a process that threatens the species or community iii. wildlife conservation plan for the species iv. management plan for Ramsar wetland v. management plan for a World Heritage property or National Heritage place;	Section 6, Appendix A

Requirement	Section addressed
vi. Marine Bioregional Plan; vii. any strategic assessment.	
13. In addition to the general requirements described above, specific information is required with respect to each of the determined controlling provisions. These requirements are outlined in paragraphs 14-19.	Controlling provisions 17 and 18 (below) apply and have triggered the preparation of this HIA
17. The EIS must identify and describe the characteristics and values, including Outstanding Universal values, of the Greater Blue Mountains Area – World Heritage property and National Heritage place that is likely to be impacted by all stages of the proposed action with appropriate reference to relevant management plans. The assessment of impacts should include information on: i. the modification, destruction, fragmentation, isolation, disturbance of an important or substantial area of habitat; ii. impacts on other users of the area; iii. the potential impacts on important amenities, navigation, culturally or historically significant sites, threatened or migratory species or sensitive habitat; iv. the potential visual impacts; v. a description of any specific mitigation and management measures proposed to protect or enhance the affected values of the World Heritage property or National Heritage place.	Section 6
18. Where a significant residual adverse impact to a World Heritage property and/or a National Heritage place is considered likely the EIS must provide information on the proposed offset strategy. The offset strategy must: i. include a discussion and supporting evidence of the conservation benefit associated with the proposed offset strategy. The conservation benefit must demonstrate, at a minimum, how the proposed offset will improve the integrity and resilience of the heritage values of the impacted heritage place or property; and ii. be consistent with the *Environment Protection and Biodiversity Conservation Act 1999* and *Environmental Offset Policy* (2012) or an endorsed state policy.	No significant residual adverse impact is likely. Refer to Section 6.10

1.4 Heritage Status

The study area falls within the World and National Heritage Lists as shown in Table 1.2. Additionally, the eastern bank of the Nepean River within the GBMWHA is listed on the Penrith Local Environmental Plan as Table Rock Lookout (#I141).

One of the 11 sites comprising the Australian Convict Sites World Heritage Listing, being the Old North Road, is located 55 km north-east of the study area. The curtilage of the World Heritage Listed portion of the Old North Road does not intersect with the Nepean or Hawkesbury Rivers[1]. The project will therefore have no direct or indirect impacts on the Old North Road.

There are no State heritage listing within direct proximity to the study area.

[1] The Nepean River meets the Grose River becoming the Hawkesbury River in the vicinity of Richmond.

Table 1.2 Heritage status

Jurisdiction	List	Identified Items
Commonwealth	World Heritage List	The Greater Blue Mountains Area (105127)
	National Heritage List	The Greater Blue Mountains Area (105999)
	Commonwealth Heritage List	None
State	State Heritage Register	None
Local	Penrith Local Environmental Plan	Table Rock Lookout (I141)

1.5 Methodology

Sydney Water have engaged specialists to prepare the geomorphology, aquatic ecology, biodiversity, Indigenous heritage, and water quality impact assessments required under the EP&A Act for the project EIS. As the World and National heritage values overlap with the NSW assessment requirements, the investigations undertaken by these specialists have been used as the basis of this HIA, supplemented with additional information where required. This HIA used the following method:

- review of the World and National Heritage Listing information and development of attributes that define the heritage values;
- review of the specialist studies undertaken for the EIS process to determine whether they contained information sufficient to assess the impacts to the World and National Heritage values;
- where the information does not cover the World and National values, liaison with the specialists to obtain the additional information;
- prepare a HIA that complies with:
  - *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Department of the Environment 2013); and
  - *Guidance on Heritage Impact Assessment for Cultural World Heritage Places* (ICOMOS (2001).

1.5.1 Impact Assessment

ICOMOS (2001) suggests, among others, the following steps be considered during the preparation of a HIA:

- The OUV are always the starting point, but they may not be detailed enough to undertake an impact assessment. It may be necessary to further define the attributes for each OUV. This has been undertaken in Section 4.
- The contribution of heritage attributes to the OUV may be graded using the following scale:
  - Very High.
  - High.
  - Medium.
  - Low.

- Negligible.
- Unknown.

The contribution of the heritage attributes is defined within Section 5.10, together with an assessment of the integrity and authenticity of the attribute.

Impacts are not only visual. Consideration of direct, indirect, temporary and permanent, reversible or irreversible, visual, physical, social and cultural and economic needs to be incorporated into the HIA. The consideration of impacts is presented in Section 6.

The *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Department of the Environment 2013) provides guidance around the assessment of impact severity for Matters of National Environmental Significance (MNES). In terms of heritage, a site becomes a MNES when that site is listed on the World or National Heritage Lists, as the GBMWHA is. The guideline sets out criteria to determine whether there is a real chance or possibility that an action will have a significant impact. The criteria are divided into:

- values associated with geology or landscape;
- biological and ecological values;
- wilderness, natural beauty or rare or unique environment values;
- historic heritage values; and
- other cultural heritage values including Indigenous heritage values.

Significant impact may occur where an action will damage, modify, alter, obscure, inhibit landscape processes or otherwise negatively impact on a geological formation, landscape, ecological community, aesthetic values, Indigenous or historical sites. This test is applied in Section 6.

In categorising the impact, the assessment uses the nine-point scale within ICOMOS (2011, p.8) to determine the "significance of the effect of the change – ie, the overall impact". These are:

- major beneficial;
- moderate beneficial;
- minor beneficial;
- negligible beneficial;
- neutral;
- negligible adverse;
- minor adverse;
- moderate adverse; and
- major adverse.

This scale allows for a fine-grained analysis of the impacts and recognises that a project may benefit the heritage values of a site, rather than solely defining them in the negative. ICOMOS (2001, p. 10) requires that the impact be assessed against each OUV, their integrity and authenticity, as well as existing policy and management plans. To remove some of the subjectivity, ICOMOS suggests the value of the heritage asset be used to guide the grading of the impact, as shown in Table 1.3.

Table 1.3 Scale and severity of change/impact

Value of heritage asset	No change	Negligible change	Minor change	Moderate change	Major change
	SIGNIFICANCE OF EFFECT OR OVERALL IMPACT (EITHER ADVERSE OR BENEFICIAL)				
Very High – attributes which convey OUV for other heritage assets or attributes	Neutral	Slight	Moderate/Large	Large/Very Large	Very Large
Very High	Neutral	Slight	Moderate/Large	Large/Very Large	Very Large
High	Neutral	Slight	Moderate/Slight	Moderate/Large	Large/Very Large
Medium	Neutral	Neutral/Slight	Slight	Moderate	Moderate/Large
Low	Neutral	Neutral/Slight	Neutral/Slight	Slight	Slight/Moderate
Negligible	Neutral	Neutral	Neutral/Slight	Neutral/Slight	Slight

Source: ICOMOS, 2001, p.9-10

Often, the World and National heritage values differ and two impact assessments, usually within the same document, may be required. This is not the case for the GBMWHA, where the official values for both listings are the same. As the criteria for assessing impacts for World and Nationally listed sites are the same within the MNES guidelines, one table and one assessment has been undertaken.

1.6 Documentation and References

This HIA has been based on the following key references:

- *Blue Mountains National Park: Plan of Management* (NSW Parks and Wildlife Service, 2001);
- *Greater Blue Mountains World Heritage Area: Strategic Plan* (NSW Parks and Wildlife Service, 2009);
- *Values for a new generation: Greater Blue Mountains World Heritage Area* (Benson (ed.), 2015);
- *The Greater Blue Mountains Area – Additional Values, nomination held in the Australian Heritage Database* (Nominators, n.d.);
- *Upper South Creek AWRC: Hydrodynamic and Water Quality Impact Assessment* (Aurecon and Arup 2021);
- *AWRC Aquatic Ecology Impact Assessment* (CT Environmental 2021);
- *Potential impacts of discharge on the Nepean River, World Heritage Area* (Streamology 2021a);
- *Upper South Creek Advanced Water Recycling Centre: Ecohydrology and Geomorphology Impact Assessment* (Streamology 2021b)

- *Upper South Creek Advanced Water Recycling Centre Biodiversity Development Assessment Report* (Draft) (Biosis 2021).

1.7 Limitations

Within this report EMM provide predictions regarding the probability of surface and subsurface archaeological material occurring within the place, based on surface indications and environmental context. However, it is possible that materials may occur in areas without surface indications and in any environmental context.

Throughout the HIA EMM relies on impact assessments and predictions from specialist third parties to inform the assessment of impacts to the GBMWHA. Any limitations within these studies form limitations to the HIA.

Section 2 provides an overview of the statutory and non-statutory obligations of the client in relation to heritage. The overview is based on the authors' experience within the heritage sector. It is not legal advice. Legislation, regulations and guidelines can change and users are encouraged to ensure statutory obligations have not changed since the report was written.

2 Legislative Context

2.1 World Heritage Convention

As a signatory to the World Heritage Convention, Australia has obligations under this convention. Article 5 of the World Heritage Convention requires that signatories:

- ensure that effective and active measures are taken for the protection, conservation and presentation of the cultural and natural heritage situated on its territory. Each signatory to this Convention should endeavour insofar as possible and as appropriate for each country;
- adopt a general policy which aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of the heritage into comprehensive planning programs;
- set up within its territories, where such services do not exist, one or more services for the protection, conservation and presentation of the cultural and natural heritage with an appropriate staff and possessing the means to discharge their functions;
- develop scientific and technical studies and research and to work out such operating methods as will make the signatory capable of counteracting the dangers that threaten its cultural or natural heritage;
- take appropriate legal, scientific, technical, administrative and financial measures to ensure the identification, protection, conservation, presentation and rehabilitation of this heritage; and
- foster the establishment or development of national and regional centres for training in the protection, conservation and presentation of the cultural and natural heritage and to encourage scientific research in this field.

Application: Australia has integrated these obligations into the EPBC Act. Complying with the EPBC Act will ensure the requirements of the World Heritage Convention are met.

2.2 Environment Protection and Biodiversity Conservation Act, 1999 (Cwlth)

The EPBC Act provides a legal framework to protect and manage nationally and internationally important heritage places, as well as flora, fauna, ecological communities and water resources. The EPBC Act establishes the National Heritage List (NHL), Commonwealth Heritage List (CHL) and the Register of the National Estate (RNE). The RNE is a non-statutory register.

Sites listed on the WHL (Section 12 of the Act) or NHL (Section 15B(1) of the Act) are defined as MNES.

An action that may potentially have a significant impact on a MNES is deemed to be a 'controlled action'. Such actions are to be referred to DAWE for determination as to whether or not it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act and can only proceed with the approval of the Commonwealth Minister for the Environment.

The EPBC Act is supported by the EPBC Regulations that require that at least one management plan is prepared for World Heritage places. The management plan must provide mechanisms to address the impacts of actions on World Heritage properties.

Application: The project may have indirect impacts on the World Heritage and Nationally Listed GBMWHA, and has been referred and been deemed a controlled action (EPBC 2020/8816). The project requires approval under the EPBC Act.

Under the bi-lateral agreement between the Commonwealth and the State of NSW, certain NSW processes are accredited under section 47 of the EPBC Act. This includes assessment under the EP&A Act. Actions assessed in the manner specified in Schedule 1 of the bi-lateral agreement do not require assessment under Part 8 of the EPBC Act.

This HIA addresses the requirements of the EPBC Act and the bi-lateral agreement on behalf of Sydney Water.

2.3 Environmental Planning and Assessment Act 1979

The EP&A Act establishes the framework for development assessment within NSW, with one of the objects of the Act being to promote the sustainable management of built and cultural heritage, including Aboriginal cultural heritage. Due to the size, economic value or impacts, some types of development are assessed as State Significant Development (SSD) or SSI. Where a project is identified as SSD or SSI, the NSW Department with responsibility for planning is the consent authority and directs the proponent to prepare an application for SEARs, which define the various studies and guidelines for the preparation of an environmental impact statement (EIS) and supporting technical reports.

Application: The project will be assessed as SSI under Division 5.2 of the EP&A Act and SEARs have been issued. For SSI projects, certain approvals do not apply. This includes approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*, or an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the *National Parks and Wildlife Act 1974*. Division 8 of Part 6 of the Heritage Act, relating to disturbance of buildings, relics etc, does not apply to prevent or interfere with the carrying out of SSI projects. The purpose of all assessment processes is to consider impacts to, among other things, cultural heritage items and places as well as archaeological sites and deposits associated with the proposal and to identify measures to avoid, mitigate or ameliorate impacts.

2.3.1 Penrith Local Environmental Plan 2010

As the majority of development assessment and consent is undertaken by Local Government (council), the EP&A Act directs council to prepare a local environmental plan (LEP) and development control plans (DCPs) for their local government. LEPs are to be developed under the standard instrument, which provides planning consistency across the State. Schedule 5 of the Standard Instrument provides a list of identified environmental heritage within the LGA, impacts to which are to be considered during the development assessment and approval process. DCPs provide policies that are specific to the local environment and character of the LGA or a subset of the LGA. The NSW department with responsibility for planning may also prepare state environmental planning policies (SEPPs) to guide planning across the State.

Part 5, Section 5.10 of the Penrith LEP addresses the conservation of heritage significance within the LGA. The objectives of the LEP in relation to heritage are:

a) to conserve the environmental heritage of Penrith;

b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views;

c) to conserve archaeological sites; and

d) to conserve Aboriginal objects and Aboriginal places of heritage significance.

Application: While approval under the LEP is not required, Schedule 5 of the LEP provides a list of heritage items, conservation areas and archaeological sites within the LGA. The study area contains one item listed on the LEP: Table Rock Lookout (ID#141).

2.4 Non-Statutory Considerations

The following non-statutory guidelines have been used to inform the assessment. The Burra Charter has informed the acceptable level of change, while the National Trust listings have been used to identify the community connections to the study area. Ask First and Engage Early have informed the Indigenous stakeholder consultations contained within the Aboriginal Cultural Heritage Report prepared for this project.

2.4.1 The Burra Charter

The Burra Charter: The Australian ICOMOS charter for places of cultural significance (ICOMOS (Australia) 2013) sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance including owners, managers and custodians. The Charter provides specific guidance for physical and procedural actions that should occur in relation to significant places. A copy of the charter can be accessed online at http://icomos.org/australia.

The Burra Charter consists of 34 articles, arranged into five sections: definitions, conservation principles, processes and practice. The principal articles of the Burra Charter are:

- conservation is based on significance;
- a cautious approach is required – changing as much as necessary, but as little as possible; and
- maintenance is fundamental to conservation.

Further articles relate to preservation (maintaining fabric in its current state), restoration and reconstruction, adaptation and the introduction of new structures or extensions.

2.4.2 National Trust

The National Trust is community-based with no statutory power. The National Trust undertakes advocacy on heritage related matters at a state/territory level.

The NSW Branch maintains a register of significant places, which can be accessed by contacting the Branch.

Listing on the National Trust List does not place statutory restrictions on the owner, rather, it provides an indication of the esteem in which the place is held by heritage professionals and the public.

2.4.3 Ask First

Ask First: A guide to respecting Indigenous heritage places and values (Australian Heritage Commission 2002) provides Commonwealth government agencies with high level advice regarding working with Indigenous representatives. *Ask First* is to be read in conjunction with *Engage Early* (Section 2.4.4).

2.4.4 Engage Early

Engage Early: Guidance for proponents on best practice Indigenous engagement for environmental assessments under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)(Engage Early) was developed by the Department of the Environment (2016) and works in tandem with *Ask First* (refer to Section 2.4.3). *Engage*

Early provides framework for an early and cooperative approach to consultation with Indigenous peoples during the environmental assessment process under the EPBC Act.

Engage Early lays out best practice consultation, which includes:

- the early identification and acknowledgement of all relevant Indigenous peoples and communities;
- building trust by early and ongoing engagement, commitment, and clarity;
- being aware of statutory processes regarding consultation and consent processes;
- establishing appropriate timeframes for consultation, and;
- demonstrating appropriate cultural awareness and respect for the Indigenous people's timeframes and desires.

2.5 Key Management Documents

The purpose of this section is to identify key documents for the management of the GBMWHA. This section will provide a broad overview of each document, but will then filter the information, defining the strategies, objectives and management policies that are of relevance to the impact assessment of the project to discuss in further detail. These will become the basis of the HIA. This section does not address the heritage significance assigned within these documents – this is outlined in Section 4.

Under Section 316 of the EPBC Act, places identified on the World Heritage List must be managed under a management plan. In the instance of the GBMWHA, this plan is divided between nine documents: an overarching Strategic Plan (NSW National Parks and Wildlife Service 2009) and eight Plans of Management for the individual parks that make up the GBMWHA. As the projects indirect impacts will be confined to the Blue Mountains National Park, with no indirect or direct impacts extending into other National Parks, this document will solely refer to the Strategic Plan and the *Blue Mountains National Park: Plan of Management* (NSW Parks and Wildlife Service 2001), hereafter the Plan of Management.

2.5.1 Greater Blue Mountains World Heritage Area Strategic Plan & Addendum

> "This Strategic Plan has been prepared to assist in meeting Australia's international responsibilities under the World Heritage Convention. It will ensure that appropriate consideration is given to the GBMWHA's World Heritage values by managers when developing management prescriptions for the GBMWHA reserves, and that they are developed and implemented in a consistent and coordinated way."
>
> (NSW National Parks and Wildlife Service, 2009:5)

The *Greater Blue Mountains World Heritage Area Strategic Plan* (hereafter: Strategic Plan) provides an overarching framework in which the individual parks that comprise the GBMA can be managed. It does not provide detailed management prescriptions, leaving this to the individual park Plans of Management. The Strategic Plan lays out the strategic objects of the plan as being:

- identify, protect, conserve, present, transmit to future generations and, where necessary, rehabilitate the World Heritage values of the GBMWHA;
- integrate the protection of the GBMWHA into a comprehensive planning program;
- give the GBMWHA a function in the life of the Australian community;

- strengthen appreciation and respect for the GBMWHA's World Heritage values, particularly through educational and information programs, and keeping the community broadly informed about the condition of the World Heritage values of the GBMWHA;
- take the appropriate scientific, technical, legal, administrative and financial measures necessary for implementing these principles;
- provide for continuing community and technical input in managing the GBMWHA; and
- manage the broad range of values, both World Heritage and non-World Heritage, ensuring that achieving the long-term conservation of the reserves' World Heritage values is the over-riding principle.

Flowing out of this, the Strategic Plan recognises ten management issues:

2. integrity;
3. major impacts;
4. biodiversity;
5. geodiversity;
6. water catchment protection
7. cultural heritage (i.e. historic and indigenous);
8. landscape, natural beauty and aesthetic values;
9. recreation and visitor use;
10. social and economic issues related to commercial tourism; and
11. education, community participation and consultation.

In 2016 the State of NSW and the Office of Environment and Heritage undertook a review of the Strategic Plan (State of NSW and Office of Environment and Heritage 2016), as required under Section 341X(1) of the EPBC Act. The *Greater Blue Mountains World Heritage Area Strategic Plan Addendum 2016* (hereafter: Addendum) reiterated the key management issues identified in the Strategic Plan and provided an update on available information.

i Application

The HIA for the project will need to demonstrate that the project does not form or contribute to the identified key management issues. Primarily integrity, major impacts, biodiversity, water catchment protection, cultural heritage, landscape, natural beauty and aesthetic values can be identified as relevant to the assessment of the project. To achieve this, the HIA refers to the updated information provided in the Addendum. The objectives, and management responses for each of the identified issues are provided in Table 8.1 of Appendix A.

The remaining three key management issues (recreation and visitor use, social and economic issues related to commercial tourism and education, community participation and consultation) will not be further analysed as the policies relate to visitor management and issues outside Sydney Water's remit. The community participation policies relate to tourism and Aboriginal cultural heritage interpretation, rather than infrastructure consultation, and is therefore not relevant to the project. The project would not interact with recreation or visitor uses, being an

infrastructure project. Similarly, it would not stimulate social or economic issues relating to commercial tourism. On these bases, EMM propose not to further consider these key management issues.

2.5.2 Blue Mountains National Park Plan of Management

The Plan of Management outlines the significance of the Blue Mountains National Park, key risks and policies and actions to protect the values. The Plan of Management identifies that the Blue Mountain National Park holds natural, Indigenous and historic heritage values.

The stated vision for the Blue Mountains National Park is:

> "a world quality national park in which human-caused environmental changes are excluded or effectively controlled, natural biodiversity is stable or increasing, significant cultural heritage is effectively protected, a range of high quality nature-based recreational experiences are available on an environmentally sustainable basis, and the maintenance of these conditions is strongly supported by the community"
>
> (NSW Parks and Wildlife Service 2001:10)

The objectives identified to achieve the vision are:

- protection of the park as part of the system of protected lands of the Sydney Basin bioregion and the Great Escarpment, with emphasis on maintenance of the ecological relationships between the park and adjoining protected areas;
- protection of catchments and water quality in the park, with priority to protection of Sydney's water supply and protection of wilderness catchments;
- identification, protection, conservation, presentation and transmission to future generations of the values of the Greater Blue Mountains World Heritage Area;
- protection and promotion of the outstanding scenic values of the park including protection of viewscapes from within and from outside the park;
- protection of the diverse range of plant and animal communities within the park, with particular attention to threatened species, endangered populations and endangered ecological communities and their habitats;
- provision of a range of high quality visitor facilities and information to encourage awareness and appreciation of the park and maintain the regional significance of the park in providing nature-based recreation and tourism opportunities;
- management of wilderness areas in conjunction with the adjoining national parks and reserves to maintain and enhance opportunities for solitude and self-reliant recreation, while ensuring the maintenance of natural processes;
- management of recreation and tourism within the park to ensure sustainable use, to minimise the impacts on the park's natural and cultural features and to maintain opportunities for a diverse range of recreational experiences;
- encouragement of public awareness and appreciation of the park's outstanding natural and cultural features through a variety of improved information, interpretation and education programs, with particular emphasis on:

- the park's outstanding biodiversity and wilderness values and its ecological links with the adjoining conservation reserves;
- the park's Aboriginal heritage;
- the park's historical features associated with its unique place in the history of settlement of New South Wales and the development of the bushwalking and conservation movement in Australia, as well as its long history of tourism use;
- the importance of water quality protection and catchment management; and
- appropriate recreational use of the park and minimal impact use.

Under the objectives, the Plan of Management identifies a series of strategies before moving on to provide policies for Natural, Cultural and Use of the Park. Each of these three headings are further subdivided. Natural contains geology, landforms and soils, catchment management, native plants and animals, introduced plants and animals, fire management, wilderness and wild rivers. The cultural section is simply divided between Aboriginal and historic. Use of the park contains four subsections: education, interpretation and promotion, recreation in a natural setting, scientific research and management operations by NSW National Parks and Wildlife and other authorities with statutory responsibilities.

i Application

In examining the potential impacts of the project, not all the policies are relevant. Those of relevance are contained within the natural and cultural policy sections. The use of the park relates to visitor management, road maintenance and the like and is specifically aimed at providing guidance around how NSW National Parks and Wildlife manage the park and are therefore not relevant to the project, with one exception. 'Alien Uses, Leases and Licences' outlines the policies that relate to infrastructure development within the park.

The HIA will need to demonstrate that it complies with the relevant policies in the Plan of Management. These are outlined in Table 8.2 of Appendix A. As the Plan of Management does not directly link the policies to the objectives, Section 6.9 provides a broad statement of suitability, grounded in the objectives.

3 Historical Context

3.1 Geological history

The Blue Mountains are a sedimentary formation that have been subject to uplift at the edge of a passive continental margin. The sedimentary rock that is visible today (sandstone primarily) are the result of shallow-water sedimentation in a basin of earlier shales, siltstones and mudstones. The sand collected in the basin was formed into the Narrabeen and Hawkesbury sandstones through heat and pressure. The sandstone sequences formed are unusual in that the bedding structure is largely flat and there are only rare instances of tectonic activity resulting in faults or folding.

During the break-up of Gondwanaland, the sandstone was pushed up, fracturing vertically into joints and forming the Great Escarpment. During this process, volcanic activity pushed lava, now igneous rocks, up through the cracks in the sandstone and shale, flowing out over the surface and capping portions of the sandstone underneath the basalt. These basalt caps are visible at Mt Coricudgy, Nullo Mountain, Mount Banks, Mount Hay and Mount Yengo as examples (Washington & Wray, 2015, p. 21).

Water has subsequently dissected the geological column, resulting in the deep, steep sided valleys found throughout the Blue Mountains. This process has been accelerated by the geological formations themselves. While sandstone is relatively hard, the underlying shales and coal deposits are weaker. The movement of water through the shale and coal dissolves these formations from underneath the sandstone and resulting in the collapse of the overlying sandstone into the deep and steep sided valleys. Conversely, in the Jenolan Karst Conservation Reserve, the overlying sediment has not collapsed and has resulted in the formation of the largest, oldest and most complex of cave systems in Australia and perhaps the world (Washington & Wray, 2015, p. 26).

3.2 Ecological history

In tandem with the geological formations, the flora and fauna of the GBMWHA developed. Eucalypts, synonymous with the Blue Mountains region, are part of the Myrtaceae family. Eucalypts originated between 35 and 50 million years ago, not long after Australia-New Guinea separated from Gondwana; however, they remained a relatively minor component of the flora species present until about 20 million years ago. Increasing charcoal deposits in the fossil record is considered likely to indicate the role of fire in the rise of the Eucalypt genus in Australia, driven by drying of the continent(Hager and Benson 2010). The GBWHA now supports a diverse range of Eucalypt species with 98 species of *Eucalyptus*, *Angophora* and *Corymbia* recorded in the reserves that form the GBMWHA (Hager and Benson 2010), representing 13% of the global total (World Heritage Centre 2000). These species range from large forest trees to woodland species and small multi-stemmed mallee species (Hager and Benson 2010).

The GBWHA also supports a number of Gondwanan relicts, including the Wollemi Pine (*Wollemia nobilis*). This relictual species, whose ancestors span back to the Jurassic period and the time of the dinosuars, was discovered in 1994 (Benson, Doug (ed.). 2015). The species is thought to have declined over millions of years due to changes in climate, fire and ongoing dominance of other species. It now persists as four small patches at a single location in the Wollemi National Park, in microclimates associated with the highly dissected canyons synonymous with sections of the GBMWHA (Threatened Species Scientific Committee 2018; Benson 2015). This species illustrates Australia's ancient connection to Gondwana and the juxtaposition of our contemporary scleromorphic flora against our ancient Gondwanana past (World Heritage Centre 2000).

3.3 Ethnohistory

Regional studies indicate that Aboriginal people first visited and occupied the Sydney Basin between ~45-35,000 years ago (ka). Populations remained low in the late Pleistocene and were focussed along the banks of major river

systems, such as the Hawkesbury-Nepean River (Williams et al. 2017). After ~18 ka, there is an increasing archaeologically observed presence across the basin, including the initiation of a number of sites, such as Burrill Lake and Bass Point. Increasing numbers and diversity of sites in the last 10 ka, and especially the last 5 ka, suggests a significant population established across most environments of the basin; and it is during this time that the socio-economic-and traditional belief systems observed at contact likely developed (Williams et al. 2018).

Information about the socio-cultural structure of Aboriginal society prior to European contact largely comes from ethno-historical accounts made by colonial settlers. These accounts and observations were often made after significant social disruption due to disease and displacement. As a result, this information is often contentious, particularly in relation to language group boundaries. Therefore, it is likely that language group boundaries were far more diffuse and complex than the arbitrary demarcations drawn by colonial observers.

Over thirty separate Aboriginal groups populated the wider Sydney Basin and Blue Mountains area in 1788, each with their own country, practices, diets, dress, and dialects. We now know of these groups as 'clans' and each identified with broader cultural-linguistic groups known as 'tribes. The GBMWHA was shared by six distinct tribal groups who have traditional rights and custodial responsibilities for the area, including the Darug, Gundungurra, Wanaruah, Wiradjuri, Darkinjung and Tharawal groups. For example, the traditional lands of the Darug clan extended from around Parramatta through to the Blue Mountains and from the Hawkesbury River in the north to Appin in the south. The many rivers and geological features acted as natural demarcation of this area.

The subsistence practices of the local people were often described in historical records. According to David Collins in 1798, "the inland clans fished for mullet and eels in rich lagoons, but much of their food came from yams dug out from the riverbanks and worms known as 'cah-bro' extracted from river driftwood. [Local Aboriginal men] Colebee and Ballederry called these people the 'climbers of trees' after their practice of skilfully ascending gums in pursuit of animals, cutting footholds in the trunks with a stone axe" (Collins 1792)

The central location and ease of movement through this area, thanks to suitable topography, meant that Darug country was a frequented by travelling groups and used as a place of meeting. "Corroboree", the word for meeting and ceremony now associated with Aboriginal meetings in the modern era, stems from the Darug language group (Troy 1994).

Environmental conditions in this region throughout the last 10,000 years were relatively stable and evidence suggests that population densities pre contact were high (Williams 2013). In the late eighteenth century smallpox and other European diseases are likely to have wiped out a significant percentage of Aboriginal peoples (>50%). In May 1789, William Bradley recorded the 'dreadful havoc' that smallpox had wrought amongst Aboriginal communities: 'we did not see a Canoe or a Native the whole way coming up the Harbour & were told that scarce any had been seen lately except laying dead in & about their miserable habitations' (Bradley 1802, 162). Traditional burial practices broke down and clans merged as entire communities were taken by the virus (Hunter 1793). The impact of smallpox and other European diseases continued to ripple across the country, reducing communities. This is large scale decrease in population accounts for the discrepancies seen between the distribution of archaeological remains and the ethnographic accounts of Aboriginal populations.

The Cumberland Plain was a point of first contact between many Aboriginal peoples and the Europeans, as the same environmental factors that supported Aboriginal peoples also made for favourable lands for settlement and agriculture. The expedition by Governor Phillip to Prospect Hill in 1788 found the lands to the west more agreeable to farming than those of the Sydney Cove area and the township of Rose Hill (renamed Parramatta the following year) was established. Competition for resources quickly flared tensions, with violence escalating throughout the region. On 1 May 1801 Governor King issued a public order requiring that Aboriginal people around Parramatta, Prospect Hill and Georges River should be 'driven back from the settlers' habitations by firing at them'. King's edicts appear to have encouraged a shoot-on-sight attitude whenever any Aboriginal men, women or children appeared (Flynn 1997).

The conflicts and subsequent reprisals by both sides spread across the region and would eventuate in the Appin Massacre of 1816; these actions would come to be known as the Cumberland Plain war. The area was not only a

site of conflict, but also served as an important reconciliation place – even, as early as 1805, during a meeting organised by the reverend Samuel Marsden and the local tribes in a bid to cease the hostilities between settlers and Aboriginals.

Hostilities between certain groups remained and many Aboriginal people continued to live a semi-traditional lifestyle or moved into a European lifestyle. Local Darug clans lived at an encampment on the Mamre Farm estate at South Creek in Orchard Hills. The Reverend Marsden established the property in 1798 as a model farm for experimental crops and animal husbandry. The estate was over 1,300 acres and an Aboriginal camp was situated on the opposite side of the creek, a few hundred metres from the homestead:

> "….the South Creek Natives live on Charles Marsden's property 'Mamre', often staying at the junction of South Creek and Eastern Creek. In comparison with some other tribes, the South Creek Natives may be considered as half-domesticated, and they often assist in the agricultural operations of the settlers" (West 1835, quoted in (Martin 1986, 80).

The first parcels of land granted to an Aboriginal person were along Bells Creek between Richmond Road and Plumpton Ridge. Governor Macquarie granted this land to Colebee and Nurragingy in 1819. Colebee did not stay long, but Nurragingy lived on the land and it remained in the family until 1920 when it was resumed by the Aboriginal Protection Board (Kohen 1986, 27).

3.4 Exploration and early settlement

The first successful exploration party to reach the foothills of the Blue Mountains was led by Captain Watkin Tench in June of 1789. The party came across a river "as broad as the Thames at Putney and apparently of great depth, the current running very slowly in a northerly direction". The River was later named the Nepean River by Governor Arthur Phillip in honour of government official Evan Nepean (Penrith Australia online; Geographical Names Board n.d). The region was not settled immediately as the expansion of the Sydney colony was initially focused on the Hawkesbury River, which was found to be part of the same river system as the Nepean in 1792. Once settlement had reached its peak along the Hawksbury, the focus shifted the area around the Nepean River.

Governor King granted 1,000 acres (405 ha) of land along the Nepean each to Captain Daniel Woodriff in 1804 and Surgeon Thomas Jamison in 1805. Woodriff's naval duties sent him away from the colony in 1804 and his portion of land was later subdivided and leased, eventually becoming location of the Penrith township (Anonymous 1977, 2–3; Tilghman 1967). Jamison, similarly, did not return to his grant after travelling to England to testify in the Bligh imbroglio in 1809 (Anonymous 1977, 3). As such, Edward Cox is recognised as the first grantee of the Mulgoa area (Penrith City Council n.d.).

The Mulgoa Valley was surveyed by James Meehan in 1809 (Friends of Fernhill and Mulgoa Valley Inc n.d.). In January of 1810 interim Governor Colonel William Paterson granted 300 acres (121 ha) to the then four-year-old Edward Cox, son of official and road maker William Cox (Penrith City Local History n.d.). The grant was upheld when Governor Macquarie was installed into office later the same year. The Cox family was granted further land in the district throughout the early nineteenth century.

3.4.1 The eastern banks of the Nepean River

Land along the eastern banks of the Nepean River was settled during the first decades of the nineteenth century. The area became an agricultural and pastoral centre of the New South Wales colony. The study area falls within land granted to the Reverend Robert Cartwright, William Cox snr, and the Norton Family.

The Reverend Robert Cartwright was granted 600 acres (243 ha) south of the confluence of Mulgoa Creek and the Nepean River in 1812 (Anon. 1977, p.4). The south-western portion of the grant is within the curtilage of the study area. In the 1820s the property was acquired by physician and reformer John Jamison, who already held extensive land in the area (Walsh 1967). In 1825 Jamison constructed a grand Georgian style house east of Mulgoa Creek and named his holdings *Regentville* (Plate 3.1). Jamison had a great interest in the betterment of agriculture and grazing activities in the colony and established *Regentville* as a model farm, installing vineyards, irrigation systems, and, in 1842, a wool mill (Walsh 1967). The plans of the mill survive and show a "cottage" and mill approximately 600 m south-east of the confluence of Mulgoa Creek and the Nepean River, outside of the project area (Plate 3.2). After Jamison's death in 1844 the property became an asylum then hotel before it was destroyed by fire in 1869. The house, to the north of the study area, remained as ruins into the early twentieth century and the site is listed on the Penrith LEP (Penrith City Council 2004)

Plate 3.1 **Regentville, the seat of Sir John Jamison, 1839 (Source: National Library of Australia, PIC Drawer 2563 #S2044)**

Plate 3.2 **Regentville survey for Captain Russell, c.1840 (Source: National Library of Australia, MAP F 12). "cottage" and "mill" circled in red.**

William Cox was granted 850 acres (344 ha) of land south of Cartwright's *Regentville*. William Cox was a lieutenant in the New South Wales Corps but was suspended from office before resigning in 1809 after which time he was made magistrate for the Hawkesbury region (Hickson 1966). In 1814, Cox was commissioned as the overseer for the construction of the Great Western Road from Sydney to Bathurst (Hickson 1966).

In 1811, Cox oversaw the construction of a cottage for his sons and their tutor on Edward's grant, east of Mulgoa Road (Penrith City Local History online). Cox's Cottage still stands and is listed on the State Heritage Register (SHI 00171, Cox's Cottage). Cox and his sons were granted approximately 4,000 acres (1,619 ha) of land within the Mulgoa Valley between 1810 and 1821, and it is likely much of this land, including the 850 acres along the Nepean River, were used as pasture for Cox's imported Spanish Merinos (Anonymous 1977, 4; Nepean Times 1939). The Cox family also established a dam/weir on the Nepean River, although the location of this construction is not clear (Plate 3.3).

Plate 3.3 Cox's Dam on the Nepean River, c.1860 (Source: Penrith City Library)

The Norton's were granted three farms on the Nepean River, to the south of Cox's grant, in 1821 (Friends of Fernhill and Mulgoa Valley Inc n.d.)f. Youngest brother, solicitor James Norton, was granted 950 acres (384 ha), which became known as *Northend*. The older brother, retired naval lieutenant Nathaniel Norton, was granted 800 acres south of James' land, known as *Fairlight*, and their father, John, was granted 800 acres (324 ha) to the east of Nathaniel known as *Govers*.

The Norton's constructed a single storey family house on the north-eastern corner of Nathaniel's *Fairlight* in 1821 (Plate 3.4) (SHI Fairlight Homestead & Barn). It must be noted that James remained in Sydney until he and his father John moved to the Kanimbla Valley leaving Nathaniel in charge of the grants. Nathaniel remained living at *Fairlight* until his death in 1863 when the land was purchased by William Arthur Helleyer (SHI Fairlight Homestead & Barn). An advertisement for the sale of *Fairlight* describes the property as having:

> A commodious Family Residence, good stabling, barns, wine cellar, drafting yards, large well-watered grazing and cultivation paddocks, an orangery and orchard, an extensive full bearing vineyard (one of the finest in the colony), &c. (*The Sydney Morning Herald*, 1867, p.7).

Helleyer established further orchards and vineyards on the property. William Jarret purchased *Fairlight* in the late nineteenth century and developed the homestead. Jarret's *Fairlight* homestead is listed on the State Heritage Register (SHI 00262).

The banks of the Nepean and Warragamba Rivers became popular recreation spots in the late nineteenth century. Jarret allowed visitors travelling along the river by boat to access to the riverside land of *Fairlight*, even establishing a campground on his property near Norton's Basin (Nepean Times 1897, 8)). By the 1920s a flying fox had been established on a crossing around the confluence of the Warragamba and Nepean Rivers, connecting *Fairlight* and Wallacia (Plate 3.5) (Sydney Mail 1922, 13).

Table Rock Lookout (Plate 3.6), known locally as "The Rock", was also a popular destination for visitors. In 1932 the owners of *Fairlight* charged 1 shilling to access the road which led to the lookout (Nepean Times 1932, 1). In 1947 preparations were underway to establish a green belt along the Nepean River as part of the Blue Mountains National Park and the lookout was presented as an important feature in these plans(Nepean Times 1947, 2). Table Rock Lookout is listed on the Penrith LEP 2010 (I141). On the 5th Nov 1965, 655.6 ha of land on the eastern banks of the Nepean River was gazetted as Public Recreation reserve. This reserve was proclaimed as part of the Blue Mountains National Park on the 24th of August 1979.

Plate 3.4 **Detail. Sheet 2, Parish of Mulgoa, County of Cumberland map, 1971, Department of Lands, Sydney. *Fairlight* circled in red.**

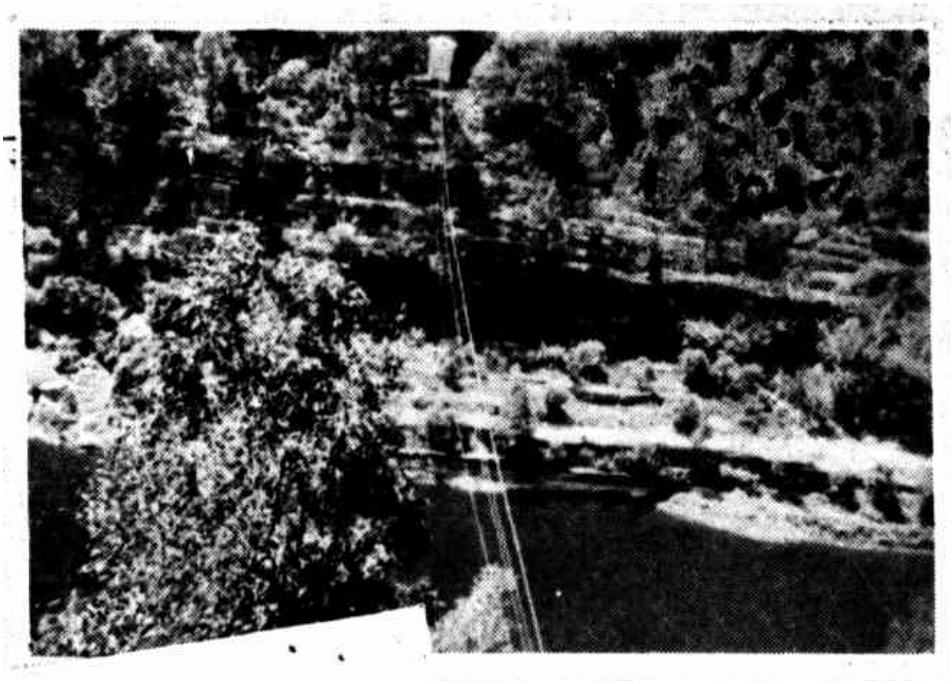


Plate 3.5 Flying fox over the Warragamba River (Source: *Sydney Mail*, 11 January 1922, p.13)

Plate 3.6 Table Rock Lookout, c.1930 (Penrith City Council)

3.4.2 The western banks of the Nepean River

While the settlement on the eastern side of the Nepean flourished from 1810, the river and terrain of the Blue Mountains foothills initially dissuaded settlers from crossing to the western side of the River. Settlers moved west from Penrith across the river from the late 1820s, but the area south of Glenbrook creek remained relatively inaccessible (Penrith City Council online). The 1898 Strathdon and 1893 Warragmaba (County Cook) parish maps

indicate the western banks of the Nepean were not settled over the nineteenth century. The banks of the Nepean River had been proclaimed a Public Recreation Reserve in 1897. The Strathdon parish map illustrates the area west of the river was gazetted as a mix of mining lease areas as well as timber and forest reserves.

The lone 40 acres (16.1 ha) of Lot 87, in the north-east of Forest Reserve 6260, were granted to Francis Forbes. Forbes was also granted 120 acres (49 ha) at Emu Plains in 1826 (Currey 1966). It seems unlikely the small, isolated property was included within this grant but may have been an economic investment, perhaps purchased for its timber. A "timber track" is marked leading to the Nepean River approximately 2km south of the property— in the approximate location of the Piscah Ridge fire trail— indicating timber getting occurred in the region. In 1920, a 28 acres (11 ha) lot (Lot 245) was established wrapping the southern and eastern boundary of Lot 87. Lot 245 was granted to Albert Edward Bennett who was also the owner of Lot 87 in the 1920s. Bennett farmed strawberries and other fruits on the property and describes the surrounding area as "partly cleared of timber. It is not good farming land. There is the ordinary coarse wire grass on it" (Nepean Times 1925, 8). Lots 87 and 245 are currently the Euroka clearing campground.

The area west of the Nepean River was classified as part of the Blue Mountains National Park Reserve on the 7th of April 1916.

3.5 Blue Mountains National Park

As indicated above, the Blue Mountains became a place of recreation and a health retreat. From the 19th century, attitudes began to change, with a "growing appreciation of natural beauty" of the Blue Mountains (McGrath 2015, p.124). Increased visitation was identified as placing development pressure on the area, even in the 1880s, with petitions to establish reserves to protect areas of particular scenic value – Katoomba Falls being the first (McGrath 2015, p.124).

Bushwalking as a means of appreciating the area increased in popularity, building on the first walking tracks laid down in the 1870s as part of the health retreat movement. Myles Dunphy, among others, was central to the growing understanding of the movement to protect the natural environment. Dunphy's first bushwalk in the Blue Mountains in 1912 lead to a life-long passion for the conservation of the area. In 1932, Dunphy developed a proposal to protect a large portion of the Blue Mountains. Individual campaigns against separate threats were undertaken by bushwalkers and conservationists, among whom Dunphy is a notable figure. These campaigns resulted in the creation of reserves. The creation of the Blue Mountains National Park is summarised by McGrath thus:

> "The Greater Blue Mountains National Park itself began with the gazettal of a reserve in the Kanangra-Boyd area in 1937, followed by the establishment of the Blue Mountains National Park in 1959 and Kanangra-Boyd National Park in 1969. Action by conservation groups in the 1960s to the 1990s led to the protection of other parts of the park scheme (NSW National Parks & Wildlife 1998 p. 176) … In 1979 a much expanded area to the north, centred on the Colo River, was included in Wollemi National Park. Nattai National Park was established in 1991 and Gardens of Stone National Park in 1994, both after long struggles by conservation groups against competing interests. By 1998 the area in the six parks related to the 1932 scheme had almost doubled the size of the original proposal (NSW National Parks & Wildlife 1998, p. 177)."
>
> (McGrath 2015, p.125)

The culmination of these efforts came in 2000 with the inscription of the six parks (and the Jenolan Caves Reserve) on the World Heritage List.

4 Significance Assessments and Definition of Attributes

The World Heritage documentation nominated the GBMWHA for its natural and Indigenous heritage values. The World Heritage Committee decided there was insufficient evidence for the world heritage Indigenous values and the area was inscribed for its natural values alone. The World Heritage Committee accepted that the natural values of the GBMWHA met two of the ten heritage criteria, as laid out in Table 4.1.

Key to successfully addressing impacts to significance is the identification of the attributes that define the identified values. Attributes provide the physical, or tangible, characteristics and elements against which it is possible to measure an impact. Listings under the EPBC Act commonly already have identified attributes, but it is noted this is not the case for the GBMWHA. The SEARs referred to these as the 'characteristics'; however, within a listing they are traditionally referred to as attributes. Alterations to attributes arising from a project are therefore defined as an impact. EMM have used the text from the documentation to create attributes.

When the GBMWHA was added to the National Heritage List in 2007, the official values were not proscribed, with the text "This place is taken to meet this National Heritage criterion in accordance with subitem 1A(3) of Schedule 3 of the *Environment and Heritage Legislation Amendment Act (No.1) 2003*, as the World Heritage Committee has determined that this place meets World Heritage criteria (ix) and (x)" appearing against criteria A (historical processes), B (rarity), C (research) and D (principal characteristics). It is therefore assumed that the assessment against the World Heritage criteria ix and x can be divided between the four EPBC Act criteria.

Further research has been undertaken over the 20 years since the original listing has led to the identification of additional values, which have been nominated for inclusion in the listing. These values are identified in:

- *Blue Mountains National Park Plan of Management* (NSW Parks and Wildlife Service 2001);
- *Values for a new generation: Greater Blue Mountains World Heritage Area* (Benson (ed.), 2015); and
- The Greater Blue Mountains Area – Additional Values, nomination held in the Australian Heritage Database (Nominators, n.d.).

The values identified in these three documents are collated, together with the World Heritage values, in Table 4.2. Attributes are assigned to the values to allow for the assessment to easily determine impacts.

Table 4.1 World Heritage Values

Criterion		Assessment	Attributes
		World Heritage Values	
(ix)	to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	The Greater Blue Mountains include outstanding and representative examples in a relatively small area of the evolution and adaptation of the genus *Eucalyptus* and eucalypt-dominated vegetation on the Australian continent. The site contains a wide and balanced representation of eucalypt habitats including wet and dry sclerophyll forests and mallee heathlands, as well as localised swamps, wetlands and grassland. It is a centre of diversification for the Australian scleromorphic flora, including significant aspects of eucalypt evolution and radiation. Representative examples of the dynamic processes in its eucalypt-dominated ecosystems cover the full range of interactions between eucalypts, understorey, fauna, environment and fire. The site includes primitive species of outstanding significance to the evolution of the earth's plant life, such as the highly restricted Wollemi pine (*Wollemia nobilis*) and the Blue Mountains pine (*Pherosphaera fitzgeraldii*). These are examples of ancient, relict species with Gondwanan affinities that have survived past climatic changes and demonstrate the highly unusual juxtaposition of Gondwanan taxa with the diverse scleromorphic flora.	• Eucalyptus and eucalypt-dominant vegetation, including diverse range of species. • Wet and dry sclerophyll forest, mallee heathlands. • Localised swamp, wetland and grassland. • Primitive relictual species: Wollemi Pine and Blue Mountains Pine (*Pherosphaera fitzgeraldii*).
(x)	to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	The site includes an outstanding diversity of habitats and plant communities that support its globally significant species and ecosystem diversity (152 plant families, 484 genera and c. 1,500 species). A significant proportion of the Australian continent's biodiversity, especially its scleromorphic flora, occur in the area. Plant families represented by exceptionally high levels of species diversity here include Myrtaceae (150 species), Fabaceae (149 species), and Proteaeceae (77 species). Eucalypts (*Eucalyptus, Angophora* and *Corymbia*, all in the family Myrtaceae) which dominate the Australian continent are well represented by more than 90 species (13% of the global total). The genus *Acacia* (in the family Fabaceae) is represented by 64 species. The site includes primitive and relictual species with Gondwanan affinities (*Wollemia, Pherosphaera, Lomatia, Dracophyllum, Acrophyllum, Podocarpus* and *Atkinsonia*) and supports many plants of conservation significance including 114 endemic species and 177threatened species. The diverse plant communities and habitats support more than 400 vertebrate taxa (of which 40 are threatened), comprising some 52 mammal, 63 reptile, over 30 frog and about one third (265 species) of Australia's bird species. Charismatic vertebrates such as the platypus and echidna occur in the area. Although invertebrates are still poorly known, the area supports an estimated 120 butterfly and 4,000 moth species, and a rich cave invertebrate fauna (67 taxa).	• Diversity: Myrtaceae (150 species), Fabaceae (149 species), and Proteaeceae (77 species). • Diversity: vertebrae taxa, including platypus and echidna; butterfly and moth species; cave invertebrates.

Source: UNESCO World Heritage Centre: https://whc.unesco.org/en/list/917

Table 4.2 Other Heritage Values

World Heritage Committee	Plan of Management	Values for a New Generation	The Greater Blue Mountains Area – Additional Values	Attributes
Criterion A – Historical Process: the place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history				
The Greater Blue Mountains include outstanding and representative examples in a relatively small area of the evolution and adaptation of the genus *Eucalyptus* and eucalypt-dominated vegetation on the Australian continent (World Heritage Centre 2000).	The GBMWHA includes numerous places of historic significance, some dating back to the earliest years of European settlement and exploration in Australia. Many locations within the GBMWHA are recorded in the journals of the earliest explorers and surveyors. Recorded sites demonstrating post-1788 human use are associated with [a range of issues] (NSW National Parks and Wildlife Service, 2009:14).	The Greater Blue Mountains is a place of outstanding importance in the Aboriginal cultural history of Australia, which maintains an ancient and continuing connection between people and Country, reflected in ancient art, historic associations and contemporary traditions which demonstrate a resilient and adaptive culture (McKay, in Benson, 2015:93). The Greater Blue Mountains are the best example in the World of a sedimentary upland, deeply dissected by rivers over tens of millions of years, and of the ongoing processes involved in sculpting these magnificent landforms'. The outcropping geology provides an outstanding illustration of the complex and long geological history of the east Australian coastal margin and highlights marine, terrestrial, volcanic and tectonic environments and processes through time. The geology also hosts exemplary erosional landforms/ elements including karst, caves, cliff lines, slot canyons, bottleneck valleys, pagodas and other sandstone landforms of national and international significance (Washington & Wray in Benson, 2015:44)	The nominator claims there has been a revolution in natural area perception noted mainly across the nineteenth century and consolidated in the twentieth century. This change in perception is located in western societies across the world. This change is described as one where people treated the land largely as a source of materials production, regarding the 'wilderness' as an unattractive hostile environment. Then in the nineteenth century a notable change of attitude towards 'wild' areas occurred. These 'wild areas' became invested with positive values for recreation, inspiration and science. The history associated with this change is diverse including perspectives from social history, geography, landscape studies, science, literature, art, politics, nature writing and conservation history. The history of Australia's environment movement is considered to be a useful way to locate the history associated with the nominator's claim. Additional topic history on the bushwalking movement, recreation movement and the National Parks movement is also included because of its specific relevance.	• Eucalyptus species. EMM note this is very broad. Further refinement of this attribute is required. • Evidence of post-1788 human uses. • Dissecting rivers as sculpting forces. • Geological features that demonstrate long/complex geological history. • Erosional landforms. • Indigenous sites that demonstrate an ancient and continuing connection. • Conservation movement and appreciation of the GBMWHA through bushwalking, tourism etc.
Criterion B -the place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history				
The site includes primitive species of outstanding significance to the evolution of the earth's plant life, such as the highly restricted Wollemi pine (*Wollemia nobilis*) and the Blue Mountains pine (*Pherosphaera fitzgeraldii*). These are examples of ancient, relict species with Gondwanan affinities that have survived past climatic changes and demonstrate the highly unusual juxtaposition of Gondwanan taxa with the diverse scleromorphic flora (World Heritage Centre 2000).	The GBMWHA protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas. They also make an important contribution to the maintenance of water quality and natural flow regimes in the Hawkesbury-Nepean and Goulburn- Hunter river systems. The GBMWHA also forms part of the upper catchment of the Lachlan and Macquarie Rivers (NSW National Parks and Wildlife Service, 2009:12).	The Greater Blue Mountains includes a rare and outstanding collection of painted and engraved Aboriginal rock art sites and places, which relate to well-known Aboriginal stories, have strong connections with Aboriginal language groups, and which provide a tangible basis for the link between Aboriginal people and Country today (McKay, in Benson, 2015:93). In many cases they [geodiversity features] are the best, **or only examples** in Australia of these features. In several cases they are the likely best in the world (Benson in Benson, 2015:43).	None explicitly identified in the Australian Heritage Database nomination	• Primitive species: Wollemi pine (*Wollemia nobilis*) and Blue Mountains pine (*Pherosphaera fitzgeraldii*). • Water quality and flow regimes, as they relate to the Hawkesbury-Nepean and Goulburn-Hunter Rivers particularly. • Painted and engraved Indigenous rock art.
Criterion C - the place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history				
None identified	Recorded sites of archaeological significance include a widespread sample of the Sydney Region's distinctive Aboriginal rock art, which incorporates two synchronous forms (i.e. pigment and engraved forms) on a scale unique in Australia. A number of scientifically important rock art sites with an unusually large number of individual motifs have been recorded within the GBMWHA and continue to be revealed, such as the Eagles Reach site (NSW National Parks and Wildlife Service, 2009:13). Given the wilderness nature of the area and the limited archaeological surveys to date, there is enormous potential for uncovering further significant sites which will contribute to a better understanding of Aboriginal use of the area over many millennia. The area is important to contemporary Aboriginal groups. Formal co-management arrangements with those groups is	The Greater Blue Mountains has outstanding research value in a national context arising from the landscape itself, which includes extensive undisturbed areas with great potential to reveal highly-significant information and more important sites, as research and exploration continue, as well as from an extraordinary suite of known Aboriginal occupation sites, rock-shelter paintings, rock-platform engravings and other Aboriginal places. In addition to their physical attributes, these places have outstanding research potential for the study of social connection between Aboriginal people and Country, at both the site/community specific level and across language groups and the landscape itself (McKay, in Benson, 2015:93).	None explicitly identified in the Australian Heritage Database nomination	• Indigenous archaeological sites. • Research into biodiversity or geodiversity. • Indigenous connections to land.

World Heritage Committee	Plan of Management	Values for a New Generation	The Greater Blue Mountains Area – Additional Values	Attributes
	underway (NSW National Parks and Wildlife Service, 2009:13).			
Criterion D - the place has significant heritage value because of the place's importance in demonstrating the principal characteristics of: (i) a class of Australia's natural or cultural places; or (ii) a class of Australia's natural or cultural environments;				
The site contains a wide and balanced representation of eucalypt habitats including wet and dry sclerophyll forests and mallee heathlands, as well as localised swamps, wetlands and grassland. It is a centre of diversification for the Australian scleromorphic flora, including significant aspects of eucalypt evolution and radiation. Representative examples of the dynamic processes in its eucalypt-dominated ecosystems cover the full range of interactions between eucalypts, understorey, fauna, environment and fire (World Heritage Centre 2000). The site includes an outstanding diversity of habitats and plant communities that support its globally significant species and ecosystem diversity (152 plant families, 484 genera and c. 1,500 species). A significant proportion of the Australian continent's biodiversity, especially its scleromorphic flora, occur in the area. Plant families represented by exceptionally high levels of species diversity here include Myrtaceae (150 species), Fabaceae (149 species), and Proteaeceae (77 species). Eucalypts (*Eucalyptus, Angophora* and *Corymbia*, all in the family Myrtaceae) which dominate the Australian continent are well represented by more than 90 species (13% of the global total). The genus *Acacia* (in the family Fabaceae) is represented by 64 species. The site includes primitive and relictual species with Gondwanan affinities (*Wollemia, Pherosphaera, Lomatia, Dracophyllum, Acrophyllum, Podocarpus* and *Atkinsonia*) and supports many plants of conservation significance including 114 endemic species and 177 threatened species (World Heritage Centre 2000). The diverse plant communities and habitats support more than 400 vertebrate taxa (of which 40 are threatened), comprising some 52 mammal, 63 reptile, over 30 frog and about one third (265 species) of Australia's bird species. Charismatic vertebrates such as the platypus and echidna occur in the area. Although invertebrates are still poorly known, the area supports an estimated 120 butterfly and 4,000 moth species, and a rich cave invertebrate fauna (67 taxa) (World Heritage Centre 2000).	In addition to its outstanding diversity of plant and animal species and communities, the area also has a diversity of landscapes and geological features including: • extensive dissected sandstone plateaux representing ongoing geological processes; • the most extensive sandstone canyon system in eastern Australia; • a significant geological boundary between the Lachlan Fold Belt and the Sydney Basin as evidenced by the diversity of geology and topography in Kanangra-Boyd National Park and the Jenolan Karst Conservation Reserve; • karst landscapes with several cave systems of importance for their antiquity, scientific, and recreational values (e.g. Jenolan Caves being the world's oldest open cave system); • a number of palaeontological (i.e. fossil) sites including evidence of the once widespread Gondwanan flora; • prominent basalt-capped peaks and other significant features associated with periods of volcanic activity; • quaternary alluvial deposits which support significant heath and woodland vegetation with an unusual mix of species and plant communities; and • a series of 'perched' perennial freshwater lakes (in Thirlmere Lakes National Park) of considerable geomorphological and biological significance because of their great age and geomorphic stability.	The Greater Blue Mountains World Heritage Area contains extensive and significant geodiversity of high geoheritage and geoconservation significance. It is an excellent example of the development of geological and geomorphological systems over time in Australia and contains features of international and national significance that compare extremely highly with other areas already recognised for national geodiversity significance (Benson in Benson, 2015:43). In many cases they are the best, or only examples in Australia of these features. In several cases they are the likely best in the world. Areas adjacent to the Blue Mountains WHA contain a further site of international significance (Wombeyan Caves), while Newnes Plateau (Newnes, Ben Bullen and Wolgan State Forests) contain nationally significant highland swamps, Aeolian dunes and smooth pagodas (as well as internationally significant platy pagodas not in the Greater Blue Mountains WHA) (Benson in Benson, 2015:43).	None explicitly identified in the Australian Heritage Database nomination	• Eucalyptus and eucalypt-dominant vegetation, including diverse range of species. • Wet and dry sclerophyll forest, mallee heathlands. • Localised swamp, wetland and grassland. • Diversity: Myrtaceae (150 species), Fabaceae (149 species), and Proteaeceae (77 species). • Diversity: vertebrae taxa, including platypus and echidna; butterfly and moth species; cave invertebrates. • Wombeyan Caves. • Newnes Plateau. • Smooth pagodas. • Geological features that demonstrate long/complex geological history. • Erosional landforms.
Criterion E - the place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.				
None identified	The GBMWHA includes some of the most dramatic scenery in Australia, with its best known landscapes dominated by striking vertical cliffs and waterfalls. With many vantage points on ridges and escarpments, the GBMWHA offers outstanding vistas, from uninterrupted views of forested wilderness covered by natural vegetation to the contrasts of steep forested slopes surrounding cleared valleys. The Jenolan Karst Conservation Reserve provides a different but still dramatic scenic landscape, and the outstanding	The place is significant under this criterion, but no values are explicitly stated.	None explicitly identified in the Australian Heritage Database nomination	• views and vistas, particularly uninterrupted views. • Jenolan Caves. • Rock formations, particularly in Wollemi and Garden of Stone National Parks.

World Heritage Committee	Plan of Management	Values for a New Generation	The Greater Blue Mountains Area – Additional Values	Attributes
	aesthetic values associated with its extensive caves have attracted a large number of visitors since the early days of tourist activity. In more recent times, the spectacular complex of narrow sandstone canyons and pagoda rock formations found largely in Wollemi and Gardens of Stone National Parks have become more widely known and appreciated (NSW National Parks and Wildlife Service, 2009:17)			
Criterion F - the place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period				
None identified	The place is significant under this criterion, but no values are explicitly stated.	The Aboriginal rock art of Greater Blue Mountains is highly- valued by the six language groups that speak for Country, as an outstanding demonstration of Indigenous creative achievement, and is comparable with other outstanding rock art sites in Australia (McKay, in Benson, 2015:93).	None explicitly identified in the Australian Heritage Database nomination	• Indigenous rock art.
Criterion G - the place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons				
None identified	Known sites provide evidence of at least 14,000 (and possibly 22,000) years of Aboriginal occupation of the area, but traditional beliefs connect Aboriginal people with the landscape back as far as the creation stories. Several prominent landscape features with spiritual significance are linked with creation stories, for example Mt Yengo in Yengo National Park and the Coxs and Wollondilly River valleys (Blue Mountains National Park) (NSW National Parks and Wildlife Service, 2009:13). As well as recorded archaeological and historic sites, the GBMWHA has a long history of human attachment and care for the landscape, evidenced by the early reservation of Crown lands for purposes such as public recreation and catchment protection, early conservation campaigns associated largely with the bushwalking movement and modern community action for protection and World Heritage listing (NSW National Parks and Wildlife Service, 2009:14).	The Greater Blue Mountains has strong, continuing, and special associations with the Darug, Darkinjung, Gundungurra, Dharawal, Wiradjuri and Wanaruah language groups. The Greater Blue Mountains includes diverse tangible and intangible evidence of past and continuing Aboriginal occupation and custodianship of this vast landscape, which juxtaposes with the highly-developed European landscape of the Sydney metropolis that it surrounds (McKay, in Benson, 2015:93-94).	Currently the GBMWHA is important to the lives of six Indigenous groups, the Darug, the Gundungurra, the Wanaruah, the Wiradjuri, the Darkinjung and the Tharawal. The members of these groups are rediscovering and reconnecting to their sites and stories through their involvement in community projects (GBMWHI and Griffith University 2007:5; Mackay 2014:6). The six groups also play an active role in the co-management of Indigenous heritage of the area with the NSW National Parks and Wildlife Service (Mackay 2014:4). Places such as the Gully, the Three Sisters, Blackfellows Hand Cave, Kings Tableland rock platform and Mount Yengo are seen as holding great significance and are gazetted as Aboriginal Places under the NSW National Parks and Wildlife Act 1974 (Mackay 2014:4-6). In addition engravings and rock paintings have a particular significance as being among the most tangible cultural expressions of the original inhabitants of the Blue Mountains (Government of Australia 1999:48; GBMWHI and Griffith University 2008:32).	• Connections for Indigenous peoples, as demonstrated through: – Indigenous archaeological sites. – Indigenous rock art sites. – Indigenous sacred sites. • Connections for bushwalkers, conservationists. – these values are intangible, but would be impacted by changes to significant elements that are touchstones for these groups.
Criterion H - the place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history				
None identified	None identified	None identified	The GBMWHA is associated with Myles Dunphy in the Greater Blue Mountains Area – Additional Values, however, it is not clear whether this value meets the threshold for National Listing.	None identified – this would be an intangible value, if demonstrated.
Criterion I - the place has significant heritage value because of the place's importance as part of Indigenous tradition				
None identified	Known sites provide evidence of at least 14,000 (and possibly 22,000) years of Aboriginal occupation of the area, but traditional beliefs connect Aboriginal people with the landscape back as far as the creation stories. Several prominent landscape features with spiritual significance are linked with creation stories, for example Mt Yengo in Yengo National Park and the Coxs and Wollondilly River valleys (Blue Mountains National Park).	The Greater Blue Mountains has strong, continuing, and special associations with the Darug, Darkinjung, Gundungurra, Dharawal, Wiradjuri and Wanaruah language groups. The Greater Blue Mountains includes diverse tangible and intangible evidence of past and continuing Aboriginal occupation and custodianship of this vast landscape, which juxtaposes with the highly-developed European landscape of the Sydney metropolis that it surrounds (McKay, in Benson, 2015:93-94).	Currently the GBMWHA is important to the lives of six Indigenous groups, the Darug, the Gundungurra, the Wanaruah, the Wiradjuri, the Darkinjung and the Tharawal. The members of these groups are rediscovering and reconnecting to their sites and stories through their involvement in community projects (GBMWHI and Griffith University 2007:5; Mackay 2014:6). The six groups also play an active role in the co-management of Indigenous heritage of the area with the NSW National Parks and Wildlife Service (Mackay 2014:4). Places such as the Gully, the Three Sisters, Blackfellows Hand Cave, Kings Tableland rock	• Indigenous archaeological sites. • Indigenous rock art sites. • Indigenous sacred sites.

World Heritage Committee	Plan of Management	Values for a New Generation	The Greater Blue Mountains Area – Additional Values	Attributes
			platform and Mount Yengo are seen as holding great significance and are gazetted as Aboriginal Places under the NSW National Parks and Wildlife Act 1974 (Mackay 2014:4-6). In addition engravings and rock paintings have a particular significance as being among the most tangible cultural expressions of the original inhabitants of the Blue Mountains (Government of Australia 1999:48; GBMWHI and Griffith University 2008:32).	

While consideration of the World and National heritage values does not extend to local heritage, Section 5.9 identifies that the locally listed Table Rock Lookout contributed to the historical identified themes of national significance, being bushwalking and conservation and tourism. As outlined in Section 3.4, the study area was not subject to development, although it was on the periphery of the Fairlight Estate and the owners initially charged entry for tourists to admire the view. The Lookout was later donated to people of Mulgoa before becoming part of the Blue Mountains National Park. The historical connection with the Fairlight Estate, as well as the tourist and aesthetic significance, are recognised through the inclusion of Table Rock Lookout on the Penrith LEP. The significance assessment and statement of significance for Table Rock Lookout are provided in Table 4.3 (Penrith City Council 2005). The significance has been assessed against the NSW heritage criteria, rather than the Commonwealth criteria.

Table 4.3 Table Rock Lookout assessment of significance

Criterion	Assessment
a) Historical	The Lookout is part of the Nepean Gorge and is significance for once being a part of the Fairlight Estate. 'The Rock' and the adjoining Nepean River Gorge, were reserved as a gift to the people of Mulgoa in the early 1900's. The lookout is significant as it shares Mulgoa's historic past and also has evidence of Aboriginal occupation pre-dating European settlement by several thousand years.
b) Associative	No significance identified in the listing.
c) Aesthetic	The Lookout has high aesthetic significance as it is associated with the Nepean Gorge area which has a diversity of plants and animals and provides spectacular views over the Nepean River.
d) Social	No significance identified in the listing.
e) Research	No significance identified in the listing.
f) Rarity	No significance identified in the listing.
g) Representativeness	No significance identified in the listing.

> Statement of Significance: The Lookout is part of the Nepean Gorge and is significance for once being a part of the Fairlight Estate. The lookout is significant as it shares Mulgoa's historic past and also has evidence of Aboriginal occupation pre-dating European settlement by several thousand years. The Lookout has high aesthetic significance as it is associated with the Nepean Gorge area which has a diversity of plants and animals and provides spectacular views over the Nepean River.
>
> (Penrith City Council 2005)

5 Existing Environment

5.1 Introduction

The GBMWHA covers over 10,000 square kilometres, with variation across the extent of the area across a range of environmental and cultural factors. While it is evident that the project would not affect the whole of the GBMWHA, it is necessary to quantify the nature and extent of the indirect impacts. To this end, the following descriptions outline a generalisation of the environment across the GBMWHA, with a targeted description of the study area, which has been defined as a 300 m buffer from the central line of the Nepean River within the GBMWHA.

Table 5.1 and Table 5.2 summarise the potential interactions between the World and National heritage values and the project and identify where further information on the existing environment and impacts to identified values/attributes can be found. This assessment provides guidance as to where to concentrate in the following descriptions and impact assessment.

Table 5.1 Potential interactions between the World Heritage Values and the project

Criterion	Attribute	Potential interaction with project?	Evidence
(xi) to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	Eucalyptus and eucalypt-dominant vegetation, including diverse range of species.	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.3.2
	Wet and dry sclerophyll forest, mallee heathlands.	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.3.2
	Localised swamp, wetland and grassland.	No	Study area is within a gorge and does not contain swamp, wetland or grassland.
	Primitive relictual species: Wollemi pine (*Wollemia nobilis*) and Blue Mountains pine (*Pherosphaera fitzgeraldii*).	No	The study area does not contain habitat suitable for these species. No nearby records.
(xii) to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	Diversity: Myrtaceae (150 species), Fabaceae (149 species), and Proteaeceae (77 species).	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.3.2
	Diversity: vertebrae taxa, including platypus and echidna; butterfly and moth species; cave invertebrates.	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.3.2

Source: UNESCO World Heritage Centre: https://whc.unesco.org/en/list/917

Table 5.2 Potential interactions between the National Heritage Values and the project

Criterion	Attribute	Potential interaction with project?	Evidence
Criterion A – Historical Process: the place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history	Eucalyptus species	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.3.2
	Evidence of post-1788 human uses	Yes	Existing environment: Section 5.9 Potential impacts: Section: 6.7.2
	Dissecting rivers as sculpting forces	Yes	Existing environment: Section 5.2 Potential impacts: Section 6.2 and 6.3

Criterion	Attribute	Potential interaction with project?	Evidence
	Geological features that demonstrate long/complex geological history	Yes	Existing environment: Section 5.2 Potential impacts: Section 6.2 and 6.3
	Erosional landforms	Yes	Existing environment: Section 5.2 Potential impacts: Section 6.2 and 6.3
	Indigenous sites that demonstrate an ancient and continuing connection	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section 6.6 and 6.7
	Conservation movement and appreciation of the GBMWHA through bushwalking, tourism etc	Yes	Existing environment: Section 5.9 Potential impacts: Section 6.7.2
Criterion B -the place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history	Primitive species: Wollemi pine (*Wollemia nobilis*) and Blue Mountains pine (*Pherosphaera fitzgeraldii*).	No	The study area does not provide habitat for these species. No nearby records.
	Water quality and flow regimes, as they relate to the Hawkesbury-Nepean and Goulburn-Hunter Rivers particularly.	Yes	Existing environment: Section 6.3 Potential impacts: Section: 6.1
	Painted and engraved Indigenous rock art.	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section 6.7
Criterion C - the place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history	Indigenous archaeological sites.	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section 6.7
	Research into biodiversity or geodiversity.	Yes	Existing environment: Section 5.3 and 5.5 Potential impacts: Section 6.2 and 6.3
	Indigenous connections to land.	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section 6.6 and 6.7
Criterion D - the place has significant heritage value because of the place's importance in demonstrating the principal characteristics of:	Eucalyptus and eucalypt-dominant vegetation, including diverse range of species.	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.4
	Wet and dry sclerophyll forest, mallee heathlands.	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.4

Criterion	Attribute	Potential interaction with project?	Evidence
(i) a class of Australia's natural or cultural places; or (ii)a class of Australia's natural or cultural environments.	Localised swamp, wetland and grassland.	No	Study area is within a gorge and does not contain swamp, wetland or grassland.
	Diversity: Myrtaceae (150 species), Fabaceae (149 species), and Proteaeceae (77 species).	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.4
	Diversity: vertebrae taxa, including platypus and echidna; butterfly and moth species; cave invertebrates.	Yes	Existing environment: Section 5.4 Potential impacts: Section 6.4
	Jenolan and Wombeyan Caves.	No	The Jenolan and Wombeyan caves are physically distant from the study area with no potential interaction.
	Newnes Plateau	No	The study area is not within and does not interact with the Newnes Plateau.
	Smooth pagodas	No	The smooth pagoda are physically distant from the study area, being within the Garden of Stone National Park, with no potential interaction.
	Geological features that demonstrate long/complex geological history.	Yes	Existing environment: Section 5.2 Potential impacts: Section: 6.2
	Erosional landforms (smooth pagodas, Three Sisters and similar formations)	No	The smooth pagodas and the Three Sisters are physically distant from the study area, being within the Garden of Stone National Park or to the north of the study area, with no potential interaction.
Criterion E - the place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.	Views and vistas, particularly uninterrupted views	Yes	Existing environment: Section 5.2 Potential impacts: Section: 6.1
	Jenolan Caves	No	The Jenolan caves are physically distant from the study area with no potential interaction.
	Rock formations, particularly in Wollemi and Garden of Stone National Parks.	No	The study area does not contain significant rock formations and the Wollemi and Garden of Stone National Parks are located to the west of the study area.
Criterion F - the place has significant heritage value because of the place's importance in demonstrating a high	Indigenous rock art.	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section: Section 6.6 and 6.7

Criterion	Attribute	Potential interaction with project?	Evidence
degree of creative or technical achievement at a particular period			
Criterion G - the place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	Connections for Indigenous peoples, as demonstrated through: Indigenous archaeological sites. Indigenous rock art sites. Indigenous sacred sites.	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section: Section 6.6 and 6.7
	Connections for bushwalkers, conservationists. these values are intangible, but would be impacted by changes to significant elements that are touchstones for these groups.	Yes	Existing environment: Section 5.9 Potential impacts: Section: 6.7.2
Criterion H - the place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history	This would be an intangible value related to the connection between Myles Dunphy (refer Section 3.5) and the establishment of the Blue Mountains National Park. As an intangible value, no physical attributes have been identified.	No	The study are does not interact with places known to be particularly significant in the life or works of Myles Dunphy.
Criterion I - the place has significant heritage value because of the place's importance as part of Indigenous tradition	Indigenous archaeological sites. Indigenous rock art sites. Indigenous sacred sites.	Yes	Existing environment: Section 5.7 and 5.8 Potential impacts: Section: 6.6 and 6.7

5.2 Landscape and visual setting

While not identified in the World or National Heritage Listings, the GBMWHA undoubtably holds scenic and aesthetic significance. Important scenic features and significant geological, geomorphic and/or pedological features identified within the *Blue Mountains National Park Plan of Management* (NSW Parks and Wildlife Service 2001, 15–16) include:

- the Jamison Valley cliffs, including the Three Sisters;
- Grose Valley cliffs, particularly Mount Banks (see section 4.3.8 Adventure Recreation for specific provisions);
- Canyons and pagodas of the Grose, Wollangambe and Bungleboori catchments;
- igneous features of the Yerranderie area;
- colluvial deposits associated with the Kurrajong fault including Portal Waterhole, Blue Gum Swamp and Burralow Creek;
- karst areas;
- diatremes;
- basalt caps;
- Wianamatta Shale areas;
- hanging swamps and valley swamps;
- talus lakes of the Grose Valley and elsewhere;
- palaeontological sites, including at Mount Hay, Narrow Neck and Broken Rock Range.

5.2.1 Study Area Interaction

The study area consists of dense eucalypt forest (refer to Section 5.4) covering the sides of a steep gorge that contains the Nepean River channel. Most of the study area is inaccessible; however, there are a small number of marked and formed walking trails on the eastern bank. There is no public pedestrian or vehicular access to the western bank of the Nepean River within the study area. Table Rock Lookout, on the eastern bank of the Nepean River, affords views along the Nepean River and west into the GBMWHA. Although not identified in the Plan of Management, Table Rock is identified in the Penrith LEP for (among other things) it's high aesthetic significance as it is associated with the Nepean Gorge area that provides spectacular views over the Nepean River.

The release structure proposed between Warragamba Dam and Warragamba Weir would be located on the eastern bank of the Warragamba River, approximately 1 km from the GBMWHA boundary. The western bank of the Warragamba River, in the vicinity of the release structure, is covered in dense eucalypt forest. W5 Erskine Range Trail, W5h Firetrail and W5g Firetrail (inset of Figure 1.2) service the top of the Warragamba River gorge from the south, where the trails connect with Crest Road at the dam wall. These trails do not meet the edge of the gorge and are not publicly accessible. Furthermore, they are outside of the GBMWHA. The eastern bank is highly modified, consisting of random rock rubble and containing the Warragamba Dam spillway, access road and associated infrastructure. There are no views between the GBMWHA and the proposed site of the release structure. Similarly, the release structure at Wallacia Weir is located over 1 km, in a straight line, from the closest boundary of the

GBMWHA. There are no views between the two points due to the intervening undulating topography and dense vegetation.

5.3 Geodiversity and Geomorphology

Geodiversity refers to "the natural range (diversity) of geological (bedrock), geomorphological (landform) and soil features, assemblages, systems and processes. Geodiversity includes evidence of the past life, ecosystems and environments in the history of the earth as well as a range of atmospheric, hydrological and biological processes currently acting on rocks, landforms and soils" (Cairnes and Australian Heritage Commission 2002, p.9). This section examines the geology, landforms and geological forces at work within the GBMWHA and the study area more specifically.

As alluded to in Section 3.1, the principal formation within the Blue Mountains is sandstone, overlain in some areas by basalt. The geological processes have formed extensive valley landforms, principally the Burragorang, Megalong, Jamison, Grose, Wolgan, Capertee and Colo Valleys of which Washington & Wray (2015, p. 24) say "[u]nusually for a 'mountain' area, here you don't look *up* at the peaks, but rather you look *down* from the plateau into the valleys" [emphasis in original].

The weathering of the sediments has resulted in the formation of three significant landform features: Platy pagodas, slot canyons and bottleneck valleys. Platy pagodas form at the edge of sandstone plateaus. These features have not been extensively studied, but are rare both in Australia and internationally (Washington & Wray, 2015, p. 26). Similarly, slot canyons are poorly understood, but are thought to be cut by streams into the soft Narrabeen sandstones (Washington & Wray, 2015, p. 30). Bottleneck valleys are described by Washington and Wray as (2015, p. 31):

> "Normal valleys widen downstream. In contrast, some of these cliff-rimmed valleys in the Greater Blue Mountains, such as the Grose, Capertee, Wolgan, Kanimbla and Wollondilly valleys, are widest in their upper reach, yet downstream the cliff walls converge to narrow gorges; all material eroded from the upper valleys has been transported through these narrow gorges or bottlenecks."

5.3.1 Study Area Interaction

In the immediate vicinity of the Nepean River, the landscape consists of rugged rolling to very steep hills of Hawkesbury Sandstone. The sandstone is overlayed with shallow (<50 cm) Lithosols/Siliceous Sands, Earthy Sands, Yellow Earths. Localised areas of deeper sand can be found associated with benches, joints and fractures.

The Nepean River sits within a confined gorge, which has been assessed as being in good geomorphic condition. Significant outcrops of bedrock and riparian vegetation contribute to a stable channel (see Section 5.5.1). The river bed consists of bedrock overlaid with gravel, cobbles and boulders (Streamology 2021b). There are a number of in-channel bars and benches.

5.4 Water and hydrology

The GBMWHA is dissected by a large number of rivers and their tributaries. In the Wollemi and Yengo National Parks these rivers include Colo, Capertee, Wolgan, Wollemi and Macdonald rivers and their tributaries, in Kanangra-Boyd and Nattai National Parks the rivers include the Nattai, Wollondilly and Coxs rivers, while in the Blue Mountains the notable rivers include the Grose and Coxs rivers (NSW National Parks and Wildlife Service 1998, p. 134-136). The Kowmung, Colo and Grose rivers have been declared as Wild Rivers under the *National Parks and Wildlife Act, 1974*. This means they have high conservation value and are integral to maintaining the water catchment in which they sit.

Rivers in the GMBWHA generally flow towards the ocean, although there is debate regarding whether this has always been the case (NSW National Parks and Wildlife Service 1998, p.86). The Strategic Plan summarises the water catchments thus:

> "The GBMWHA protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas. They also make an important contribution to the maintenance of water quality and natural flow regimes in the Hawkesbury-Nepean and Goulburn- Hunter river systems. The GBMWHA also forms part of the upper catchment of the Lachlan and Macquarie Rivers."
>
> (NSW National Parks and Wildlife Service 2009, p.12)

The action of water on the sandstone and basalt geological formations is integral to the formation of the complex formations discussed in 5.3. The numerous waterfalls add to the aesthetic appeal of the GBMWHA (NSW National Parks and Wildlife Service 1998, p.138).

5.4.1 Study Area Interaction

The project would be situated within the Lower Nepean River Management Zone of the Hawkesbury-Nepean Catchment (Streamology 2021b). The Hawkesbury Nepean catchment covers an area of approximately 21,000 km^2. Aurecon Arup (2021) summarise the Nepean River thus:

> "The headwaters of the Nepean River rise near Robertson, about 100 kilometres south of Sydney before flowing north through an unpopulated catchment area and later past the town of Camden and the city of Penrith. Near Wallacia it is joined by the dammed Warragamba River; and north of Penrith, near Yarramundi, at its confluence with the Grose River, the Nepean River becomes the Hawkesbury River. It then continues on a meandering course for ~140 km, combining with the significant tributaries of South Creek, Cattai Creek, Colo Creek and MacDonald River before reaching the ocean between Barrenjoey and Box Head."

Within the study area, the Nepean River has been assigned a Strahler stream order of 9 and is not a Wild River under the *National Parks and Wildlife Act, 1974*. River depths vary between 2 and 11 m within the study area. Flows through the Nepean River are controlled via a series of dams and weirs including Warragamba Dam, Wallacia Weir, Warragamba Weir and Penrith Weir. This control results in low hydraulic gradient; that is, it is slow flowing with low velocities through the majority of the study area. The river base is bedrock, with some coarse-grained sediment (Streamology 2021b). Slightly higher velocities are noted immediately downstream of the Warragamba River confluence. This area has been historically modified by sand mining, which has altered the morphology and sediment loads in this area (Streamology 2021a).

No water flow monitoring has been undertaken within the GBMWHA reach of the Nepean River, but data has been collected at Warragamba Weir, Warragamba Dam and Wallacia Weir. Data collected from these points indicates that median flow is 229 ML/day, with low flows during summer and higher flows during autumn and winter (Streamology 2021b). WaterNSW releases environmental flows from Warragamba Dam to dilute treated water released from the Wallacia wastewater treatment plant. These releases occur from the water supply pipe as at Megarritys Creek (Streamology 2021b).

In relation to water quality, baseline assessments undertaken by Aurecon and Arup (2021) indicate:

- nitrogen levels in the river between Penrith Weir and Bents Basin are generally elevated and above the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018) derived waterway objective of 0.35 mg/L for both the wet and dry years;
- total phosphorus concentrations appear consistently below the objective of 0.025 mg/L;

- ammonia concentrations are generally shown to be compliant;
- nitrate levels are generally recorded above the ANZG waterway objective;
- with respect to phosphate, the data indicates compliance with the waterway objective;
- between Penrith Weir and Bents Basin (which includes the study area), chlorophyll *a* concentrations are relatively low but still generally above the ANZG derived waterway objective;
- salinity levels are compliant with ANZG objectives; and
- within the limited data available, suspended sediment levels are are compliant with ANZG objectives and within the study area are "relatively low with maximum concentrations recorded up to ~20 mg/L" (Aurecon and Arup 2021).

5.5 Biodiversity (Flora and Fauna)

The ecology of the GBMWHA is naturally closely linked to the underlying geology. The basalt has weathered to form nutrient rich soils capable of supporting rainforest, in comparison to the dry sclerophyll woodlands that inhabit areas of eroded sandstone soils (Washington and Wray 2015, 21). The Plan of Management summarises the biodiversity across the GBMWHA thus:

> The park reserves natural environments over a wide altitudinal range from less than 20 m on the Nepean River to 1215 m on Mount Werong in the southern Blue Mountains. This altitudinal change and the complex topographic features of the park create a great diversity of environmental conditions affecting the distribution of plants and animals across the park. At least 40 distinct vegetation communities have been recognised in the park, ranging from the windswept heaths on the high sandstone plateau of the upper Blue Mountains (above approximately 600 m), to rainforests in sheltered gullies and on richer soils, to open eucalypt woodlands in the drier areas at lower altitudes.
>
> (NSW Parks and Wildlife Service 2001, 7)

In relation to fauna, the GBMWHA is known to support at least 423 native terrestrial vertebrates, including 66 mammals, 71 reptiles, 35 frogs and 251 birds (P & J Smith Ecological Consultants 2017a; 2017c; 2017b; 2017d).

5.5.1 Study Area Interaction

Biosis (2021), using regional vegetation datasets, aerial mapping, BioNet species records and previous studies in the surrounding areas; has identified the following potential biodiversity values within the broader impact area:

- PCT (Plant Community Type) 835 Forest Red Gum – Rough-based Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.
    - This PCT meets the key diagnostic criteria for the listing of River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Critically Endangered, EPBC Act, Endangered, NSW *Biodiversity Conservation Act 2016*).
- PCT 1078 Prickly Tea-tree - sedge wet heath on sandstone plateaux, central and southern Sydney Basin Bioregion (Tree-tree - sedge wet heath) (comprising Coastal Upland Swamp EEC).
- PCT 1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion.

- PCT 1284 Turpentine - Smooth-barked Apple moist shrubby forest of the lower Blue Mountains, Sydney Basin Bioregion (comprising Sydney Turpentine-Ironbark Forest CEEC).

- PCT 1292 Water Gum - Coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion.

The area does not hold habitat suitable for Wollemi Pine (*Wollemia nobilis*) or the Blue Mountains Pine (*Pherosphaera fitzgeraldii*); there are no recorded individuals in the study area.

Due to the terrain, fauna survey was not undertaken within the study area. The Plan of Management identifies that the Blue Mountains National Park provides habitat for:

> Forty six mammals including 27 marsupials and 2 monotremes, over 200 birds, 58 reptiles and 32 amphibians have been recorded for the Blue Mountains dissected plateau area including Blue Mountains National Park and adjacent reserves. Invertebrate distribution is very poorly known, but the exceptional diversity of open forest and woodland communities in the park is likely to support a high diversity of invertebrates.
>
> (NSW Parks and Wildlife Service 2001, 21)

P & J Smith Ecological Consultants (2017a, 2017c, 2017b, 2017d) contains tables identifying the fauna sighted within the Blue Mountains National Park and it is considered a proportion of those species identified would interact with the study area. Of note amongst the identified fauna are the Blue Mountains Water Skink (*Eulamprus leuraensis*), the Platypus (*Ornithorhynchus anatinus*) and the Echidna (*Tachyglossus aculeatus*): the first as a species known only within a restricted habitat within the Blue Mountains National Park and the second and third as species specifically identified within the heritage listings.

Background research returned no previous records for the Blue Mountains Water Skink within 10 km of the impact assessment area. The Blue Mountains Water Skink is restricted to swamp and sedge habitats in the middle and upper Blue Mountains between the Newnes Plateau and Hazelbrook (NSW National Parks and Wildlife Service 2001). The study area is therefore outside the known range of the species and the species is considered highly unlikely to occur within the study area.

Platypus prefer shallow rivers and streams with steep banks into which they can dig their burrows. Burrows are usually located 0.5 m above the water level. Their home ranges can vary between 2.9 and 7 km for males and 1.5 km for females. Platypus feed on benthic aquatic macro-invertebrates, including species from the Trichoptera (caddisfly), Diptera (fly), Coleoptera (beetle), Ephemeroptera (mayfly), and Odonata (dragonfly and damselfly) orders. Platypus generally feed within the top two metres of the water column, focusing on the stream margins. Biosis undertook a search of Bionet records for Platypus within the study area, incorporating a 4 km buffer, being the average home range. No sightings have been recorded within the study area, although 13 have been reported within the buffer:

- two records within the GBMWHA being:
    - one on Erskine Creek, approximately 2.5 km upstream from the Nepean River; and
    - one at Duck Hole, on Glenbrook Creek, approximately 6 km upstream from the Nepean river;
- eleven records downstream of the GBMWHA being:
    - two records associated with tributaries of the Nepean River: Mulgoa Creek and School House Creek;
    - six records of individuals foraging within the Nepean River near the Western Motorway overpass;
    - two deceased or injured individuals; and

- one record 720 m upstream of Wallacia Weir.

The number of records associated with the Western Motorway is likely to be a factor of ease of public access via Tench Reserve.

Given the spread of the recorded sightings, it is considered probable that Platypus exist within the study area, particularly as the Nepean River through this stretch is likely to contain their primary food source: benthic invertebrates.

Similarly, Bionet records sightings of Echidnas in the areas surrounding the study area, with one sighting within the study area, being in the vicinity of Table Rock Lookout (refer to Section 5.9). As primarily land-based animals that consume ants and termites, Echidnas use water for hydration and they are also known to bath and swim. As such they and their food sources are not affected by minor changes in nearby water bodies.

5.6 Aquatic ecology

The Nepean River is identified habitat for the Macquarie Perch (*Macquaria australasica*), identified as Endangered under the EPBC Act. The Macquarie Perch inhabit river areas that "contain flowing runs or riffles and small complex rock piles" (Department of the Environment and Energy 2018, p.8). It is described as "a moderate sized, large eyed, secretive freshwater fish" (Department of the Environment and Energy 2018, p.10). The species migrates upstream during spring to spawn. The Recovery Plan for the species states:

> "Laboratory observations have shown that Macquarie perch feed using a sucking action; evidenced by the frequent occurrence of sand grains, gravel and detritus in stomach analyses of the species ... Macquarie perch predominantly feed upon benthic aquatic insects and insect larvae, particularly beetles, mayflies, caddis flies and midges. Decapod crustaceans (shrimp and crayfish) are also an important food source with other known prey including dragonfly larvae, molluscs and small fish…"
>
> (Department of the Environment and Energy 2018, p.18)

Access to Decapoda are considered significant factors in maintaining populations of Macquarie Perch, together with interconnectivity with other breeding populations.

5.6.1 Study Area Interaction

The study area is mapped as potential habitat for the Macquarie Perch by DPI Fisheries on the Freshwater Threatened Species Distribution Maps (NSW Department of Primary Industries – Fisheries 2021).

Assessment of the macroinvertebrate community structure indicates species that range from pollution tolerant to pollutant sensitive, but the family richness is low. Both aquatic and terrestrial Groundwater Dependent Ecosystems are considered to exist along the banks of the Nepean River (CT Environmental 2021).

Nine species of macrophyte (aquatic plants) have been recorded within the Nepean River, consisting of six native and three exotic species (CT Environmental 2021).

5.7 Indigenous connections

The landscape for Indigenous peoples is cultural, having been formed by creation beings or embodying ancestors. It is not viewed as 'natural', it is formed by the creation beings and modified through interactions with Indigenous people in the time since. The Three Sisters are a well-known example of this (Mackay 2015, p. 88).

The process of dislocation from country that arose from European settlement is described by Mackay as placing:

> Aboriginal people under continuing pressure; some responded by re-locating, thereby creating new, more-recent associations with different places and establishing new links and traditions based on contemporary family experience. An example is the Gundungurra people whose story evolved during a century of post-European life in the Burragorang Valley. Aboriginal people thereby developed a complex, almost dual, cultural heritage combining traditional beliefs, language practices with new experiences and stories – but always connected to Country.
>
> (Mackay 2015, p. 84)

Mackay further describes the connection of Aboriginal people as being a continuation, an adaptation or a re-establishment for the six groups that straddle the GBMWHA: Darkinjung, Darug, Gundungurra, Dharawal, Wanaruah and Wiradjuri. The Gully in Katoomba is an example of this (D. Johnson 2007). Contemporary connections are "a composite evolved story that is inseparable from the place itself" (Mackay, 2015, p. 87).

5.7.1 Study Area Interaction

Sydney Water have provided initial responses from Registered Aboriginal Participants (RAPs) for the project around their connection to waterways, with a focus on South Creek and the Nepean River. Responses were received from Robyn Straub of Tharawal Local Aboriginal Land Council Phil Khan of Kamilaroi-Yankuntjatjara Working Group and Jamie Eastwood of Arangung Aboriginal Cultural Heritage Sites Assessments. The responses speak more generally about water courses, but also identify that the Nepean River as the life blood of the people (as Darug man Jamie Eastwood states). The Nepean River provided food and water, a place to grind axes, but also identity. The Nepean River formed a trading route, song line and the associated landforms are used as clan boundary markers. Rivers were important foci for woman, allowing them to wash in running water after giving birth.

A review of the information in *Sacred waters: the story of the Blue Mountains gully traditional owners* (D. Johnson 2007) and *People of the river: lost worlds of early Australia* (Karskens 2020) did not identify information pertinent to the study area in particular. More generally, these texts reinforce the sentiment expressed by the RAP respondents with regard to the importance of waterways in both practical and spiritual ways.

The Gundungurra People have entered into an Indigenous Land Use Agreement (ILUA) with the NSW Government. The boundary of the ILUA, as it interacts with the project, is the western bank of the Nepean River, as shown on Figure 5.1. The ILUA specifies that the Gundungurra be afforded the opportunity to be consulted with respect to the management of land and waterways within National Park Lands, Sydney Catchment Authority Lands, Forestry Corporation of NSW lands and Black Mountains City Council Lands. The Nepean River falls outside of the ILUA and is therefore not strictly relevant to the project. Consultation undertaken with Registered Aboriginal Parties for the project is outlined in the Aboriginal Cultural Heritage Assessment Report (Kelleher Nightingale Consulting 2021).

Additionally, Sydney Water is undertaking an Aboriginal Cultural Values Study with the local Aboriginal communities to increase insight into the intangible cultural heritage values of the western Sydney area. The study is focused on South Creek and the Nepean River. The study is separate to the project and in its early stages so as yet no specific cultural values have been identified beyond those discussed here.

5.8 Indigenous heritage sites

5.8.1 Regional archaeological context

The study area sits at the intersection of two major environmental areas, characterised in the west by the rugged upland Hawkesbury sandstone environment of the Greater Blue Mountains area, and in the east by the more undulating crest and valley landform that is typical of the Cumberland Plain which covers much of the Sydney Basin. There have been several significant archaeological studies focused on this western edge of the Cumberland Plain since the 1940s (eg, at Lapstone Creek (McCarthy 1948), Emu Plains (Kohen, Stockton, and Williams 1981), Windsor (AAJV 2018), and Pitt Town (AHMS 2005; 2013). The Hawkesbury-Nepean River is evidently a major focal point of

activity in the Cumberland region, and studies into the sand bodies associated with this river system have revealed deeply buried, extensive and significant cultural materials (usually stone artefacts) of great antiquity that date from ~36,000 years ago to the post-contact (post-1788) period.

While there has been no systematic archaeological or cultural studies of the Greater Blue Mountains area, owing to its inaccessibility and vast size (NSW National Parks and Wildlife Service 1998) an extensive record of Aboriginal occupation has been established for the Greater Blue Mountains area. More than 1,000 sites are identified in the Aboriginal Heritage Information System (AHIMS) as being located within the GBMWHA (Mackay, 2015, p.83). This is largely the result of pioneering archaeological excavations of rock shelter sites since the 1960s, at Shaw's Creek, Springwood Creek, Kings Table, Lyre Bird Dell, Walls Cave, Blackfellows Hand shelter, Capertee 1-5, Emu Plains Shelter and Lapstone Creek (McCarthy 1964; Stockton 1970; 1973; I. Johnson 1979; Kohen 1981; 1984). Dated rock shelter sites in the area suggest that Aboriginal occupation extended as far back as 14,000 years ago, and potentially as early as 22,000 years ago (Stockton 1973; Stockton and Holland 1974). Early stone tool industries tend to be dominated by poorer quality raw stone material including quartz, chert and river pebbles. About 5,000 to 4,000 years ago, rock shelter site use intensified (Attenbrow 1981; Stockton 1973; Kohen, Stockton, and Williams 1981). Assemblages at this time contain a much larger proportion of fine-grained raw materials, with backed implements appearing before 3,000 years ago. Flake debris and artefacts also tend to be smaller in size. In the last 1,000 years there is a marked increase in the presence of quartz flakes and quartz bipolar cores, and a decline in fine-grained materials. Bondi points and geometric backed artefacts were less common and there was a shift towards the production of eloueras (McDonald 1997).

In contrast to shelters, open sites in the Lower Blue Mountains are comparatively rare and are characterised by low density surface scatters, dominated by quartz. The sites are often found in elevated areas above swamps or creeks and rarely contain diagnostic tool types such as Bondi points. Most assemblages contain between 10 and 30 amorphous broken flakes and flaked pieces (AHMS 2005, 23).

The Blue Mountains landscape also contains art sites, modified trees and grinding grooves, preserving a vital record of social interactions and artistic activities for the various clans that occupied the land. The rock art contained within the GBMWHA represents an important constituent of the Sydney regional art style – which incorporates drawings, stencils, paintings and engravings – and exhibits significant stylistic variability. The stylistic variability within it can be attributed to cultural variation, based on language groupings and social organisation. At Eagles Reach cave in Wollemi, for example, 206 individual motifs were recorded, comprising of 166 drawings, 39 stencils and one painting, arranged in twelve superimposed layers. The motifs included several birds, mammals and reptiles as well as double-headed human-like figures and animal-headed beings with human bodies. The oldest stencils, in red and a dark yellow, are believed to between 2000-4000 years old. The oldest charcoal drawings are at least 1,600 years old (Tacon et al. 2007, 14).

5.8.2 Registered Aboriginal sites in the AHIMS database

EMM conducted a search of the AHIMS register on 9 April 2021. The search covered an area of approximately 108 km^2 (9 km by 12 km) between Glenbrook and Wallacia; but also extended beyond the study area into the GBMWHA and as far east as Mulgoa Creek. The search captured the dichotomous relationship between the more rugged uplands environment of the Greater Blue Mountains area, as well as the more populated town centres and cleared pastureland of Glenmore Park, Mulgoa and Wallacia.

The aim of the search was to identify if any Aboriginal sites or places are registered within the study area; and to aid the predictions for the study area from the frequency and distribution of Aboriginal site types in the broader landscape. The registered locations of each AHIMS site are shown in Figure 5.1Figure 5.1, and the data summarised in Table 5.3.

To summarise, the AHIMS search identified 118 registered Aboriginal sites in the search area (Table 5.3). The majority of these sites are open artefact sites that are located in relatively open country to the east of the Nepean River; while closed rock shelter sites with art and occupation deposit, and grinding grooves predominate in the

densely vegetated and steeply sloping areas to the west of the Nepean River. The open artefact sites are typically within 500 m of creeklines where limited development has occurred, especially along Littlefields Creek, Mulgoa Creek, Jerry's Creek and their associated tributaries. Descriptions of the size and density of these sites are limited, but where provided, generally appear to indicate isolated objects or very small campsites (<30 artefacts per campsite). Several culturally modified trees have also been reported in the camping area at the end of Ironbarks Trail in the Blue Mountains National Park, and along Silverdale Road at Wallacia.

Table 5.3 Aboriginal sites registered on the AHIMS database within the 108km^2 search area.

Site feature	Number	Percentage
Artefact sites	85	72.03
Open camp site	*64*	*54.23*
Isolated find	*18*	*15.25*
Potential Archaeological Deposit (PAD)	*3*	*2.54*
Shelters	18	15.25
Shelter with art	*8*	*6.78*
Shelter with deposit	*6*	*5.08*
Shelter with art and deposit	*1*	*0.85*
Shelter with art and stone arrangement	*1*	*0.85*
Shelter with art and deposit and grinding groove	*2*	*1.69*
Culturally modified trees	6	5.08
Axe grinding grooves	4	3.39
Stone arrangements	3	2.54
Art sites (Pigmented or engraved)	2	1.69
TOTAL	**118**	**100**

Of particular relevance to the study area is its unique topography, geology and landform characteristics which influences the types of Aboriginal sites that may be preserved within the study area. The ~300 m wide corridor flanking the Nepean River can be characterised as steep and heavily incised, and has likely been formed over several millennia by the constant erosion of the underlying sandstone geology, which has historically transported a large volume of sandy sediment downstream into the Hawkesbury River where it was deposited at places such as Windsor, Pitt Town and Peachtree Creek. In this sense, the likely archaeological resource to be encountered within the study area are sandstone overhangs that retain evidence of Aboriginal pigmented art on walls, as well as overhangs with occupation deposits containing stone, shell, bone or charcoal. Grinding grooves may also be present in areas of relatively flat outcropping sandstone adjacent to (or within the path of) running or pooled water, including areas where water runoff from wet weather occurs. Several short perpendicular drainage lines enable water runoff from the mountainous terrain above to drain off into the River; and it is at these points where access down to the water may have been possible for past Aboriginal populations, and therefore evidence of occupation in the form of artefact sites may be preserved – provided that such sites have not been subjected to past flooding and scouring of deposits. Otherwise, it would have been especially difficult to access the River and its resources, and there may therefore have been a greater preference for utilising the resources of the surrounding creeklines and waterways instead.

With regards to isolated stone artefacts and campsites, previous flooding regimes may also have played a key role in the survival of any surface or sub-surface stone artefact material along the river's edge. The degree of impact has

been heavily influenced by the velocity of the moving floodwater and the degree to which the nearby sediment was transported downstream. Specifically, high-energy flood events resulting in fast-moving water are likely to have scoured away fine and coarse-grained sediment, as well as any cultural material that may have been preserved along the river's edge - leaving behind only the harder sedimentary sandstone and/or shale-lensed bedrock. Over time, the effect of frequent flooding along the Nepean has resulted in the weathering of the bedrock to form steep gorges, with very little deposition of material evident in the study area.

FIGURE REDACTED FOR PUBLIC EXHIBITION DUE TO SENSITIVITY OF IMAGE

Figure 5.1 Gundungurra Indigenous Land Use Agreement Area and Aboriginal Heritage Information Management System search results

According to Molino Stewart, when a flood occurs upstream of Warragamba dam the water is generally confined to the deep Nepean gorges that are relatively undeveloped. Below the Nepean gorge, these floodwaters fan out across the floodplain, inundating large sections of Penrith, Emu Plains, Richmond and Windsor. The largest flood on record in the Hawkesbury-Nepean Valley occurred in 1867, when the river level reached 19.3 m AHD at Windsor (Molino Stewart Environment and Natural Hazards 2012, 3).

Five sites have been previously registered on the AHIMS database within the study area, and these correlate with the predictions outlined above. These sites are shown in Figure 5.1 and labelled with their site number. Specifically, there is one artefact site, two shelters with art, one open (pigmented or engraved) art site and one artefact site with PAD. Of the two shelters with art, both are located on steeply sloping terrain, the first adjacent to Euroka Creek ("Euroka Clearing (Glenbrook)" AHIMS ID #45-5-0116) and the second ("Euroka Clearing; Glenbrook; Nepean River;" #45-5-0119) on the western bank of the Nepean River. "Euroka Clearing (Glenbrook)" is described as a cave with human figurine charcoal drawings, and is mapped on the AHIMS database as being 75 m east of the Fern Glen walking track, on steeply sloping terrain overlooking Euroka Creek. The site card provides no additional information to describe the site or its location, and therefore based on the recorded co-ordinates the site is located 82 m from the water's edge, and at an elevation of 43 m above sea level (ASL). "Euroka Clearing; Glenbrook; Nepean River;" similarly is described as a cave with human and fish charcoal drawings and is mapped on the AHIMS database as being 86 m north-east of the Fern Glen walking track, on the western bank of the Nepean River. The site card provides no additional information to describe the site or its location, and therefore based on the recorded co-ordinates the site is located 3 m from the water's edge, and at an approximate elevation of 13 m ASL.

The third site, "Glenbrook Rock Art" (#45-5-5220), is erroneously recorded as an open art site, and is incorrectly mapped as being located within the study area - on the eastern bank of the Nepean River <600 m south-west of Rileys Mountain Lookout. Further interrogation of the data and information contained within the site card confirms that the site is a closed rock shelter with 33 red pigmented hand prints, some of which may be cultural in origin and others of which appear to be more recent additions. The site is located 25 m above the Main Western Railway line and 1.4 km down-track of Glenbrook station, at the following co-ordinates [redacted]). This site is 1.77 km northwest of the Nepean River's edge at an elevation of 138 m ASL.

The fourth site, an artefact site, "Machin's Saddle Glenbrook Mt Henry" (AHIMS ID #45-5-0099), is mapped on the AHIMS database as being located on the western bank of the Nepean River at its confluence with Erskine Creek. However, further interrogation of the site description and detail on the site card suggests that the site was located on a fire trail on a saddle, on the "ridge running north of Erskine Creek (near the outlet to the Nepean) and just overlooking the volcanic neck called Machin's Crater. The situation is an open-forest ridge-top like the Iron Barks". The exact site location is difficult to pin down from the description; however, the nearby Nepean Lookout walking trail terminates at a minimum distance of 177 m from the water's edge, and sits at a minimum elevation of 170 m ASL.

The fifth site, an artefact scatter containing 29 Aboriginal objects and an area of potential archaeological deposit "WP4 and PAD" (AHIMS ID #45-5-3175)" is erroneously mapped as being located within the study area - opposite Warragamba Park (also known as Norton Basin car park) on steeply sloping ground in the Blue Mountains National Park. However, further interrogation of the site card data confirms that the site is a high-density artefact scatter extending across a 30 x 20 m area, on the Norton Basin Road walking track on an elevated terrace at the base of the steep hill slope, roughly 60m southeast of the Warragamba/Nepean River junction. The site should be registered at the following co-ordinates: ([redacted]). It contains a variety of tuff, quartzite, chert and silcrete flakes and three cores, as well as a broken hammerstone, chert microlith and quartzite blade. The site is 90 m from the Nepean River's edge and is located at an elevation of 44 m ASL.

In summary, while five sites have been mapped within the study area, three of these have been erroneously mapped and the study area therefore contains two previously identified sites. Both sites are located beyond the existing and anticipated water levels: "Euroka Clearing (Glenbrook)" (AHIMS ID #45-5-0116) being 43 m ASL and "Euroka Clearing; Glenbrook; Nepean River;" (#45-5-0119) being 13 m ASL.

5.9 Historical heritage sites

The GBMWHA is primarily listed for its natural heritage values; however, as Ann McGrath succinctly states:

> The Greater Blue Mountains holds a special place in the making of the Australian nation. It is a location of demonstrable and outstanding national historical significance. With its iconic profile and famous heritage, it has long been recognised as an area that was foundational to the building of the Australian nation… The Blue Mountains Crossing of 1813 has become a mainstay of school history textbooks over Australia's first century of federated nationhood. Australia's best-known poets, novelists, artists and others have popularised its heritage.

(McGrath 2015, 97)

McGrath identifies six themes around which the Blue Mountains has contributed to the Australian psyche:

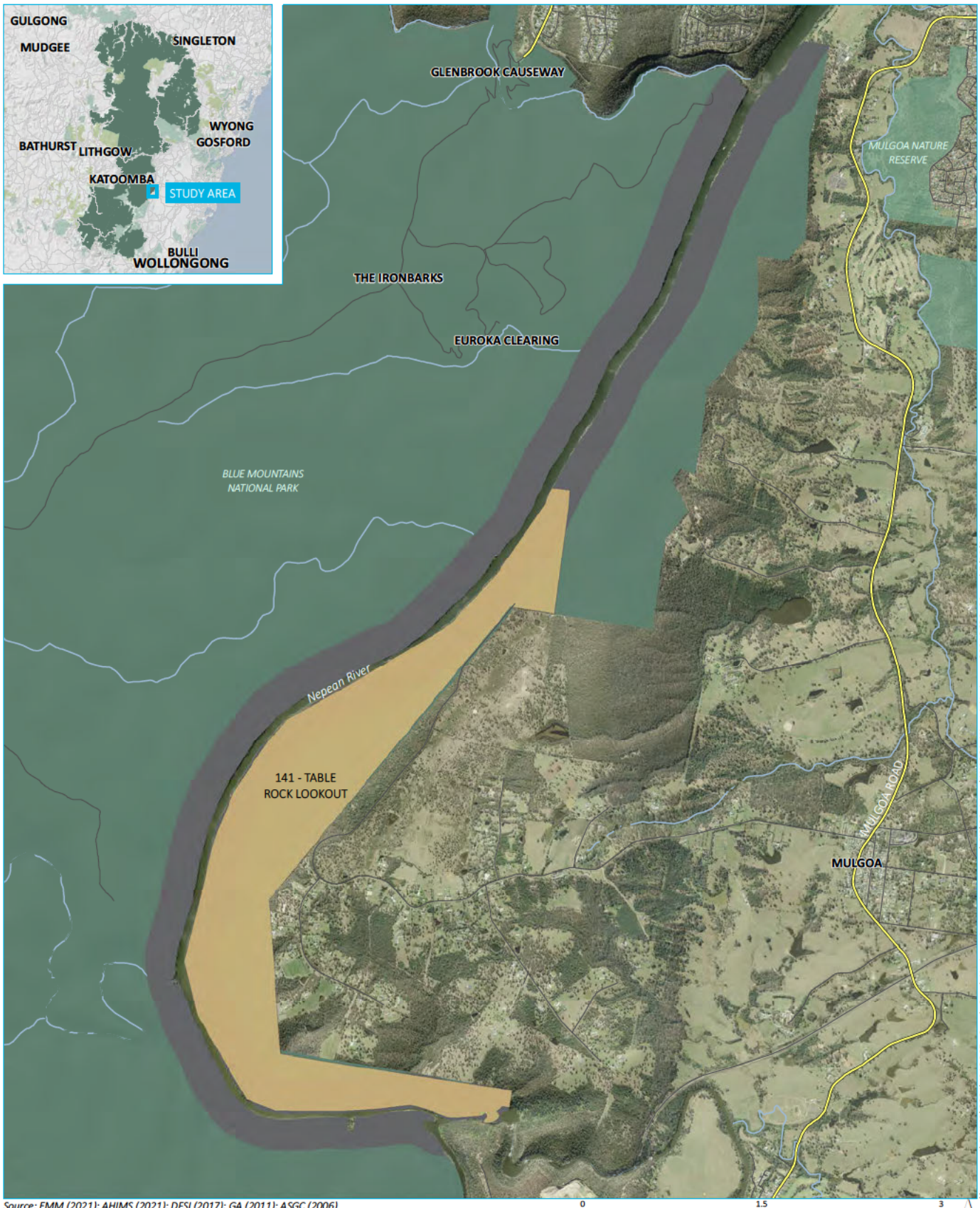
1. A theatre for the foundational national history;
2. Fathers of Federation;
3. Exploring and 'opening up the land';
4. Gold, and the coming of the railway;
5. The tourist industry: Jenolan Caves; and
6. Bushwalking and the Conservation movement.

While the GBMWHA as a whole embodies these values for the Australian nation, there are iconic sites that are the focus for this sentiment: the route of the 1813 crossing of the Blue Mountains to the north of the study area, Jenolan Caves and Medlow Bath for their links to tourism, Falconbridge and Medlow Bath have strong associations with the Fathers of Federation Alfred Deakin and Henry Parkes and the ZigZag Railway with the coming of the railway. Also contributing to the theme of foundational national history, one of the 11 World Heritage Listed Australian Convict Sites, the Old Great North Road, is contained within the GBMWHA. As noted in Section 1.4, the Old Great North Road curtilage does not intersect with the Nepean or Hawkesbury Rivers and would not be impacted by the project. The locally listed Table Rock Lookout (Penrith LEP #141) indicates that the study area, at least the eastern bank, contributes to the theme of bushwalking and conservation that is also closely connected with tourism.

5.9.1 Study Area Interaction

The Table Rock Lookout site consists of dense eucalypt forests, with formal walking trails, car parks and other small scale infrastructure supporting nature-based activities. The primary walking trail leads to Table Rock Lookout, a large flat rock that provides views in both directions along the Nepean River and west into the GBMWHA. No access to the riverbank is available from the Lookout. The Lookout has been associated with bushwalking and local tourism since the early 1900s. Evidence of the former flying fox across the Nepean may be evidenced thorough holes or bolts within the rocks at the departure and landing points.

The historical background identified that Fairlight was partially irrigated from the Nepean River. It may therefore be anticipated that some infrastructure associated with the irrigation could be preserved adjacent to the River on the eastern bank. Given the steep terrain within the GBMWHA, it is probable that the irrigation ran from the Nepean River at southern end of the Fairlight Estate, possibly Norton's Basin. No evidence of the irrigation infrastructure has been recorded.



Source: EMM (2021); AHIMS (2021); DFSI (2017); GA (2011); ASGC (2006)

0 1.5 3 km

GDA 1994 MGA Zone 56

N

KEY

- Study area
- Penrith Local Environmental Plan 2010
- Greater Blue Mountains World and National Heritage Area
- Major road
- Minor road
- Named watercourse
- NPWS reserve
- State forest (refer to inset)

Statutory heritage register sites

Upper South Creek Advanced Water Recycling Centre
Heritage impact assessment
Figure 5.2

EMM
creating opportunities

5.10 Assessment of Heritage Assets

The *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties* impact assessment guideline (ICOMOS 2001) replicated in Table 1.3 uses the value of the heritage asset as a metric for determining the level of impact. Table 5.4 assesses the relative heritage values within the study area. The value has been derived from the integrity and authenticity in conjunction with the contribution it makes to the World and National heritage listings.

Table 5.4 Heritage values within the study area

Value	Integrity and authenticity	Value	Justification
Geodiversity and Geomorphology	High	Low	The study area does not contain the features identified as being of World or National Heritage value
Water - flows	Low	Low	The Warragamba and Nepean Rivers are controlled waterways with weirs. They do not operate as natural rivers and therefore have low integrity and authenticity and make a low contribution to the GBMWHA.
Biodiversity	High	High	The vegetation communities in this area display a high degree of authenticity and integrity.
Aquatic ecology	Low	Low	Water quality has affected the family richness and the introduction of exotic species impacts the integrity and authenticity.
Indigenous connections	High	High	Connections are likely to be highly valued by the Aboriginal community.
Indigenous sites	Unknown	Low	The study area does not contain art or open sites of research
Aesthetics (visual)	High	Low	While containing views of the GBMWHA, the area is not identified as one of the key lookouts in the Blue Mountains.
Historic sites	Low/Moderate	Low	While associated with tourism in the Blue Mountains, it is not a key site.

6 Impact assessment

This section outlines the project impacts and assesses the impacts using the criteria outlined in Table 1.3.

6.1 Landscape and visual setting

6.1.1 Project impacts

Potential alterations to the views and amentity of the area arise from three components; the two release points and the alteration in water level. The AWRC itself is located 5 km east of the GBMWHA and would not be visible from any viewpoints.

The release points are located:

- downstream (north-east) of the Warragamba Dam wall, outside of the GBMWHA, on the southern side of the Warragamba River; and
- adjacent to the Wallacia Weir, located on the Nepean River outside of the GBMWHA.

In relation to the Warragamba Dam outlet structure, the Nepean River stretches approximately 1 km before reaching the boundary of the GBMWHA at the intersection of the Warragamba River and the Nepean River and the GBMWHA boundary to the north is also approximately 1 km from the proposed release structure. There is no public access to W5 Erskine Range Trail, W5h Firetrail and W5g Firetrail from the south where the trails connect with Crest Road at the dam wall. It could not be determined whether public access is possible to these trails from the westerly connecting trails, although it is believed that these trails originate within declared catchments to which public access is prohibited. However, should there be access that is not restricted by locked gates, accessibility is restricted to four-wheel drive vehicles or bike, at a distance of approximately 45 km on gravel road. The number of visitors is considered to be very low. It is therefore considered that the end of the trails are not frequently visited lookout locations, and are not within the GBMWHA, so views towards the proposal are not considered sensitive.

The Wallacia Weir outlet structure is located approximately 1 km outside of the GBMWHA. Dense vegetation and undulating topography means there are no view lines to the outlet structure from within the GBMWHA.

Alterations at Table Rock Lookout would consist of changes in views associated with water level increases ranging from 3 to 10 cm.

6.1.2 Impact assessment

Impacts have been considered from the construction of the environmental flows outlet structures near the Warragamba Dam wall. As discussed in Section 5.2, access to the firetrails on the western bank is limited, with minimal visitor numbers as these trails are primarily for management purposes. Furthermore, these firetails are located outside of the GBMWHA, with the boundary being over 1 km north and 1 km east of the outlet structure. Tall native trees obscure views from the GBMWHA out towards the Warragamba River gully and location of proposed environmental flows outlet structures. The proposed Wallacia outlet structure is located over 1 km east of the GBMWHA boundary and there are no view lines from within the World Heritage area due to the intervening undulating topography that is densely vegetated.

The visual impacts associated with a 5 to 10 cm rise in water levels within the GBMWHA reach of the Nepean River is unlikely to be perceptible whether viewed from water level or from Table Rock Lookout. The project would result in a negligible visual impact.

This is rated as a negligible change resulting in a negligible impact for an overall impact of neutral.

6.2 Geodiversity and Geomorphology

6.2.1 Project impacts

Low flow conditions upstream of the discharge site are controlled by Wallacia Weir, which minimises the impact on flow velocities and depths within the study area. Within the GBMWHA stretch of the Nepean River the river is confined in nature, with bedrock substrate. Water velocity and shear stress, being the point at which sediment is mobilised, would see a negligible change of <0.01 m/s (Streamology 2021b). Even in conjunction with a rise in water level of <3 cm, the modelling indicates that there is no increase in flows above bed mobilisation thresholds, meaning no additional erosion is anticipated. As the riverbed is stable and the impacts are negligible, no alterations to the geodiversity or geomorphology of the study area are anticipated.

6.2.2 Impact assessment

A less than 2 m increase in wetted perimeter and a <0.01 m/s increase in water velocity has been modelled in both scenarios. The impact of these alterations is explained by Streamology (2021b, p.53) thus:

> It should be noted that under all flow conditions described here the flows remain within the channel and so changes in wetted perimeter are limited to wetting of in-channel bars and benches. There is no engagement of the floodplain or additional overbank flow as a result of the releases.

As the river would remain within the stable channel and the change in velocity is negligible, no additional erosional effects are anticipated and therefore no alterations to the geodiversity or geomorphology of the study area are anticipated.

This is rated as a negligible change resulting in a negligible impact for an overall impact of neutral.

6.3 Water quality and hydrology

6.3.1 Project impacts

a Hydrology

Streamology (2021) have modelled the effect of 50 ML/day and 100 ML/day treated water release under a number of environmental conditions. The project will be constructed to release up to 50 ML/day initially. Using the flow data collected from gauge 212202 at Wallacia weir between 2010 and 2018, 'baseline' flow has been identified at 229 M/L day. With the addition of 50 ML/day, the future mean flow is anticipated to be 279 M/L day at 50 ML/day and 329 M/L day at 100 M/L day. Using GIS and topographic models, Streamology modelled the spatial extent of the inundation and identified that a <3 cm increase in river level could be anticipated within the World Heritage Reach of the Nepean River at 50 M/L day, with some localised sections being up to 5 cm (Streamology 2021b). At 100 M/L day, the increase in river level would be <10 cm. The wetted perimeter, that is the cross-section of the area that is wet (ie in contact with the flow), would increase by less than two metres under both the 50 and 100 M/L day scenarios. The river is confined to the channel, which accounts for the lack of differentiation between the two scenarios. Under either scenario, navigation of the river would not be altered. This information is summarised in Table 6.1.

Table 6.1 Modelled condition changes

Metric	Current	50 M/L day	100 M/L day
Water flow	229 M/L day	279 M/L	329 M/L
Water level	Baseline	Up to 5 cm	<10 cm
Wetted perimeter	Baseline	<2 m	<2 m

b Water quality

Water quality modelling indicates the project would result in lower nutrient concentrations, reduced oxygen sag and improved turbidity. The improvement in water quality is considered a beneficial impact with Aurecon Arup (2021, p.233-234) drawing, verbatim, the following conclusions:

- Based on the modelling undertaken, the introduction of the AWRC releases provided for many improvements in the water quality of the Nepean River. The environmental impacts from the treated water releases immediately downstream of the release point were predominantly positive.

- Further downstream of the initial footprint (~20 km), the impacts were predicted to be either not significant, or predicted not to present negative effects on the river water quality and/or ecosystem health. This is predominantly a result of the comparatively low release volumes, and quality of the treated water being released.

- With the introduction of AWRC releases into the Wallacia Weir pool, water levels are increased, and despite anticipated rates of extraction, allow for a more consistent flow regime in the Nepean River, downstream of the weir.

- Across the range of climatic years that were analysed, the AWRC release scenarios demonstrated, on average, a relative improvement in water quality in downstream reaches of the Nepean River, compared to the background conditions. The predicted improvements were generally due to increases in flows, flushing and dilution from introduction of the advanced treated water from the AWRC releases.

- With respect to compliance with relevant project waterway objectives, analysis of the impacts on annual median profiles indicated that, if AWRC releases were introduced, there would be potential for an improvement, or at least maintenance, of the levels of compliance.

- The improvements included reductions in nutrient concentrations as well as increases in dissolved oxygen levels. The footprints of these improvements extended to 15 to 20 km (from the Wallacia release point), and 20 to 30 km (from the South Creek confluence).

- The chlorophyll *a* concentrations and risk of algal blooms was also generally improved due to reduced nutrient concentrations and improved flushing under dry conditions, but small changes in water clarity and temperature mean that, overall, the median algal biomass is likely to be similar to background conditions with introduction of the AWRC releases.

- During more severe wet weather, higher concentrations of nutrients were introduced in the AWRC releases due to higher content of tertiary treated water. These 'spikes' presented localised downstream effects but were short-lived, and the nutrient concentrations were predicted to drop quickly to levels lower than the background simulation within a few days. As discussed above for South Creek, the frequency of these more severe weather events was determined to be relatively low.

- The predicted influence of the AWRC releases on water quality between the wet and dry years is generally consistent, and the differences in the levels of impact were predicted to be relatively minor, particularly when compared to the inter-annual differences that occur naturally between these climatic and hydrological conditions.

- From analysis of the Stage 1 nutrient loads, it was estimated that the AWRC releases accounted for <1% of the total nitrogen load in the wider Hawkesbury Nepean catchment for the representative wet and dry years. Similarly, the AWRC accounted for approximately 0.6% of the total phosphorus load in the dry year, increasing to 1% in the wet year.

- With respect to the advanced treatment shutdown scenario, similar to the South Creek modelling, there was only one event in the wet year where a shutdown of the advanced treatment (reverse osmosis) process was predicted. The consequences to the Nepean River releases included changes to daily release volumes and water quality. The relative impacts from this event were however again predicted to be insignificant.

6.3.2 Impact assessment

Increases in water level would be up to 5 cm at 50 M/L day and 10 cm at 100 M/L day and water velocity is modelled to increase by 0.01 m/s throughout the study area with increases of 0.03 m/s on the northern boundary of the GBMWHA.

Positive and neutral water quality changes downstream of the discharge points have been modelled, including:

- lower nutrient concentrations are anticipated within 20 km of the discharge locations, which would include a portion of the study area;

- reduction in oxygen sag, meaning the oxygen level in the water is closer to saturation;

- no material changes in algal bloom peaks;

- improved turbidity; and

- no changes in E.coli and Enterococci loads.

Modelling indicated that the variations between 50M/L and 100 M/L per day are minimal, but increased water releases would have a diluting effect on nutrient levels, but would not off-set the spikes related to wet weather run-off. In summary, the changes are small relative to the variability seen throughout an average year.

This is rated as a negligible change resulting in a negligible impact for an overall impact of negligible beneficial.

6.4 Biodiversity

6.4.1 Project impacts

Biodiversity impacts are limited to indirect impacts during the operational phase resulting from increased water levels (up to 5 cm at 50 ML day and up to 10 cm at 100 ML day), and the inundation of biodiversity values within the additional wetted perimeter and <2 m within in channel bars and benches) and increased saturation frequencies during flood events higher up the river banks. On this basis, Biosis have identified the impacts outlined in Table 6.2. At present, there is 0.62 ha of vegetation within the 229 ML day (the median flow rate) inundation extent. At 50 ML day, 0.74 ha would fall into this range, an increase of 0.12 ha. At 100 ML day, 0.81 ha would fall into this range, an increase of 0.19 ha above the current situation. Biosis' calculations have been based on the following methodology and assumptions:

- Biodiversity values present on the river bank, between the current and future inundation extents, are anticipated to be subject to differential changes in periodic inundation. Expected changes in inundation frequency are:

  - Biodiversity values present between the existing low flow extent (25 ML/day) and median flow extent (229 ML/day), are currently subject to inundation >50 % of the time;

    - With an increase of 50 ML/day the frequency with which these biodiversity values will be inundated will increase from >50 % of the time to >63% of the time;

    - With an increase of 100 ML/day the frequency with which these biodiversity values will be inundated will increase from >50% of the time to >74% of the time;

  - Biodiversity values present between the existing median flow extent (229 ML/day) and the potential future median flow extent for 50 ML/day releases (279 ML/day), are currently subject to inundation between 40 and 50 % of the time, which will increase to >50 % of the time.

  - Biodiversity values present between the existing median flow extent (229 ML/day) and the future median flow extent for 100 ML/day releases (329 ML/day), are currently subject to inundation between 27-50 % of the time, which will increase to >50 % of the time.

Table 6.2 Biodiversity values impacted by increased mean inundation extent

Flow scenario	PCT 835	PCT 1078	PCT 1181	PCT 1284	PCT 1292	Total
Existing conditions						
Biodiversity values within 229 ML/day inundation extant	0.46	0.04	0.06	0.03	0.03	0.62
Increased 50 ML/day release scenario						
+50 ML/day releases: 279 ML/day	0.55	0.06	0.07	0.03	0.03	0.74
% change in inundation	20	50	17	0	0	
Hectares change	0.09	0.02	0.01	0.00	0.00	0.12
Increased 100 ML/day release scenario						
+100 ML/day releases: 329 ML/day	0.59	0.07	0.07	0.04	0.04	0.81
% change in inundation	28	75	17	33	33	
Hectares change	0.13	0.03	0.01	0.01	0.01	0.19

Impacts to terrestrial fauna arising from the project consist of loss of habitat equal to the increase in the wetted perimeter. The loss of habitat would be equal to the hectares (or part thereof) identified in Table 6.2. It is not anticipated this would result in a loss of food sources, burrows, hollows or habitat fragmentation. It is not anticipated that the indirect impacts associated with the project would lead to the death of individuals in the short or long term and the area of increased inundation does not support a significant portion of the species that make up the uniqueness of the GBWHA. The forecast increases in water quality may be beneficial to the health of animals who access the River as a source of water.

Analysis of the anticipated alterations in water quality and flow regimes, including the turbidity and depth increases to which platypus are sensitive, would be negligible and is unlikely to cause stress to individuals living in or passing through the Nepean River within the GBMWHA. Increases in water quality may result in improved benthic aquatic

macro-invertebrates communities, thereby increasing the available food resources. The anticipated increase in water level of <2cm is unlikely to result in inundation of burrows.

6.4.2 Impact assessment

Increased inundation frequency is predicted to result in impacts to and additional 0.12 to 0.19 ha of native vegetation. These levels of impacts are considered unlikely to result in a significant impact to these species and communities. Further, these impacts are unlikely to alter the diversity of plants from the Myrtaceae, Fabaceae or Proteaeceae or vertebrate taxa and the study area does not support any of the rare or primitive species unique to the GBMWHA.

This is rated as a negligible change resulting in a slight impact for an overall impact of slight.

Impacts to Platypus include:

- burrows are typically situated at least 50 cm above the water level and a rise of <10 cm could be accommodated by individuals by restructuring the entrance of their burrow if required;
- no alteration to home ranges would occur as a result of the project;
- while the depth of the water would be subject to a minor increase, individuals would continue to be able to feed within the top two meters of the water column and along the river banks; and
- benthic aquatic macro-invertebrates would not be impacted by changes in water quality and flow regimes and will therefore remain available as a food source. It is possible that the increase in water quality will improve the benthic communities within the GBMWHA stretch of the Nepean River, thereby increasing the available food sources.

These impacts to the Platypus are considered to be negligible.

No impacts to Echidnas have been identified as arising from the project.

This is rated as a negligible change resulting in a negligible impact for an overall impact of neutral.

6.5 Aquatic ecology

6.5.1 Project impacts

Minor positive increases in water quality are anticipated as a result of the project, together with a minor increase in habitat availability through the increase in water levels and wetted perimeter. Such changes may result in increased numbers and diversity of aquatic populations generally.

As changes in flow velocity have the potential to alter aquatic macroinvertebrate assemblages that may also impact on Macquarie Perch and other species that feed on them, a consideration of velocity was undertaken by CT Environmental (2021). The outcome of this assessment is provided in Section 6.4.2.

6.5.2 Impact assessment

CT Environmental (2021) conclude the impacts to aquatic ecology associated with alterations in water levels and wetted perimeter will have a negligible impact on riparian flora and macrophytes. Impacts to aquatic fauna will be beneficial as the project would lead to an increase in aquatic habitat availability.

Alterations in modelled water velocity for the study area range between no change and 0.01 m/s. CT Environmental conclude that this change would have a negligible impact on aquatic macroinvertebrates, macrophytes and aquatic fauna, including Macquarie Perch. However, flows at the confluence of Glenbrook Creek and the Nepean River indicate that flows may increase by up to >0.3m/s. The Glenbrook Creek confluence marks the edge of the GBMWHA. CT Environmental conclude that this increase "considered to have the potential to alter the aquatic macroinvertebrate community assemblage, as it is within the range of flow velocities considered to pose an impact to individual mobilization for taxa known, or with potential to occur, in the Nepean River." (CT Environmental 2021, p.178). This impact is considered negligible.

Negative impacts to the Macquarie Perch are not anticipated and minor positive increases in water quality may improve food sources and thereby population health. The project does not contravene the strategies contained within the National Recovery Plan and may contribute to the protection and restoration of Macquarie perch habitat (Strategy 2) through the modelled minor improvements in water quality (Department of the Environment and Energy 2018).

This is rated as a negligible beneficial change resulting in a negligible beneficial impact for an overall impact of neutral.

6.6 Indigenous connections

6.6.1 Project impacts

Indigenous connections to the Nepean River entail looking after the river and the country more generally. Indigenous communities own a sense of responsibility to care for heritage sites, plants, animals, rivers, creeks and the land itself. Identification of the impacts of the project on the environment and heritage sites as a whole would feed into Indigenous communities connection to the area.

6.6.2 Impact assessment connections

The project would not alter the ability of Indigenous people to visit and connect to the Nepean River within the study area. No significant impacts are identified to Indigenous sites or the environment more broadly and it is therefore considered that the project does not inhibit the ability of Indigenous people to care for country.

This is rated as a negligible change resulting in a negligible impact for an overall impact of neutral.

6.7 Indigenous sites

6.7.1 Project impacts

While five sites have been identified within the study area, three of these have been erroneously mapped and the study area therefore contains two previously identified sites. Both sites are located beyond the existing and anticipated water levels: "Euroka Clearing (Glenbrook)" (AHIMS ID #45-5-0116) being 43 m ASL and "Euroka Clearing; Glenbrook; Nepean River;" (#45-5-0119) being 13 m ASL.

6.7.2 Impact assessment

While five sites have been mapped within the study area, three of these have been erroneously mapped and the study area therefore contains two previously identified sites. Both sites are located beyond the existing and anticipated water levels: "Euroka Clearing (Glenbrook)" (AHIMS ID #45-5-0116) being 43 m ASL and "Euroka Clearing; Glenbrook; Nepean River;" (#45-5-0119) being 13 m ASL. No previously identified sites have therefore been recorded within the impact area, being within 10 cm of the waterline. The inaccessible nature of the riverbanks, while not precluding the existence of sites, does make them unlikely, particularly within 10 cm of the

water level. Predictive modelling indicates Indigenous people preferenced elevated areas away from inundation zones. Sites that would exist on the waters edge are grinding grooves that, if present, would not be impacted by the increase to the wetted perimeter, which is expected to occur to in-channel bars and benches, not the banks where grinding grooves would be anticipated (Streamology 2021).

This is rated as a negligible change resulting in a negligible impact for an overall impact of neutral.

6.8 Historical heritage sites

Table Rock Lookout has been identified as holding local heritage significance. The significance is attached to the historical association with the Fairlight Estate, but more important for this assessment is the identification of the area as an early tourism destination for its aesthetic views along the Nepean River corridor. The physical expression of the early tourism industry may consist of holes or bolts in the Rock that were anchor points for the former flying fox. As these are at the top of the gorge, they would not be impacted by a rise of up to 10cm in water height.

6.8.1 Historical Heritage

Physical manifestations of the historical flying fox at Table Rock Lookout would be at the top of the gorge and would not be impacted by a rise of up to 10 cm in water height. As stated in Section 6.1.2, this water level rise is unlikely to make an appreciable difference to tourists viewing the Nepean River from Table Rock Lookout.

This is rated as a negligible change resulting in a negligible impact for an overall impact of neutral.

6.9 Heritage Impact Statement

Table 6.3 provides a summary of the heritage impacts, using the criteria provided in the significant impact guidelines *Matters of National Environmental Significance, Significant Impact Guidelines 1.1* (Department of the Environment 2013:21) for the shared World and National Heritage values. The additional National Heritage values are summarised in Table 6.4. Table 6.5 summarises the identified impacts.

In summary, the overall impact of the project on the heritage values of the GBMWHA would be neutral. No impacts to amenities or navigation have been identified. Some slightly beneficial impacts to water quality and aquatic ecological habitats have been identified, while there may be some loss of individual trees associated with increased inundation times. In making the assessments reference has been made to the GBMWHA Strategic Plan and the Blue Mountains National Park Plan of Management. Assessment against the objectives and strategies of these plans has been provided in Appendix A. In summary, the project does not contravene the policies or objectives contained within the *Greater Blue Mountains World Heritage Area Strategic Plan* or the *Blue Mountains National Park Plan of Management*. It is therefore considered that the project is acceptable under these management plans.

The studies synthesised in this HIA have been undertaken based on modelling of water quality and hydrology. While there is potential for minor inaccuracies in the modelling or the terrestrial or aquatic communities identified to react in unanticipated ways, these eventualities have been addressed within the specialist reports and considered in their impact assessments. It is therefore not considered that the relevant impacts are likely to be unknown, unpredictable or irreversible (SEAR 9ii).

Table 6.3 Significant impact criteria identified in *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Department of the Environment, 2013) shared World and National Heritage values

Criterion	World and National Heritage Assessment
Values associated with geology or landscape	
damage, modify, alter or obscure important geological formations in a World/National Heritage property;	**No.** Raising the water level by less than 10 cm will not damage, modify, alter or obscure important geological formations as no important geological formations have been identified within the study area.
damage, modify, alter or obscure landforms or landscape features, for example, by excavation or infilling of the land surface in a World/National Heritage property;	**No.** The project would raise the water level by less than 10 cm and would not result in increases in erosion. The project would therefore not damage, modify, alter or obscure landforms or landscape features.
modify, alter or inhibit landscape processes, for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes, in a World/National Heritage property;	**No.** Due to the channelised nature of the Nepean River, no acceleration or increased susceptibility to erosion is anticipated. The increased water flows would not modify, alter or inhibit landscape processes.
divert, impound or channelise a river, wetland or other water body in a World/National Heritage property; and	**No.** The project does not divert, impound or channelise the Nepean River.
substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body in a World/National Heritage property.	**No.** Water quality modelling indicates a slight overall improvement in water quality, resulting in a beneficial positive impact to this value.
Biological and ecological values	
reduce the diversity or modify the composition of plant and animal species in all or part of a World/National Heritage property;	**No.** The project may result in the loss of individual trees due to increases in inundation periods over a very small area of increased inundation (0.19 ha), but the overall diversity and composition would not be altered to any measurable extent. No negative impacts to aquatic ecology, including Macquarie Perch, are anticipated. Increases in aquatic habitat may have a beneficial impact on aquatic fauna.
fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World/National Heritage property;	**No.** While minor impacts have been identified to terrestrial flora, these would not fragment or isolate and are unlikely to result in substantial damage habitat important for conservation. Increases in water levels may provide for a slight improvement in connectivity between breeding populations of Macquarie Perch and an increase in habitat for aquatic fauna more generally. No fragmentation, isolation or substantial damage is anticipated to the aquatic habitat within the GBMWHA.
cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World/National Heritage property; and	**No.** Reduction in the number of individual trees may occur as a result of increased inundation frequencies over an area of no more than 0.84 hectares. The impact is not considered a significant impact (Biosis 2021).
fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World/National Heritage property.	**No.**

Criterion	World and National Heritage Assessment
Values associated with geology or landscape	
	While impacts have been identified, these would not fragment or isolate and are unlikely to result in substantial damage habitat important for conservation.
Wilderness, natural beauty or rare or unique environment values	
involve construction of buildings, roads, or other structures, vegetation clearance, or other actions with substantial, long-term or permanent impacts on relevant values	**No.** The proposal does not include any of these actions in the GBMWHA
introduce noise, odours, pollutants or other intrusive elements with substantial, long-term or permanent impacts on relevant values	**No.** Water quality modelling indicates a slight overall improvement in water quality. Modelling indicates the project would not result in the introduction of noise, odours, pollutants or other elements with impacts on the values.

Table 6.4 Significant impact criteria identified in *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Department of the Environment, 2013) National Heritage values

Criterion	National Heritage Assessment
Historic heritage values	
permanently remove, destroy, damage or substantially alter the fabric of a National Heritage place in a manner which is inconsistent with relevant values;	**No.** No built National heritage places fall within the study area.
extend, renovate, refurbish or substantially alter a National Heritage place in a manner which is inconsistent with relevant values;	
permanently remove, destroy, damage or substantially disturb archaeological deposits or artefacts in a National Heritage place;	**No.** No archaeological deposits have been identified within the inundation zone.
involve activities in a National Heritage place with substantial and/or long-term impacts on its values;	**No.** Section 6.8.1 concluded that the impacts to the National historical heritage values would be negligible.
involve the construction of buildings or other structures within, adjacent to, or within important sight lines of, a National Heritage place which are inconsistent with relevant values; and	**No.** The project does not include construction within the GBMWHA.
make notable changes to the layout, spaces, form or species composition of a garden, landscape or setting of a National Heritage place in a manner which is inconsistent with relevant values.	**No.** Raising the water level by a maximum of 10 cm would not notably change the landscape.
Other cultural heritage values	
restrict or inhibit the continuing use of a National Heritage place as a cultural or ceremonial site causing its values to notably diminish over time;	**No.** Access to the study area would not be altered by the project.

Criterion	National Heritage Assessment
permanently diminish the cultural value of a National Heritage place for a community or group to which its National Heritage values relate;	**No.** The project would not result on impacts to archaeological or rock art sites or restrict access. The cultural value would not be diminished.
destroy or damage cultural or ceremonial, artefacts, features, or objects in a National Heritage place; and	**No.** The project would not result on impacts to archaeological or rock art sites as none have been identified within the inundation zone.
notably diminish the value of a National Heritage place in demonstrating creative or technical achievement.	**No.** The study area does not contain sites that demonstrate creative or technical achievement.
Indigenous heritage values	
restrict or inhibit the continuing use of a National Heritage place as a cultural or ceremonial site causing its values to notably diminish over time;	**No.** Access to the study area would not be altered by the project. The study area has not been identified as containing cultural or ceremonial sites.
permanently diminish the cultural value of a National Heritage place for an Indigenous group to which its National Heritage values relate;	**No.** Raising the water level by a maximum of 10 cm would not permanently diminish the cultural value as there would be no noticeable change to the landscape.
alter the setting of a National Heritage place in a manner which is inconsistent with relevant values;	**No.** Raising the water level by a maximum of 10 cm would not notably change the setting.
remove, destroy, damage or substantially disturb archaeological deposits or cultural artefacts in a National Heritage place;	**No.** No archaeological deposits have been identified within the inundation zone.
destroy, damage or permanently obscure rock art or other cultural or ceremonial, artefacts, features, or objects in a National Heritage place;	**No.** The project would not result on impacts to archaeological or rock art sites as none have been identified within the inundation zone.
notably diminish the value of a National Heritage place in demonstrating creative or technical achievement;	**No.** The study area does not contain sites that demonstrate creative or technical achievement.
permanently remove, destroy, damage or substantially alter Indigenous built structures in a National Heritage place; and	**No.** The study area does not contain Indigenous built structures.
involve activities in a National Heritage place with substantial and/or long-term impacts on the values of the place.	**No.** Raising the water level by a maximum of 10 cm would not notably impact on the values.

Table 6.5 Heritage Impact Statement

Value	Identified impact	An action is likely to have a significant impact on the heritage values if there is a real chance or possibility that it will cause:		
		One or more of the heritage values to be lost	One or more of the heritage values to be degraded or damaged	One or more of the heritage values to be notably altered, modified, obscured or diminished
Geodiversity and Geomorphology	None	No	No	No
Biodiversity	Yes (slight negative)	No	No	No
Water	Yes (negligible beneficial)	No	No	No
Aquatic ecology	Yes (negligible beneficial)	No	No	No
Indigenous connections	None	No	No	No
Indigenous sites	None	No	No	No
Historical Heritage sites (including visual)	None	No	No	No

6.10 Mitigation and management measures

SEAR 10, Attachment 1, requires that information on the proposed avoidance and mitigation measures be provided where significant impact has been identified, including the predicted effectiveness, statutory basis, cost and management plans. That level of detail is not required as no significant impact has identified, with the assessment indicating the impact will range from slight (biodiversity), through none (geodiversity and geomorphology and Indigenous or historical heritage sites) to slightly beneficial (water quality and aquatic ecology).

The specialist studies from which the information in this HIA has been drawn contain mitigation measures. A review of these measures indicates they are satisfactory to address the slight to negligible beneficial impacts identified to the heritage values of the GBMWHA.

The following management and mitigation measures are recommended in relation to the World and National Heritage values of the GBMWHA:

- Biosis (2021) have identified a number of mitigation measures design to mitigate impacts of the project on biodiversity values. This includes ensuring the quality of water released into the Nepean River, monitoring of biodiversity offsets that cover the potential loss of vegetation for the project as a whole, including the indirect impacts within the GBMWHA. These measures should be adopted;
- CT Environmental (2021) and Aurecon Arup (2021) have both recommended on-going water quality and aquatic ecology monitoring. This measure should be adopted; and
- The Aboriginal Cultural Values Study should be reviewed once complete and relevant recommendations considered for implementation in relation to the Indigenous connections to the GBMWHA section of the Nepean River.

7 Conclusion and Recommendations

Sydney Water is planning to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas. The proposed development will include a wastewater treatment plant and associated pipelines, collectively known as the 'project'.

The project has been declared a controlled action under the EPBC Act with World Heritage Properties and National Heritage Places listed as controlling provisions (EPBC 2020/8816). The project was deemed to have potential to impact on the World Heritage Listed GBMWHA, which is also identified on the National Heritage List as holding natural heritage values.

The interaction between the project and the GBMWHA is confined to a small portion of the Blue Mountains National Park. The two release points for treated water from the AWRC are into Warragamba River downstream (north-east) of the Warragamba Dam wall and into Nepean River upstream of its confluence with the Warragamba River. Both these locations are outside of the GBMWHA. The Warragamba River stretches approximately 1 km before reaching the boundary of the GBMWHA, while the release point into the Nepean River is approximately 1.5 km from the GBMWHA boundary. Flows of treated water, mixed with the waters of the Nepean River, would flow through the GBMWHA for approximately 13 km prior to the Nepean River exiting the GBMWHA. This HIA has focused on the 13 km stretch within the GBMWHA, identifying and assessing the impacts to the World and National heritage values. The HIA has looked beyond the listed natural values to encompass the Indigenous and historical heritage values ascribed by the broader Australian community, but not yet acknowledged within the formal National Heritage Listing.

The Nepean River sits within a confined channel bed within the bedrock, which has been assessed as being in good geomorphic condition. The river bed consists of bedrock overlaid with gravel, cobbles and boulders and there are a number of in-channel bars and benches. The existing terrestrial environment is made up of five Plant Community Types: 835 Forest Red Gum, PCT 1078 Prickly Tea-tree, PCT 1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint, PCT 1284 Turpentine - Smooth-barked Apple and PCT 1292 Water Gum – Coachwood. The area provides habitat for platypus, echidna and a range of birds, mammals and reptiles. The aquatic environment has been identified as habitat for the endangered Macquarie Perch. Aquatic plants consist of both native and exotic species and the macroinvertebrate community structure indicates low family richness, probably as a result of water quality.

No Indigenous archaeological or art sites have been identified within the immediate waters edge. The eastern bank of the Nepean River is listed on the Penrith LEP as Table Rock Lookout with aesthetic and historical significance. The historical significance relates to both Indigenous and historical activities. No built or historical heritage sites have been identified within the immediate waters edge. Preliminary consultation with local Aboriginal communities indicates has not identified particular sites or points of connection within the study area, but Aboriginal communities view rivers, including the Nepean as sources of both spiritual and practical nourishment. Caring for country is a deeply held obligation.

Hydrological modelling of project impacts has identified that a rise in water level of up to 5 cm at 50 M/L day and 10 cm at 100 M/L day is anticipated. The wetted perimeter could increase by up to 2 m, although this would impact on in-channel bars and benches, with no additional overbank flow as the Nepean River is contained within a channel within the bedrock. Changes to water velocity would be <0.01 m/s, which is negligible. Water quality modelling indicates that there would be a slight improvement in quality.

The impacts associated with these alterations would be:

- imperceivable alteration to views or landscape setting within the GBMWHA, including at Table Rock Lookout;
- no increase in erosion and therefore no impact on the geodiversity or geomorphology of the GBMWHA;

- improved water quality, resulting in slightly beneficial outcomes for aquatic ecology;
- inundation frequencies of individual trees within an additional area of 0.19 of a hectare
- no impact to Indigenous archaeological or art sites;
- no alteration in Indigenous community connections – visitation would not be altered and as the impacts of the project are slight, the country is being cared for.

In summary, the assessment indicating the impact will range from slight (biodiversity), through none (geodiversity and geomorphology and Indigenous or historical heritage sites) to slightly beneficial (water quality and aquatic ecology). As Indigenous connections is based on consideration of caring for the whole of environment, on balance it is likely that the project would be considered as caring for country.

The specialist studies from which the information in this HIA has been drawn contain mitigation measures. A review of these measures indicates they are satisfactory to address the slight to negligible beneficial impacts identified to the heritage values of the GBMWHA.

The following management and mitigation measures are recommended in relation to the World and National Heritage values of the GBMWHA:

- Biosis (2021) have identified a number of mitigation measures design to mitigate impacts of the project on biodiversity values. This includes ensuring the quality of water released into the Nepean River, monitoring of biodiversity offsets that cover the potential loss of vegetation for the project as a whole, including the indirect impacts within the GBMWHA. These measures should be adopted;
- CT Environmental (2021) and Aurecon Arup (2021) have both recommended on-going water quality and aquatic ecology monitoring. This measure should be adopted; and
- The Aboriginal Cultural Values Study should be reviewed once complete and relevant recommendations considered for implementation in relation to the Indigenous connections to the GBMWHA section of the Nepean River.

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Appendix A

Application of Strategic Plan and Plan of Management policies

A.1 Strategic Plan

Table 8.1 Greater Blue Mountains World Heritage Area Strategic Plan objectives, management response and application of selected key impacts

Objective	Background	Management response	Application to HIA
		Integrity	
To maintain, and wherever possible, improve the current and future integrity of the GBMWHA.	Identified as a potential impact to integrity is the long and complex boundary, with a large number of landholders and land uses. Global climate change is also identified as a risk to the integrity of the GBMWHA.	1.1 Ensure that statutory plans of management of all GBMWHA reserves are reviewed and amended to specifically address World Heritage objectives and meet the requirements of the Australian World Heritage management principles and this Strategic Plan and that they contain provisions for evaluating and monitoring their effectiveness.	Outside of remit of HIA
		1.2 Assess existing reserved areas not within the GBMWHA for potential addition to the GBMWHA and seek the addition of suitable qualifying areas to the GBMWHA.	Outside of remit of HIA
		1.3 Acquire high conservation value and/or strategically located freehold land within or adjacent to the GBMWHA, on a voluntary acquisition basis.	Outside of remit of HIA
		1.4 Support and encourage appropriate “off-park” conservation programs and, where appropriate, negotiate Voluntary Conservation Agreements with adjacent landholders.	The project is an “off-park” development. The project will improve water quality, which would have a positive impact on aquatic communities.

Objective	Background	Management response	Application to HIA
		1.5 Investigate and pursue the establishment of a Greater Blue Mountains Biosphere Reserve which encourages the compatible management of lands adjoining the World Heritage Area.	Establishment of the Greater Blue Mountains Biosphere Reserve is outside the remit of Sydney Water and the HIA. However, improvements in water quality and aquatic communities supports the intent of the initiative.
		1.6 Provide ongoing and proactive input to the establishment and implementation of effective local government planning and land management controls for land adjacent to the GBMWHA.	Establishment of effective local government planning is outside of Sydney Water's remit. However, the EIS assesses consistency of the project against the local strategic planning statements of the five local government areas through which the project passes.
		1.7 Establish a system for formal auditing and reporting on the state of the GBMWHA's World Heritage values based on systematic monitoring of the impact of threatening processes (including environmental changes partly or largely attributable to global climate change).	Establishment of the system is outside Sydney Water's remit. Assessment of the potential impacts of the project would be captured within this system and the HIA should identify why the project is not a 'threatening process'.
		1.8 Maintain and enhance the wilderness and wild river quality and values of the GBMWHA through formal declaration and appropriate management programs (see also Key Issues — Biodiversity).	The project has no interaction with wilderness areas or wild rivers.
		1.9 Collaborate with the Blue Mountains World Heritage Institute and the GBMWHA Advisory Committee to identify gaps in existing databases of both indigenous and scientific knowledge, and develop and implement appropriate research programs which will assist in management of the GBMWHA, maintenance of its integrity and in identifying National and additional World Heritage values (see also Key Issues — Major Impacts, Biodiversity, Geodiversity, Water catchment protection and Cultural heritage).	Outside of Sydney Water's remit, however, the data collected during the impact assessment process may be provided to the Blue Mountains Heritage Institute and Advisory Committee as a means of knowledge sharing to close gaps.
		Major Impacts	
To reduce the potential for major impacts to adversely affect the integrity of the GBMWHA.	Developments or activities with potential and existing major impacts include increasing urbanisation of adjacent land, adjacent or underlying mining operations, the proposal for a "superhighway" along the existing Bells Line of Road which traverses east-west	2.1 Ensure that environmental impact assessments for proposals that may affect the GBMWHA (whether or not on the reserves themselves) adequately address potential and existing impacts on World Heritage values and are carried out in accordance with the principles of the EPBC Act and, where required, referred to the Australian Government Minister for the Environment.	The HIA is being prepared in response to this management measure. The HIA should consider impacts to World Heritage values and outline proposed management and mitigation measures.
		2.2 Provide information to local and state government authorities and other relevant organisations (for example, those responsible for infrastructure) about the GBMWHA's World Heritage values and ensure they are aware of legal provisions to protect these values.	Sydney Water are aware and are responding to the World Heritage Values by assessing the impacts.

Objective	Background	Management response	Application to HIA
	through the centre of the GBMWHA and upgrading of telecommunications, electricity, water supply and other infrastructure….[A]ny action that will or is likely to have a significant impact on World Heritage values may be taken only if it is approved by the Australian Government Environment Minister, either directly or via an approved plan of management	2.3 Work with local councils to develop suitable local and regional planning instruments (e.g. Local and Regional Environment Plans) for areas adjacent to the GBMWHA.	Outside Sydney Water's remit. Relevant LEP and REP instruments are being addressed within the State assessment process for the project.
		2.4 Where there is doubt about the potential impacts of an action on World Heritage values the precautionary principle shall be applied; every effort will be made in consultation with the relevant parties to minimise any risk of adverse impacts.	The HIA is being prepared in accordance with the precautionary principle to demonstrate what impact the project may have.
		2.5 Continue to work with the Blue Mountains World Heritage Institute to better understand and monitor the impacts of surrounding land uses on World Heritage values.	No new information regarding heritage sites has been identified as a result of this assessment that is relevant to this management response.
		Biodiversity	
To conserve the GBMWHA's biodiversity and ensure the ecological viability and capacity for ongoing evolution of its World Heritage and other natural values is maintained.	To conserve the GBMWHA's World Heritage values, management aims to maintain species richness and genetic diversity, to ensure populations of threatened species remain viable, to control threatening processes and to maintain opportunities for continued natural evolution… Invasion by pest species (both plants and animals) is a potential major threat to the area's World Heritage value.	3.1 Support and undertake relevant co-ordinated research programs, in conjunction with the Blue Mountains World Heritage Institute and other organisations, which will assist managers, particularly in relation to threatened species, monitoring, fire management, pest species control and impacts of visitor use.	Sydney Water could consider providing relevant data to the Blue Mountains World Heritage Institute to assist.
		3.2 Develop an integrated data storage and retrieval system accessible to managers in all relevant agencies to provide information relevant to improved management of World Heritage and other values.	Outside of Sydney Water and the HIA's remit.
		3.3 Review current pest species management and fire management priorities and programs to ensure they are adequate for conservation of biodiversity and maintenance of World Heritage values.	CT Environmental considered pest species and concluded the project would not exacerbate the spread of pest species.
		3.4 Strengthen and expand existing cooperative pest species management programs, with particular emphasis on programs which encourage ongoing community and neighbour involvement.	CT Environmental considered pest species and concluded the project would not exacerbate the spread of pest species.
		3.5 Encourage and assist local councils to develop suitable statutory controls (e.g. vegetation management orders or animal management orders) in areas which may impact on the GBMWHA to prevent the spread of weeds and introduced animals into the GBMWHA.	CT Environmental considered pest species and concluded the project would not exacerbate the spread of pest species.
		3.6 Give priority to the implementation of threat abatement plans and the preparation and implementation of recovery plans for all endangered ecological communities, endangered populations and threatened species within the GBMWHA.	Outside of Sydney Water and the HIA's remit.

Objective	Background	Management response	Application to HIA
		Geodiversity	
To protect the GBMWHA's geodiversity. Background	The GBMWHA represents a major geological feature of eastern Australia. It is a dissected upland plateau extending from the Southern Tablelands in the south to the Hunter Valley in the north, and from the Central Tablelands in the west to the Cumberland Plain in the east. The altitude of the plateau surface ranges between	4.1 Support and undertake geodiversity research and education programs, in conjunction with the Blue Mountains World Heritage Institute, the Australian Speleological Federation and other relevant research organisations to better understand the relationship with World Heritage values.	Outside of Sydney Water and the HIA's remit.
		4.2 Research, record and assess the significance of the geodiversity values of the GBMWHA against State, National and World Heritage listing criteria and seek formal recognition as appropriate.	The HIA did not identify geodiversity values within the study area of significance at a State, National or World level.
		4.3 Support and undertake geodiversity research and education programs to inform and support a program of better protection of geodiversity.	Outside of Sydney Water and the HIA's remit.

Objective	Background	Management response	Application to HIA
	about 1000m and 200m, falling from the uplifted Great Divide and Central Tablelands in the west towards the coastal lowlands around Sydney in the east and the Hunter Valley in the north. In places where this fall is sudden, the plateau is edged by steep escarpments (e.g. southern rim of the Hunter Valley). Dramatic pagoda formations (sandstone pinnacles) are another special feature, occurring on the western part of the Narrabeen Sandstone, in Wollemi and Gardens of Stone National Parks. The geology and geomorphology of the GBMWHA underpin the World Heritage natural values, because of their crucial role in the evolution of the Area's ecosystems and plant and animal communities.	4.4 Prevent or minimise unnatural chemical and mechanical weathering and other damage to geological features/diversity through intervention, monitoring and stabilisation.	The HIA did not identify geodiversity values within the study area of significance at a State, National or World level. Regardless, the project has been assessed as having no impact on the geodiversity of the study area.
		Water Catchment Protection	
To maintain and improve the water quality and water	…a number of largely undisturbed catchments within the GBMWHA make a significant contribution to	5.1 Review current catchment protection priorities and programs and co-operative management arrangements to ensure they are adequate for the maintenance and improvement of World Heritage and other values of the GBMWHA.	Water quality modelling indicates the project would result in an improvement to water quality.

Objective	Background	Management response	Application to HIA
catchment values of the GBMWHA.	water quality in the Hawkesbury-Nepean river system and the water storage reservoirs which supply Sydney and adjacent urban areas. Because of the geography of the GBMWHA, the potential for adverse impacts on water quality from urban and industrial land uses, particularly stormwater runoff and sewage pollution, arise largely within the City of Blue Mountains, upstream from Blue Mountains National Park… The combination of nutrient enrichment and water extraction from these sources reduces water quality and poses a potential threat to the maintenance of World Heritage values, including some threatened species.	5.2 Support and encourage catchment education and research programs in conjunction with the Sydney Catchment Authority, catchment management authorities and the Blue Mountains World Heritage Institute.	Outside of Sydney Water and the HIA's remit. However, Sydney Water's existing education programs can benefit this management response generally.
		Cultural Heritage	
To identify, formally recognise and protect the cultural heritage values of the GBMWHA. To manage the GBMWHA jointly with local Indigenous people.	The long history of Aboriginal occupation and connection to the Countries that comprise the GBMWHA, as well as its diversity of non-Aboriginal cultural sites, and the history of early conservation campaigns, were factors cited in support of its nomination under the World Heritage Convention's cultural criteria, a proposal which was	6.1 Continue and further develop close consultation with local Aboriginal peoples through the Living Country Aboriginal Co-management Project and the Central Coast / Hunter Range Region Co-management Committee.	Outside of Sydney Water and the HIA's remit.
		6.2 Through the Mapping Country Project and in partnership with local Aboriginal communities, appropriately document the Indigenous cultural values of the GBMWHA.	No sites or values have been identified that could be added to the Project.
		6.3 Ensure valid native title is recognised and Indigenous Land Use Agreements negotiated, consistent with Australia's obligations under the World Heritage Convention and the restrictions on land use imposed by law.	The Gundungurra ILUA skirts the western side of the study area and has been addressed within the report.

Objective	Background	Management response	Application to HIA
	subsequently not endorsed by the World Heritage Committee due to lack of adequate information available at the time. The potential for listing of the GBMWHA under the criterion relating to outstanding universal cultural associations needs to be further explored.	6.4 Through the Living Country Co-management Project, prepare and implement agreed GBMWHA Indigenous heritage strategies, consistent with government and agency cultural heritage policies (e.g. Cultural Heritage Conservation and Cultural Heritage Community Consultation Policies).	No relevant strategies have been identified.
		6.5 Investigate the feasibility of establishing an Aboriginal employment / capacity-building program and develop strategies for working towards Aboriginal co-management of the GBMWHA reserves.	While not directly relevant, Sydney Water may consider employment of Indigenous people during construction and operation of the project.
		6.6 Research, record and assess the significance of the cultural heritage values of the GBMWHA against State, National and World Heritage listing criteria and seek formal recognition as appropriate.	The HIA did not undertake field inspections and previously identified sites were adequately assessed to allow for the determination of impacts.
		6.7 Encourage cultural heritage research projects which assist with the protection and management of the GBMWHA's cultural heritage values.	Outside of Sydney Water and the HIA's remit.
		6.8 Emphasise the importance of Indigenous culture and history, by identifying suitable Aboriginal words for naming / co-naming the GBMWHA and its reserves.	Outside of Sydney Water and the HIA's remit.
		6.9 Ensure recognition of non-Aboriginal heritage values, including art inspired by the landscape, relationships between people and the environment, early conservation campaigns, built heritage, and recreational activities and infrastructure.	The HIA identified Table Rock Lookout as holding non-Aboriginal heritage values. No impacts to the Lookout have been identified as part of the project.
		Landscape, natural beauty and aesthetic values	
To protect the landscape, natural beauty and aesthetic values of the GBMWHA.	The aesthetic beauty of the landscape of the GBMWHA was not recognised by the World Heritage Committee as being of outstanding universal significance, nonetheless the area's natural beauty and scenic landscapes unquestionably make a major contribution to the positive experiences of domestic and international visitors to the area and contribute to the significant	7.1 Research, record and assess the significance of the natural beauty and aesthetic values of the GBMWHA against State, National and World Heritage listing criteria and seek formal recognition as appropriate.	The HIA has considered the natural and aesthetic significance of the study area. No impacts were identified.
		7.2 Ensure that management activities and visitor use within and adjacent to the GBMWHA have minimal impacts on the area's scenic and aesthetic values.	Outside of Sydney Water and the HIA's remit.
		7.3 Improve visitor identification of the GBMWHA as a region, develop a sense of arrival at entry points, and ensure development of visitor facilities / interpretation of appropriate character, design and construction.	Outside of Sydney Water and the HIA's remit.
		7.4 Ensure that the impact of new developments within and adjacent to the GBMWHA on the area's scenic and aesthetic values are considered, including any adverse impacts associated with lighting.	The HIA has considered the natural and aesthetic significance of the study area. No impacts were identified.

Objective	Background	Management response	Application to HIA
	levels of visitation. They are also of special significance to neighbouring communities, as evidenced by the large body of contemporary literature and artwork inspired by the landscape which has been produced by these communities over a long period. Scenic values can be compromised by inappropriate developments in prominent locations adjoining the area. Properties adjoining the GBMWHA with prominent vantage points are highly valued and under pressure for residential and tourist development.	7.5 Continue to work with the relevant agencies, aviation industry and military to implement and monitor the existing Fly Neighbourly program to ensure that any impact of aircraft on the GBMWHA (especially wilderness areas), park visitors and neighbouring communities is minimised.	Outside of Sydney Water and the HIA's remit.
		7.6 Seek the establishment of a Restricted Area under the Air Services Regulations to provide statutory restrictions on tourist flights over the GBMWHA.	Outside of Sydney Water and the HIA's remit.
		7.7 Work with local government authorities to introduce appropriate development controls for lands adjoining and within, scenery catchments of the GBMWHA.	The HIA has considered the natural and aesthetic significance of the study area. No impacts were identified.
		7.8 Assess scenery catchments, particularly at approaches, access points and visitor facilities to identify negative features and develop short and long-term amelioration measures.	The HIA has considered the natural and aesthetic significance of the study area. No impacts were identified.
		Community Participation and Consultation	
To encourage community stewardship of the GBMWHA through education, consultation and the provision of opportunities for community participation in its protection.	As recognised in the World Heritage Convention, a sense of community "ownership" of the GBMWHA is essential to achieving the stated strategic objectives of conserving and transmitting its outstanding universal values to future generations. Community members who have a sense of connection to the area and understand their important stewardship role will be more likely to support the area's conservation into the future and less likely to oppose management proposals	10.1 Work with reserve neighbours and local communities to develop and implement new partnership programs, for example World Heritage Neighbourhood Watch and GBMWHA "Ambassadors".	Outside of Sydney Water and the HIA's remit.
		10.2 Establish a forum for information exchange and neighbour input into the management of the GBMWHA.	Outside of Sydney Water and the HIA's remit.
		10.3 In partnership with local agencies, support and expand community-based volunteer rehabilitation programs to maximise the effectiveness of pest species control programs and rehabilitation of degraded areas.	Outside of Sydney Water and the HIA's remit.
		10.4 Support and expand education programs for tourism operators (as per the GBMWHA Interpretation and Visitor Orientation Plan).	Outside of Sydney Water and the HIA's remit.
		10.5 Support and expand education programs regarding the GBMWHA such as DECC Discovery and seek interagency support and external funding for improved education packages, particularly for use in schools and other environmentally based community activities, such as the Earth Journeys Schools program.	Outside of Sydney Water and the HIA's remit. Sydney Water may be able to indirectly contribute to this management response through their current education programs.

Objective	Background	Management response	Application to HIA
	aimed at enhancing the area's integrity and conserving its significant values.	10.6 Support the GBMWHA Advisory Committee and effectively engage the community and the National Parks Regional Advisory Committees in the implementation of this Strategic Plan. (See also Key Issue — Cultural Heritage re partnerships with Aboriginal groups).	Outside of Sydney Water and the HIA's remit.
		10.7 Support and assist local Aboriginal people to develop further educational cultural heritage programs and activities for schools, visitors, and local communities regarding the GBMWHA.	Outside of Sydney Water and the HIA's remit.

A.2 Blue Mountains Plan of Management

Table 8.2 Blue Mountains National Park Plan of Management policies and their application to the HIA

Subheading	Policy	Application to HIA
	Conservation of Natural Heritage	
Geology, Landforms and Soils	The Service will minimise the impacts of visitor use, management activities and adjacent land uses on geological, geomorphological and hydrological processes within the park by imposing conditions of use on activities within the park and through liaison with determining authorities and neighbours outside the park.	The HIA has not identified impacts to geological, geomorphological and hydrological processes arising from the project.

Subheading	Policy	Application to HIA
	Important scenic features and significant geological, geomorphic and/or pedological features will receive priority protection from adverse impacts of use, activities and developments, including the following features: • the Jamison Valley cliffs, including the Three Sisters (see section 4.3.8 Adventure Recreation for specific provisions); • Grose Valley cliffs, particularly Mount Banks (see section 4.3.8 Adventure Recreation for specific provisions); • Canyons and pagodas of the Grose, Wollangambe and Bungleboori catchments; • igneous features of the Yerranderie area; • colluvial deposits associated with the Kurrajong fault including Portal Waterhole, Blue Gum Swamp and Burralow Creek; • karst areas; • diatremes; • basalt caps; • Wianamatta Shale areas; • hanging swamps and valley swamps; • talus lakes of the Grose Valley and elsewhere; • palaeontological sites, including at Mount Hay, Narrow Neck and Broken Rock Range.	No impacts to these scenic features have been identified.
	Soil erosion and sedimentation control standards will be developed co-operatively with the Department of Land and Water Conservation and the Sydney Catchment Authority. All relevant management activities in the park will be consistent with these standards and, for areas within the Warragamba Special Area, the Sydney Catchment Authority Soil Conservation Manual.	The geomorphological assessment has not identified additional risk of erosion as a result of the project.
	Soil erosion and sedimentation control measures will be implemented in areas subject to accelerated erosion and instability arising from visitor use, management activities and adjacent land uses.	The geomorphological assessment has not identified additional risk of erosion as a result of the project.
	The extraction of sand, clay, rock, gravel or any like substance will be prohibited, except for an essential management work where no practical/prudent alternative is available and where environmental impact is considered acceptable.	No extraction is proposed by the project.
	The Service will include objectives and actions for minimising erosion arising from prescribed and wildfires in its fire planning and management programs (see also section 4.1.5 Fire Management).	Not relevant to the project.

Subheading	Policy	Application to HIA
Catchment Management	The Service will seek to achieve effective catchment protection, through liaison with appropriate authorities and individuals, with the following specific aims: • to achieve co-ordinated water quality monitoring programs; • to identify, control, reduce and where possible eliminate sources of water pollution; • to reduce the impact of upstream land uses on water quality and quantity entering the park; • to achieve classification of all waters in the park under the Protection of the Environment (Operations) Act 1998; • to determine and achieve minimum water flow requirements from impoundments in the headwaters of park streams to maintain downstream riparian ecosystems, particularly in the Coxs River catchment.	Modelling indicates that there is likely to be an increase in water quality, which has been assessed as a negligible beneficial impact.
	The Service will consider further actions in response to any adopted outcomes from the Healthy Rivers Commission that relate to the park.	Outside of Sydney Water and the HIA's remit.
	Priority in catchment protection programs will be given to the control and elimination where possible of disturbances affecting: declared or potential wild and scenic rivers; pristine catchments; streams only minimally affected by introduced species; wilderness areas; recreational values; important water supplies; natural features of hydrological importance (e.g. karst, swamps) and significant species, populations and communities (see also section 4.1.3 Native Plants and Animals).	No interaction with wild or scenic rivers, pristine catchments and the like would occur as a result of the project.
	That part of the Warragamba Special Area within Blue Mountains National Park will be managed in accordance with the strategic plan of management jointly sponsored by NPWS and Sydney Catchment Authority for the Special Areas, this plan of management, and detailed joint management guidelines agreed between the Service and the Authority.	The project does not interact with the Warragamba Special Area in Blue Mountains National Park
	The Service will work co-operatively with the Sydney Catchment Authority to minimise the impacts of recreation on water quality within the Warragamba Special Area, particularly in the Schedule One water quality protection zone.	Outside of Sydney Water and the HIA's remit.
Native Plants and Animals	The Service will seek to maintain plant and animal diversity and distribution through the maintenance of natural processes, the mitigation of human impacts and through specific conservation programs where necessary	The project would not impact on terrestrial plant or animal diversity. While individual trees may be lost due to more frequent inundation, the mix of trees would not be altered. The aquatic diversity may be increased through water quality improvements.

Subheading	Policy	Application to HIA
	The Service will develop specific conservation programs where required (Table 3) for native plant species, populations and communities that are: • threatened with extinction, destruction or loss of diversity and productivity in the park (but not necessarily listed under the TSC Act); • endemic to the park; • at the limits of their geographic distribution; • restricted in their distribution; • of particular scientific interest; • of other specific conservation value; and • subject to specific impacts or disturbances.	The project would result in more frequent inundation to 0. 84 hectares of five Plant Community Types: 835 Forest Red Gum, PCT 1078 Prickly Tea-tree, PCT 1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint, PCT 1284 Turpentine - Smooth-barked Apple and PCT 1292 Water Gum – Coachwood. This has been assessed as a slight impact based on the limited area impacted.
	Specific conservation programs will be developed and applied to native animal species and populations where their conservation status and potentially threatening processes indicate active management is required to ensure their long term conservation within the park. Particular attention will be given to the following habitats or components of habitat (Table 3): • seasonal food sources; • sheltered topographical aspects; • the habitats of rare or threatened species, endangered populations and endangered ecological communities; • critical habitats; • riparian communities; • swamps, heaths, tall open forests and rainforests; • sites of particular scientific interest; and • bioindicator study reference catchments.	Not relevant.
	Priority for development and implementation of conservation programs will be given to threatened species, endangered populations and endangered ecological communities and their habitats as identified under the TSC Act.	The HIA should demonstrate that the proposed works are not contrary to any proposed conservation program.
	The Service will ensure during rehabilitation of disturbed areas that material which is foreign to the site or area and introduced species with potential to survive or spread are not introduced (see also section 4.1.4 Introduced Plants and Animals).	The HIA should demonstrate how this would be managed for the project or that it is not relevant.
	Research programs will be encouraged into the distribution, habitat requirements and threats to native plants and animals, with priority to threatened species, endangered populations and endangered ecological communities (see also section 4.3.8 Research).	Outside of Sydney Water and the HIA's remit.

Subheading	Policy	Application to HIA
Introduced Plants and Animals	Introduced species will be eradicated from the park wherever possible, with emphasis on those with a high invasive potential.	Outside of Sydney Water and the HIA's remit. CT Environmental's assessment indicates no new pest species are likely to be introduced as a result of the project.
	Where eradication is not possible or practical, introduced species will be contained or controlled to minimise their impacts on the park and neighbouring land uses.	Outside of Sydney Water and the HIA's remit.
	Introduced species control programs will be developed based on the following priorities…(refer to NSW Parks and Wildlife Service, 2001:32 for the priorities)	Outside of Sydney Water and the HIA's remit.
	The Service will continue to monitor and assess existing programs and to research and develop new control methods for introduced species in order to maximise efficiency and effectiveness and minimise non-target impacts.	Outside of Sydney Water and the HIA's remit.
	The Service will seek to implement all programs on a co-operative basis with other management agencies, landholders and relevant community groups so that the benefits of control programs to both the park and park neighbours are maximised.	Outside of Sydney Water and the HIA's remit.
	No European honey bee hives will be permitted within the park.	The introduction of bees is not proposed by the project.
	Because of their impacts on the park's natural and recreation values, stock will be excluded from the park except: • during transport on declared Public Roads; • during transport by vehicle to and from inholdings; and • for horses and other pack animals only, in association with authorised activities (see section 4.3.6 Horse Riding).	No stock introduction or movements are proposed by the project.
	Removal of any introduced plants with potential historic significance will only be undertaken after preparation of a conservation policy for the site (see section 4.2.2 Historic Heritage).	No tree removal within historic sites is proposed by the project.
Fire Management		Not relevant to project. The policies have not been included here for brevity.
Wilderness and Wild Rivers		Not relevant to project – the project would not have direct or indirect impacts on the three areas declared as Wilderness Areas as the Nepean River has not been identified as a Wild River. The policies have not been included here for brevity.
	Cultural Heritage	
Aboriginal Heritage	Aboriginal sites will be preserved through the mitigation of impacts, the modification of management programs with potential to adversely affect sites and, where necessary, the implementation of site specific conservation programs.	Aboriginal sites would not be impacted by the project.

Subheading	Policy	Application to HIA
	The Service will seek to involve the Aboriginal community in the management and interpretation of the park's Aboriginal heritage, including significance assessment, conservation planning, protection, interpretation and promotion.	Outside of Sydney Water and the HIA's remit.
	The park will be progressively surveyed to locate and record Aboriginal sites as resources permit, with priority to areas most threatened with human impact or natural deterioration.	No new sites have been identified during the preparation of this HIA.
	Aboriginal sites and places will be assessed on a priority basis to determine their significance, condition, threats to their conservation and assess management options, including suitability for interpretation.	Outside of Sydney Water and the HIA's remit.
	Conservation policies will be prepared and implemented for significant sites and places under threat with priority to those at greatest risk and of greatest Aboriginal, cultural or scientific importance.	No additional relevant policies were identified.
	Following assessment and Aboriginal community consultation, a limited selection of readily accessible sites will be interpreted to the public in a culturally sensitive manner consistent with their conservation.	Outside of Sydney Water and the HIA's remit.
	Consideration will be given to aesthetics and the suitability of materials in designing any site protection works.	No construction is proposed within the WHL curtilage and this policy is therefore not relevant.
	Management activities with the potential to damage Aboriginal sites and places will be preceded by site survey, Aboriginal community consultation and heritage impact assessment. Works will be modified or relocated to protect sites and places of cultural significance.	No Aboriginal sites would be impacted by the project.
	Research activities which are supported by the Aboriginal community and which are compatible with conservation objectives for specific sites and culturally important places will be encouraged. Priority will be given to research which will provide the basis for an ability to predict site occurrence throughout the park.	Outside of Sydney Water and the HIA's remit.
	Sites and places open to public access will be monitored and appropriate protection works implemented where necessary.	Outside of Sydney Water and the HIA's remit.
Historic Heritage	Historic heritage within the park will be managed in accordance with the provisions of the Burra Charter (ICOMOS 1988).	The HIA has referenced *The Burra Charter* and complies with it.
	Historic places, including historic park infrastructure and cultural landscape elements, will be protected from natural threatening processes, where possible, and from impacts arising from management and use of the park until their significance has been established and long term conservation policies have been developed to guide management.	Outside of Sydney Water and the HIA's remit.

Subheading	Policy	Application to HIA
	Research into the history of the park and surveys to locate and record historic places will be undertaken as resources permit, with priority to areas threatened with human impact, development or natural deterioration.	No new sites were identified as part of the project.
	Historic places will be assessed on a priority basis as resources permit to determine their significance, condition, impact on other park values, threats to their conservation and suitability for interpretation or other use.	Outside of Sydney Water and the HIA's remit.
	Conservation policies will be developed and implemented for significant places under threat based on the above assessment. Management options will include passive management and periodic monitoring, stabilisation, adaptation, restoration, interpretation or other use, or recording and removal.	No additional relevant policies were identified.
	Natural decay will generally be preferred to removal, except where there is no effective alternative for reasons of public safety or environmental impact.	Outside of Sydney Water and the HIA's remit.
	Management activities with the potential to damage historic places will be preceded by site survey and heritage impact assessment. Works will be modified or relocated to protect sites of cultural significance.	No impacts to historic places would occur as a result of the project.
	A limited number of representative and readily accessible historic places will be interpreted to the public, in a manner consistent with their long term conservation.	Outside of Sydney Water and the HIA's remit.
	For sites within the Warragamba Special Area, protection of water quality will take precedence over historic heritage protection where necessary, and preparation and implementation of conservation plans will be undertaken in consultation with the Sydney Catchment Authority.	Outside of Sydney Water and the HIA's remit.
	Use of the Park	
Alien Uses, Leases and Licences	The Service will liaise with organisations and individuals occupying or using lands reserved as Blue Mountains National Park to assess the nature, authority, impact and necessity for their presence.	Not relevant to the project. Sydney Water do not propose the occupation or use of lands.
	The Service will formalise and update agreements for all essential works, facilities and operations by other organisations (eg transmission lines, water pipelines and radio towers) and authorised access to inholdings (other than via public access roads) within the park in accordance with the Act and Service policy, with the specific aim of minimising adverse impacts on the park.	Not relevant to the project. Sydney Water do not require access.
	Other alien uses which are not essential and/or not covered by formal agreements within four years will be terminated and/or removed.	Not relevant to the project.

Subheading	Policy	Application to HIA
	New works, facilities or operations proposed by any organisation or individual will not be permitted within the park unless they are consistent with the purpose of reservation of the park and the provisions of this plan and, for lands included in Warragamba Special Area, the provisions of the jointly sponsored Special Areas Strategic Plan of Management.	The HIA has demonstrated that the project would not contravene this policy.