



Artist's Impression

Environmental Impact Statement – Chapter 20: Protected and sensitive lands

Warragamba Dam Raising

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20 Protected and sensitive lands

This chapter provides an assessment of protected and sensitive lands for the Warragamba Dam Raising Project as identified in the Secretary's Environmental Assessment Requirements (SEARs).

Table 20-1. Secretary's Environmental Assessment Requirements: Protected and sensitive lands

Desired performance outcomes	Secretary's Environmental Assessment Requirements ¹	Where addressed
<p>13. Protected and Sensitive Lands</p> <p>Desired performance outcomes: The project is designed, constructed and operated to avoid or minimise impacts on protected and sensitive lands.</p>	<p>1. The Proponent must assess the impacts of the project on the water catchment and processes (and the impact of processes on the project) including, but not limited to:</p> <p>(a) protected areas (including land and water) managed by OEH and/or DPI Fisheries under the <i>National Parks and Wildlife Act 1974</i> and the <i>Marine Estate Management Act 2014</i></p>	<p>Section 20.3 Section 20.4 Section 20.5</p>
	<p>(b) Key Fish Habitat as mapped and defined in accordance with the <i>Fisheries Management Act 1994</i> (FM Act)</p>	<p>Section 20.3.8 Section 20.5.9</p>
	<p>(c) waterfront land as defined in the <i>Water Management Act 2000</i></p>	<p>Section 20.1.7</p>
	<p>(d) land or waters identified as Critical Habitat under the TSC Act, FM Act or EPBC Act</p>	<p>Section 20.5.6 Section 20.5.7 Section 20.5.9</p>
	<p>(e) biobank sites, private conservation lands and other lands identified as offsets.</p>	<p>Section 20.5.10</p>
	<p>2. Maps should be included that clearly indicate the proposed high-water mark line and current high-water mark line, as well as protected area boundaries.</p>	<p>Throughout</p>
<p>14. Socio-economic, land use and property</p> <p>The project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities.</p> <p>The project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure.</p>	<p>6. Where land is reserved or acquired under the <i>National Parks and Wildlife Act 1974</i> (NPW Act), the EIS must detail:</p> <p>(a) effects of accurately predicted intermittent inundation regime, and predictions of habitat, biodiversity and cultural heritage loss or change within the OEH estate</p>	<p>Section 20.5.3 Section 20.5.4 Section 20.5.5 Section 20.5.6 Section 20.5.7 Section 20.5.9 Chapter 8 Chapter 9 Chapter 10 Chapter 12 Chapter 17 Chapter 18</p>
	<p>(b) expanded consideration of indirect effects of inundation, especially in the context of land reserved under the NPW Act</p>	<p>Section 20.5.3</p>
	<p>(c) consider impacts of the project on visual amenity and visitor experience in land reserved under the NPW Act</p>	<p>Section 20.5.4 Chapter 25</p>

Desired performance outcomes	Secretary's Environmental Assessment Requirements ¹	Where addressed
	(d) identification of any proposed infrastructure (including roads) proposed within the OEH estate. Additional access and recreational opportunities that may be provided by proposed roads must be considered and discussed with NPWS	Section 20.5.4 Chapter 5
	(e) predictions of the time and degree of disruption to recreational and management access during construction and the mitigation measures that will be undertaken. Changes to management and visitor access and infrastructure should be identified including walking track easements and access to heritage	Chapter 21
	(f) consideration of alternative options to avoid reserved lands and justification	Chapter 4
	(g) if on-park impacts are considered unavoidable and revocation/de-listing is required, consideration of the issues identified in Revocation, Re-categorisation and Road Adjustment Policy (OEH 2012) is required, along with justification.	N/A; revocation/ delisting not identified as likely to be required.

1. This chapter specifically addresses SEARs 13 and 14, in addition to those general requirements of the SEARs applicable to all chapters and as identified as such in Chapter 1 (Section 1.5, Table 1-1).

The protected and sensitive lands assessment should be read in conjunction with Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment), Chapter 10 (Biodiversity construction area), Chapter 11 (Aquatic ecology), Chapter 15 (Flooding and hydrology), Chapter 17 (Non-Aboriginal heritage), Chapter 18 (Aboriginal cultural heritage), and Chapter 21 (Socio-economic, land use and property), Chapter 27 (Water quality), and Appendix J (World Heritage assessment report). The proposed management and mitigation measures in this section are collated in Chapter 29 (EIS synthesis, Project justification and conclusion).

20.1 Legislative context

Legislative considerations relevant to protected and sensitive lands are listed in Table 20-2 and discussed as follows. These and all other legislation relevant to the EIS are discussed in detail in Chapter 2 (Statutory and planning framework). Consideration has also been given to the *Convention concerning the Protection of World Cultural and Natural Heritage*.

Table 20-2. Legislation relevant to protected and sensitive lands

Legislation	Where addressed
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Section 20.5
<i>National Parks and Wildlife Act 1974</i>	Section 20.5
<i>Threatened Species Conservation Act 1995</i>	Section 20.5
<i>Marine Estate Management Act 2014</i>	Section 20.5
<i>Fisheries Management Act 1994</i>	Section 20.5
<i>Water Management Act 2000</i>	Section 20.5
<i>Wilderness Act 1987</i>	Section 20.5

20.1.1 Convention Concerning the Protection of World Cultural and Natural Heritage

The *Convention Concerning the Protection of World Cultural and Natural Heritage* (the Convention), also referred to as the *World Heritage Convention*, provides State Parties (that is, countries) with guidance on how to identify potential sites for inscription on the World Heritage List. Once inscribed, the Convention provides additional guidance on what

is required of each State Party in the protection and preservation of such sites. The Convention was adopted by the General Conference of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) on 16 November 1972.

Signatories to the Convention pledge to conserve world cultural and natural heritage sites situated on their territory, and to take active measures to protect their national heritage. The Convention aims to promote international cooperation to protect heritage that is of such outstanding universal value that its conservation is important for current and future generations. The Convention also sets out the criteria that a site must meet to be inscribed on the World Heritage List.

Encouragement is provided to each of the State Parties to ensure that the protection of world and national heritage is integrated into relevant planning process and programs, and provide sufficient resourcing to protect, conserve, and communicate the significant values of each place.

UNESCO summarises the importance of the Convention by stating:

The most significant feature of the 1972 World Heritage Convention is that it links together in a single document the concepts of nature conservation and the preservation of cultural properties. The Convention recognises the way in which people interact with nature, and the fundamental need to preserve the balance between the two. (UNESCO n.d.)

Outstanding Universal Value (OUV) is the central concept underpinning the Convention. The current criteria for assessing OUVs are (UNESCO, n.d.):

- (i) *Represent the masterpiece of human creative genius*
- (ii) *Exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design*
- (iii) *Bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living, or which has disappeared*
- (iv) *Be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history*
- (v) *Be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change*
- (vi) *Be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria)*
- (vii) *Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*
- (viii) *Be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features*
- (ix) *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*
- (x) *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.*

20.1.2 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides the legislative framework for the protection and management of MNES, that is, flora, fauna, ecological communities and heritage places of national and international importance. Heritage places are protected through their inscription on the World Heritage List (WHL), Commonwealth Heritage List (CHL) and/or the National Heritage List (NHL).

Under Part 9 of the EPBC Act, approval is required for any action occurring within, or outside, a heritage place that has, will have, or is likely to have a 'significant impact' on the heritage values of a World, National or Commonwealth heritage listed property (referred to as a 'controlled action' under the Act). A 'significant impact' is defined as:

an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts

The EPBC Act stipulates that a person who has proposed an action that will, or is likely to, have a significant impact on a site that is listed on the World Heritage List, National Heritage List, or Commonwealth Heritage List, must refer the action to the Minister for the Environment (hereafter the Minister). The Minister will then determine if the action requires approval under the EPBC Act. If approval is required, an environmental assessment would need to be prepared. The Minister would approve or decline the action based on this assessment.

The significance of the action is based on the sensitivity, value and quality of the environment that is to be impacted, and the duration, magnitude and geographic extent of the impact. If the action is to be undertaken in accordance with an accredited management plan, approval is not needed, and the matter does not need be referred to the Minister.

Impacts to places listed on the World Heritage List, National Heritage List, and Commonwealth Heritage List are assessed through the *Matters of National Environmental Significance Significant Impact Assessment Guidelines 1.1* (DoE 2013).

The Project was referred to the former Department of the Environment and Energy¹ (DoEE) (EPBC Act referral 201717940) and was deemed a controlled action due to potentially significant impacts to World Heritage properties and national heritage places and listed threatened species and ecological communities.

20.1.2.1 Bilateral agreement made under section 45 of the EPBC Act

The bilateral agreement allows the assessments of matters addressed under the EPBC Act through formally accredited NSW process cited in the agreement. For development, this means a single approval process is followed, instead of the former dual Commonwealth/State processes. The former DoEE provided guidelines and identified key issues to be addressed in the EIS for the Project. These were included as Attachment A to the SEARs issued under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Attachment A to the SEARs identifies the MNES protected under the EPBC Act that have been triggered for assessment. These are referred to as the 'controlling provisions', with those relevant to the Project being:

- World Heritage properties
- national heritage places
- listed threatened species and ecological communities.

The first two controlling provisions are addressed in this chapter (and in Appendix J World Heritage Assessment Report). The third controlling provision is addressed in Chapter 12 (Matters of NES – Biodiversity) and in Appendix F5 (Matters of NES – Biodiversity).

20.1.2.2 MNES Significant Impact Assessment Guidelines 1.1

The *Matters of National Environmental Significance Significant Impact Assessment Guidelines 1.1* (Impact Guidelines) (DoE 2013) provide the framework for the assessment of various MNES under the EPBC Act. The Impact Guidelines state that:

Approval under the EPBC Act is required for any action occurring within or outside a declared World Heritage property that has, will have, or is likely to have a significant impact on the World Heritage values of the World Heritage property.

An action is likely to have a significant impact on the World Heritage values of a declared World Heritage property if there is a real chance or possibility that it will cause:

- *one or more of the World Heritage values to be lost*
- *one or more of the World Heritage values to be degraded or damaged, or*
one or more of the World Heritage values to be notably altered, modified, obscured or diminished. (DoE 2013)

¹ DoEE ceased to exist on 1 February 2020 when the Department of Agriculture, Water and the Environment (DAWE) commenced operation. The Environment portfolio within DoEE was incorporated into DAWE.

This approach is also used in assessing impacts to places of national heritage significance.

20.1.2.3 World, national, and Commonwealth heritage principles

Under the EPBC Act, actions that have, will have, or are likely to have a significant impact on the values of a World, National, or Commonwealth heritage property must be in line with the Heritage Principles, as presented in Schedules 5, 5B, and 7B of the EPBC Act Regulations respectively. These principles are reproduced in Appendix J.

The principles guiding the statement include

...to identify, protect, conserve, present and transmit, to all generations ... the values of the places on each list, and in the case of the WHL, to ... if appropriate, rehabilitate the World Heritage values of the property.

Properties inscribed on the World Heritage List that are within the Project study area are described in Section 20.3.1.

Properties inscribed on the National Heritage List that are within the Project study area are described in Section 20.3.2.

20.1.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the protection of Aboriginal sites and designated conservation areas as well as the flora and fauna within conservation areas. While works associated with the Project would not occur directly in any conservation area declared under the NPW Act, conservation areas both upstream and downstream may be impacted by changes in temporary inundation and flooding due to operation of the Project.

The NPW Act also provides for the declaration of wild rivers within national parks and reserves, and for the protection of such river. Section 61(4) of the NPW Act provides that wild rivers are those

exhibiting substantially natural flow (whether perennial, intermittent or episodic) and containing remaining examples, in a condition substantially undisturbed since European occupation of New South Wales, of:

- a) the biological, hydrological and geomorphological processes associated with river flow, and*
- b) the biological, hydrological and geomorphological processes in those parts of the catchment with which the river is intrinsically linked.*

20.1.4 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) was repealed when the *Biodiversity Conservation Act 2016* commenced on 25 August 2017. However, transitional arrangements allow state significant infrastructure (SSI) projects to be considered under previous legislation if the SEARs were issued before 25 August 2017. The initial SEARs for the Project were issued on 30 June 2017 and therefore the TSC Act still applies.

The TSC Act provided for the identification, conservation and recovery of threatened species and their populations and communities. A licence/approval is required under the TSC Act, the NPW Act or the EP&A Act for any action which would harm a threatened species, population, or ecological community.

There are threatened ecological communities (TECs) and threatened flora and fauna species in the operational and construction study areas. The impacts of the Project on TECs and threatened flora and fauna species are assessed in Chapters 8 to 12 (Biodiversity). Mitigation measures to minimise negative impacts are also discussed in these chapters and in Chapter 13 (Biodiversity offset strategy).

The TSC Act and BC Act provide for conservation on private land though there some differences in the nature of these agreements between the two Acts.

Part 3 of the TSC Act provides for the declaration of critical habitat for endangered species, populations and ecological communities, and critically endangered species and ecological communities. Section 50 requires public authorities to have regard to critical habitat in relation to using land that it owns or controls and contains critical habitat and exercising its functions in relation to land that is within or contains critical habitat.

20.1.5 Marine Estate Management Act 2014

The *Marine Estate Management Act 2014* provides for management of the marine estate of New South Wales, for the declaration and management of marine parks and aquatic reserves, and for other purposes. The marine estate includes the; ocean, estuaries, coastal wetlands (saltmarsh, mangroves, seagrass), coastline including beaches, dunes and headlands, coastal lakes and lagoons connected to the ocean, and islands.

There are no marine estates within the Project study area and therefore no impacts to marine estates would occur due to the Project.

20.1.6 Fisheries Management Act 1994

The objectives of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. More detailed objectives relevant to the Project are:

- to conserve fish stocks and key fish habitats
- to conserve threatened species, populations and ecological communities of fish and marine vegetation
- to promote ecologically sustainable development, including the conservation of biological diversity.

As noted in Chapter 2 (Statutory and planning framework) of this EIS, certain separate approvals under the FM Act are not required if the Project is approved under Part 5.2 of the EP&A Act. However, other requirements of the FM Act would need to be considered including:

- impacts on threatened fish and aquatic species and key fish habitat
- key threatening processes to aquatic ecosystems and species needs to be considered.

The assessment of potential impacts to key fish habitat is presented in Chapter 11 (Aquatic ecology).

20.1.7 Water Management Act 2000

The objective of *Water Management Act 2000* (WM Act) is to provide for the sustainable and integrated management of the water sources in NSW for the benefit of both present and future generations. General consideration of the Project in relation to the WM Act are discussed separately in this EIS. In relation to the assessment of potential impacts on protected and sensitive lands, this concerns waterfront lands as defined under the WM Act. Waterfront lands are defined under the Act as:

The bed of any river, lake or estuary, and the land within 40 metres of the river banks, lake shore or estuary mean high water mark.

Controlled activities (as defined by the Act) carried out on waterfront land typically require an approval under the WM Act; however, as noted in Chapter 2 (Statutory and planning framework), certain separate approvals under the WM Act are not required if the Project is approved under Part 5, Division 5.2 of the EP&A Act.

20.1.8 Wilderness Act 1987

The objectives of the *Wilderness Act 1987* (Wilderness Act) are:

- to provide for the permanent protection of wilderness areas
- to provide for the proper management of wilderness areas
- to promote the education of the public in the appreciation, protection, and management of wilderness.

Development cannot occur in a wilderness area subject to a wilderness protection agreement or conservation agreement unless subject to written consent under section 15 of the Wilderness Act from the Minister administering the Act. Development under the Wilderness Act is defined as ‘the use of that area’ and temporary inundation could be defined in this way. Some areas of the GBMWA potentially impacted by the Project are in the Nattai and Kanangra-Boyd Wilderness Areas and would experience increased temporary inundation due to the operation of the Project. However, these areas are not subject to either a wilderness protection agreement or conservation agreement. Therefore, consent, under section 15 of the Wilderness Act from the Minister administering the Act, is not required.

20.2 Assessment methodology

Protected and sensitive lands were identified through a desktop review of relevant databases, mapping, and literature pertinent to the Project study area, as well as impact assessments undertaken to inform other aspects of this environmental impact statement (EIS). Database searches relevant to the assessment of potential impacts to protected and sensitive lands were detailed in Chapter 8 (Biodiversity – upstream), Chapter 9 (Downstream ecological assessment), and Chapter 10 (Biodiversity – construction area). Of relevance is the search of the EPBC Act protected matters database (Appendix F5) which identified matters of national environmental significance (MNES) potentially occurring within the study area. A 10-kilometre buffer was applied to the study area for the searches to protected

sensitive lands in adjacent environs. Protected sensitive lands within and outside of the 10-kilometre buffer were considered unlikely to be impacted by Project activities.

Protected and sensitive lands include:

- World Heritage properties and other sites covered by international treaties or agreements (for example, Ramsar wetlands)
- national parks
- state conservation areas
- karst conservation reserves
- declared wild rivers
- declared critical habitat, now known as areas of outstanding biodiversity value
- key fish habitat and aquatic reserves
- biobank sites, private conservation areas, and other lands identified as offsets.

These areas were assessed relative to potential impacts resulting from the construction and operation of the Project, particularly those impacts associated with temporary inundation. The boundary of the Project study area was defined as follows:

- upstream – defined by the extent of the probable maximum flood (PMF) with the Project
- downstream – defined by the extent of the existing PMF (as the Project would result in a smaller PMF extent).

Notwithstanding the above definition of the downstream study area, the hydrological and water quality assessments have identified that the practical downstream limit of the Project in terms of its influence on the environment occurs around Wisemans Ferry.

With regard to the PMF, it should be noted that it is a hypothetical flood estimate relevant to a specific catchment whose magnitude is such that there is negligible chance of it being exceeded. It represents a notional upper limit of flood magnitude and no attempt is made to assign a probability of exceedance to such an event (Ball *et al.* 2019). The PMF is unlikely to occur in nature given the size of the Warragamba Dam catchment.

Assessment of potential impacts in the upstream study area has focussed principally on the area between 119.5 mAHD (2.78 metres above full supply level, FSL) and 126.97 mAHD (10.25 metres above FSL), referred to as the 'upstream impact area'. A full description of the derivation of this area and the reasons for adoption of this area in the impact assessment are provided in Section 5 of the World Heritage Assessment report (Appendix J). The size of the upstream impact area is about 1,400 hectares with 304 hectares occurring within the GBMWA. This represents about 0.03 percent of the total area of the GBMWA.

20.3 Existing environment

The following sections summarise the biophysical and socio-economic environment relevant to protected and sensitive land considerations for the Project.

20.3.1 World Heritage properties

Parts of both the upstream and downstream study areas overlap the curtilage of three places listed on the World Heritage List. These are listed in Table 20-3 and shown in Figure 20-1.

Table 20-3: World Heritage properties within or adjacent to the study area

Protected area	ID ¹	Status	Criteria	Values/Comment
Greater Blue Mountains World Heritage Area	105127	Declared property	ix, x (natural)	Outstanding examples of ongoing ecological and biological processes significant in the evolution of Australia's highly diverse ecosystems and communities of plants and animals, particularly eucalypt dominated ecosystems. Significant natural habitats for the <i>in situ</i> conservation of biological diversity, including the eucalypts and eucalypt dominated communities, taxa with Gondwanan affinities, and taxa of conservation significance. This site is discussed further in Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment), and Chapter 10 (Biodiversity construction area), Chapter 12 (MNES – Biodiversity), and Appendix J (World Heritage assessment report).
Australian Convict Sites (Old Great North Road)	106209	Declared property	iv, vi (cultural)	The Old Great North Road is a significant example of major public infrastructure developed using convict labour. Situated in its unaltered natural bushland setting, the Old Great North Road is the best surviving example of an intact convict-built road with massive structural works, which remains undisturbed by later development. This site is discussed further in Chapter 17 (Non-Aboriginal heritage) and Appendix J (World Heritage assessment report).
Australian Convict Sites (Old Great North Road Buffer Zone)	106209	Buffer		

1. Australian Heritage Database Place ID number

The GBMWhA covers an area of 1, 032,649 hectares and comprises eight protected areas: Blue Mountains, Nattai, Gardens of Stone, Thirlmere Lakes, Wollemi, Kanangra-Boyd, and Yengo National Parks, and the Jenolan Karst Conservation Reserve. It contains the largest integrated system of protected areas in NSW, providing outstanding opportunities for the conservation of natural communities and processes. The GBMWhA is characterised by sandstone plateaux, escarpments, and gorges, and is dominated by temperate eucalypt forests. It includes the most extensive aggregations of temperate eucalypt wilderness in south-eastern mainland Australia. The area was inscribed onto the World Heritage list in 2000 (DECC 2008).

The downstream study area overlaps the Australian Convict Sites World Heritage Properties – Old Great Northern Road, and Australian Convict Sites World Heritage Properties – Old Great Northern Road Buffer Zone. These sites were inscribed onto the World Heritage list in 2010. There would be no impact from the Project on the Australian Convict Sites World Heritage Properties – Old Great North Road.

Further assessment of World Heritage properties and their interactions with the Project is provided in Appendix J (World Heritage Assessment Report) to the EIS.

20.3.1.1 The Greater Blue Mountains World Heritage Area

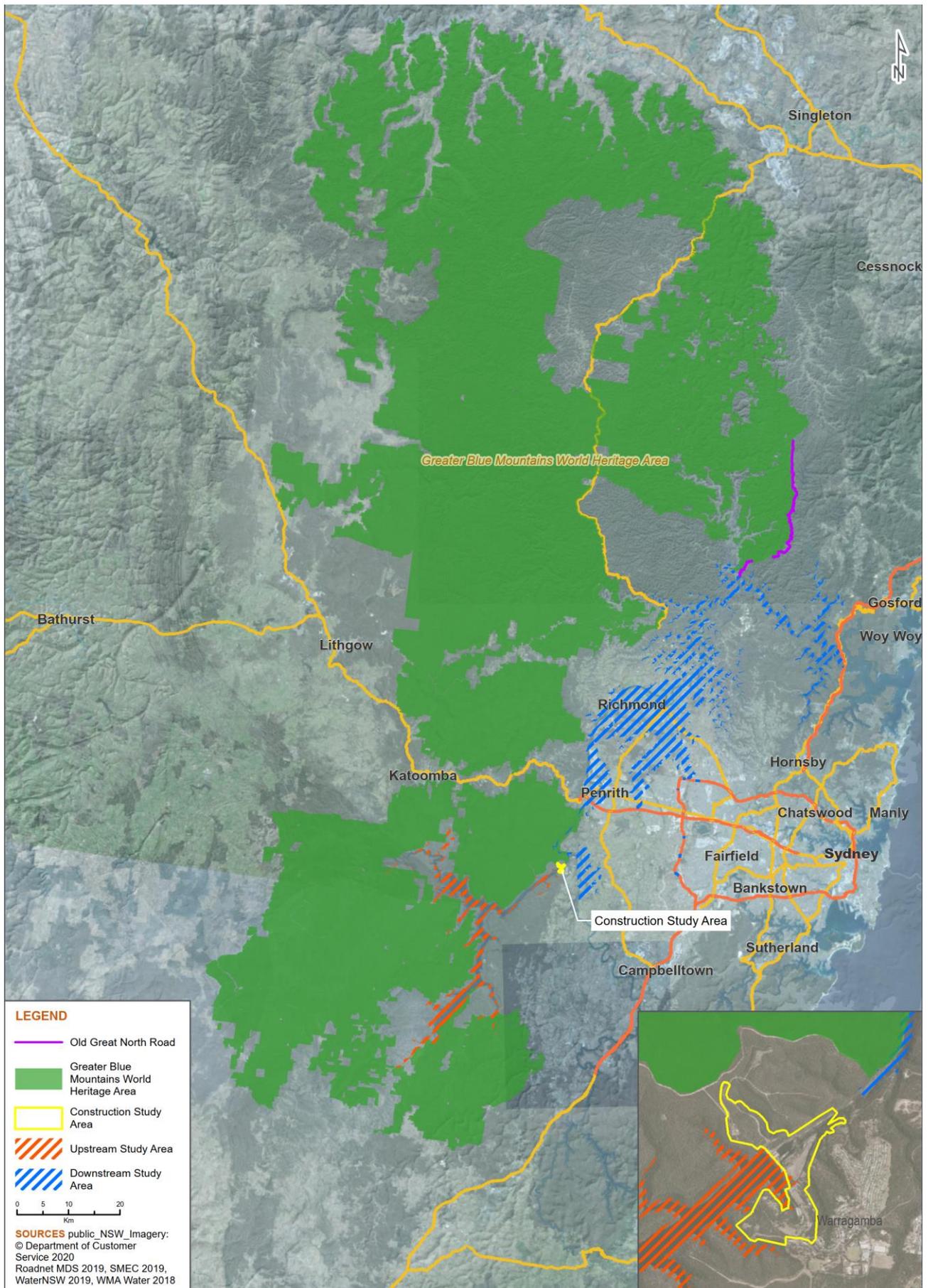
The GBMWhA is one of the largest and most intact areas of protected bushland in Australia. It is a deeply incised sandstone tableland covering over one million hectares spread across eight adjacent conservation reserves, extending almost 250 kilometres from the edge of the Hunter Valley to the Southern Highlands near Mittagong, NSW.

The Greater Blue Mountains was inscribed onto the World Heritage List in 2000 in recognition of its significant natural values against the following two criteria:

- Criterion (ix):
 - 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.
- Criterion (x):
 - 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 Proteaceae (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 percent 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.

In the World Heritage nomination for the GBMWhA, the presence and function of Warragamba Dam was recognised including the important role that the protection of catchment to maintain drinking water quality had made in also protecting biodiversity and other values. The 1995 proposal to raise Warragamba Dam by 23 metres and the temporary storage of water for up to five weeks for flood mitigation was also mentioned. The current Project while having the same flood mitigation objectives, would have a significantly lower impact than the 1995 dam raising proposal. This Project involves providing capacity to facilitate flood mitigation by increasing the crest levels of the central spillway by approximately 12 metres, the auxiliary spillway by 14 metres and temporary storage of flood waters above FSL for up to two weeks.

Figure 20-1. Greater Blue Mountains World Heritage Area



20.3.1.2 Management of the GBMWhA

The Australian Government, as signatory to the World Heritage Convention, works in cooperation with the NSW Government (and other states) to ensure management of World Heritage is consistent with the Convention, and administers the EPBC Act under which World Heritage is a MNES.

World Heritage advisory committees in New South Wales advise managing agencies and government ministers responsible for World Heritage on matters relating to the identification, protection, conservation and presentation of World Heritage values. This includes strategic policies in relation to Australia's obligations under the World Heritage Convention. The committees may also be asked to consider and provide advice on issues that may have a significant impact on the area or on natural and cultural-heritage conservation.

The Advisory Committee may make recommendations on matters relating to the protection, conservation, presentation and management of the GBMWhA, including strategic policies in relation to Australia's obligations under the World Heritage Convention. The committee may also be requested to consider and comment on issues that are likely to have some impact on the GBMWhA under the NPW Act (NSW) or the EPBC Act or on natural and cultural heritage conservation generally.

The Advisory Committee when undertaking its duties must:

- consider and advise on the views of community interests
- consider and advise on technical and scientific matters including scientific research priorities, relevant new information or developments in science, the scientific basis of management principles and practices, the appropriateness of current and proposed research, and the maintenance of the values and integrity of the GBMWhA
- provide advice to the Management Committee or the relevant Ministers on issues referred to it for consideration.

Day-to-day management activities of the GBMWhA are undertaken by the NSW National Parks and Wildlife Service (NPWS).

The *Greater Blue Mountains World Heritage Area Strategic Plan* (Department of Environment and Climate Change (DECC) 2009a) provides the framework for the management of the World Heritage Area and was prepared to help meet Australia's international responsibilities under the World Heritage Convention. It aims to 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. The document also serves as a public statement of the commitment of the management agencies to the long-term survival of the GBMWhA. The Strategic Plan is part of the overall planning framework for the GBMWhA and does not attempt to provide detailed management prescriptions for the individual reserves in the GBMWhA, which are provided for national park and state conservation area plans of management.

The principal features of the Strategic Plan are:

- World Heritage management obligations – these are the management requirements the Federal Government must achieve to maintain World Heritage listing. There are six obligations some of which are relevant to the Project
- World Heritage values – the GBMWhA was listed based upon on two key values – namely unique and natural eucalypt dominated ecosystems and the significant of biodiversity exhibited within the World Heritage area (WHA)
- other values – the strategic management plan also identifies other values of the WHA which contribute to its overall value and could potentially be additional values for listing considered by the World Heritage Committee in the future. There are 10 additional values many of these values have a subset of specific values
- threats – the strategic management plan nominates six keys threats to the WHA, some of which are relevant to the Project
- management responses – the strategic management plan contains 59 management responses across 10 aspects; many of these have relevance to the Project.

The potential impacts of the Project have been assessed against the Strategic Plan.

Indigenous land use agreements (ILUAs) made under the *Native Title Act 1993* between the Australian Government and Native Title claimants or holders have been used to resolve Native Title claims and establish access and

management arrangements between native title claimants and other landowners within a claim area. The Gundungurra ILUA was signed in 2014 by the Gundungurra people and relevant government agencies and Ministers, and registered with the Native Title Tribunal in the *Greater Blue Mountains World Heritage Area Strategic Plan Addendum* 2016. The ILUA acknowledges the Gundungurra people's custodianship, use and management of their traditional land and waters across an area of about 6,942 square kilometres. The Gundungurra people's traditional land and waters include 20 national parks and reserves and some of the GBMWA. The Gundungurra people agreed to withdraw their Native Title claim on registration of the agreement.

20.3.2 National heritage properties

There are three places within the study area on the National Heritage List and a further two nominated places. The study area is located partially within the curtilage of The Greater Blue Mountains Area (ID #105999) both upstream and downstream of the proposed construction zone. Other downstream listed places include the Old Great North Road and the Ku-ring-gai Chase National Park, Lion Island, Long Island and Spectacle Island Nature Reserves.

The two nominated places are The Greater Blue Mountains Area – Additional Values (ID #105696) and Great North Road, Wisemans Ferry to Bucketty (ID #106318).

20.3.3 National parks, state conservation areas and karst conservation reserves

National parks, state conservation areas and karst conservation reserves that overlap, or are adjacent to, the Project study area are detailed below. The values of each of these conservation areas (as established through their respective plans of management required under the NPW Act) are summarised in Table 20-4. Note that not all of the total areas of the national parks (NP) that make up the GBMWA (Blue Mountains NP, Nattai NP, Thirlmere Lakes NP, Kanangra-Boyd NP, Wollemi NP, Yengo NP, Gardens of Stone NP) are represented in the study area. Those that are not represented in Section 20.3.3.1 do not overlap the Project study area and have been excluded from the assessment.

20.3.3.1 National parks

The study area is within, or is adjacent to, the following national parks: Blue Mountains, Kanangra-Boyd, Nattai, Wollemi, Dharug, Marramarra, Cattai, and Scheyville. These are shown in Figure 20-2.

20.3.3.2 State conservation areas

The study area is within, or adjacent to, the Burratorang, Nattai and Yerranderie State Conservation Areas. These areas are shown in Figure 20-3.

20.3.3.3 Karst conservation reserves

Karst conservation reserves are outstanding cave areas that offer important evidence of past life, such as relics and fossils, as well as evidence of atmospheric, hydrological and biological processes. The Jenolan Karst Conservation Reserve, shown in Figure 20-3, is one of the eight protected areas that make up the GBMWA.

Table 20-4. National parks within or adjacent to the Project study area

Protected area	Values/comments
Blue Mountains National Park	<p>The diversity of environments across Blue Mountains National Park create habitats for a wide range of native plants and animals, including many rare or threatened species. There are rare and ancient plants in its forests, and isolated animal populations tucked away in its deep gorges. Over 1,000 species of flowering plants occur in the park, including the waratah, the floral emblem of NSW.</p> <p>Blue Mountains National Park also protects the habitat of 41 threatened animal species including the sooty owl, glossy black cockatoo, bush stone curlew, superb parrot, yellow-bellied glider and booroolong frog. Some of these threatened species are endemic to the Blue Mountains, including the Blue Mountains water skink.</p> <p>Blue Mountains National Park is part of the traditional lands of the Gundungurra, Darkinjung, Dharug and Wiradjuri peoples. There are several Aboriginal sites in the Blue Mountains National Park which remain important to Aboriginal people today; they are the physical evidence of a link to their ancestors, including sites such as Red Hands Cave.</p>

Protected area	Values/comments
Kanangra-Boyd National Park	The Kanangra-Boyd National Park is characterised by high plateaus and sheltered slopes, which provide habitat for a diverse range of plant-life, some of which is unique to the national park. Mallee-heath dominate areas that are exposed to wind and weather, while tall snow gum forests dominate elsewhere. The park is also home to the State-listed Kanangra wattle, which grows along the Kowmung and Coxs Rivers (and tributaries) and is endemic to the Kanangra-Boyd and Blue Mountains National Parks. The park is also home to Red-necked wallabies, which thrive in this area, honeyeaters, wrens, and fruit-eating pigeons which are some of the 195 species of birds that can be found in the park.
Nattai National Park	Nattai National Park includes a diverse range of environments, from exposed sandstone plateau tops to wild rainforest and sheltered gorges. Eucalypts, blue-leaved stringybark forest and stands of Nattai Sandstone River peppermint forest dominate the lowland vegetation. In the north of the park, there are communities of red bloodwood, Sydney blackbutt, red ironbark, scribbly gum, Sydney peppermint, and smooth-barked apple trees. The park also provides habitat for a diverse range of wildlife including up to nine species of frogs, 160 species of birds, and 19 species of reptiles; plus, wallaroos, emus, swamp wallabies, grey kangaroos, dingoes, wombats, echidnas, forest microbats, and gliders. Threatened species found in the park include brush-tailed rock wallabies, long-nosed potoroos, tiger quolls, powerful owls, and glossy black cockatoos.
Wollemi National Park	Wollemi National Park is characterised by soaring sandstone escarpments, plunging gorges and canyons, winding river valleys and impressive geological and geomorphological features such as pagoda rock formations, basalt-capped mountains and diatremes. The spectacular Colo River gorge and its tributaries form the most extensive sandstone canyon system in eastern Australia. These landscapes provide habitat for a diversity of habitat types, including the rare Wollemi pine, open eucalypt forest and woodlands including Hawkesbury and grey box, rainforests and perched swamps. These habitat types make the park appealing for populations of eastern grey kangaroos, red-necked wallabies, brush-tailed rock wallabies, broad-headed snakes, regent honeyeaters and glossy black cockatoos. Around 55 species of butterfly have also been recorded in the park. The area now called Wollemi National Park, holds significance to Wiradjuri, Dharug, Wanaruah, and Darkinjung peoples dating back at least 12,000 years. The park includes around 120 known Aboriginal sites including ceremonial grounds, stone arrangements, grinding grooves, scarred trees, and rock engravings.
Dharug National Park	Dharug National Park contains the Old Great North Road, one of 11 historic sites which form the Australian Convict Sites World Heritage listing. It is an example of early colonial engineering and demonstrates the use of convict labour; up to 720 convicts worked on the road, which spanned 264 kilometres, connecting Sydney to the settlements of the Hunter Valley. Only 43 kilometres of the road remain relatively intact, running from Wisemans Ferry in the south to Mount Manning in the north and includes the oldest surviving stone bridges in mainland Australia. The park houses abundant animal, plant, and bird life, with rugged bushland that is home to species such as gang-gang cockatoos, satin bowerbirds, and Lewin's honeyeaters. Dharug National Park is the traditional country of the Dharug people who used the area to source food, medicines, and shelter.
Marramarra National Park	Marramarra National Park is characterised by high sandstone ridges and deep gullies, which support a wide range of environments. These include salt marsh and mangrove forests along the Hawkesbury River to tall open forest and ridge-top woodlands. Marramarra National Park is part of the traditional lands of the Dharug people, and includes several significant Aboriginal sites including cave art, rock engravings, grinding grooves, middens, scarred trees, and other occupational deposits and stone arrangements.
Cattai National Park	Cattai National Park is located on Hawkesbury River and Cattai Creek, within the Cumberland Plain, an important land system in the Sydney region which has been impacted by historical agricultural practices and urban development. Areas of the park contain much of the regions original vegetation including paper bark, red gum, stringy bark, grey gum, and cabbage gum. The park is historically significant because it includes parcels of land that were granted to the First Fleet assistant surgeon, Thomas Arndell. The land remained with the Arndell family for nearly 180 years, and several historic heritage sites relating to their tenure are present today, including the Arndell's 1821 homestead, convict-built walls and roads, grain silos and ruins of a windmill believed to be Australia's oldest industrial building.

Protected area	Values/comments
Scheyville National Park	<p>Scheyville National Park is in the same region as Cattai National Park and has a similarly rich historical heritage. Previous land uses have included: as a government cooperative farm and an agricultural training facility, an internment camp during World War I, a training base for the First Australian Parachute Battalion in World War II, a migrant camp for new Australians, and an officer's training facility during the Vietnam War. Due to this history, Scheyville National Park is listed on the NSW State Heritage Register.</p> <p>In addition to its historical heritage values, Scheyville National Park protects a large area of the Cumberland Plain Woodland, a small area of Castlereagh scribbly gum woodland and shale transition forest. These provide habitat for an array of fauna species including over 140 species of waterbirds, the swift parrot and turquoise parrot, and the endangered regent honeyeater.</p>
Burratorang State Conservation Area	<p>Burratorang State Conservation Area forms part of the catchment of Lake Burratorang and borders the Nattai State Conservation Area to the south, and the Blue Mountains National Park to the north. The area is home to myriad flora and fauna species, including the glossy black cockatoo (<i>Calyptorhynchus lathami</i>), yellow tail black cockatoo (<i>Calyptorhynchus funereus</i>), Gang-gang cockatoo (<i>Calyptorhynchus fimbriatum</i>), Eagles, satin bowerbirds, catbirds and lyrebirds. The land that the area overlaps is the traditional home of the D'Harawal and Gundungurra and Dharug peoples.</p>
Nattai State Conservation Area	<p>The Nattai State Conservation Area was declared in 1991. It is situated in the north of Nattai National Park, providing a conservation corridor between the national park, Warragamba Dam and Burratorang State Conservation Area. The area provides habitat for a diverse range of wildlife including frogs, birds, reptiles, wallaroos, emus, swamp wallabies, grey kangaroos, dingoes, wombats, echidnas, forest microbats, and gliders. Flora species include red bloodwood, Sydney blackbutt, red ironbark, scribbly gum, Sydney peppermint, and smooth-barked apple trees</p>
Yerranderie State Conservation Area	<p>Yerranderie State Conservation Area is situated to the south west of Lake Burratorang, between the Blue Mountains National Park and the lake. The area includes the historical Yerranderie township, which retains much of the history of its history of mining and settlement in the early twentieth century. The township is surrounded by sandstone escarpments and dense bushland. The area shares similar wildlife to surrounding protected areas.</p>
Jenolan Caves Karst Conservation Reserve	<p>Jenolan caves was one of Australia's first tourist attractions, established in 1866. The reserve comprises more than 300 caves, containing a range of geological formations including stalactites, stalagmites, helictites and stromatolites. The caves hold significance to the Gundungurra people. The caves house large numbers of the eastern bentwing bat (<i>Miniopterus schreibersii oceanensis</i>).</p>

Figure 20-2. National parks adjacent to the Project study area

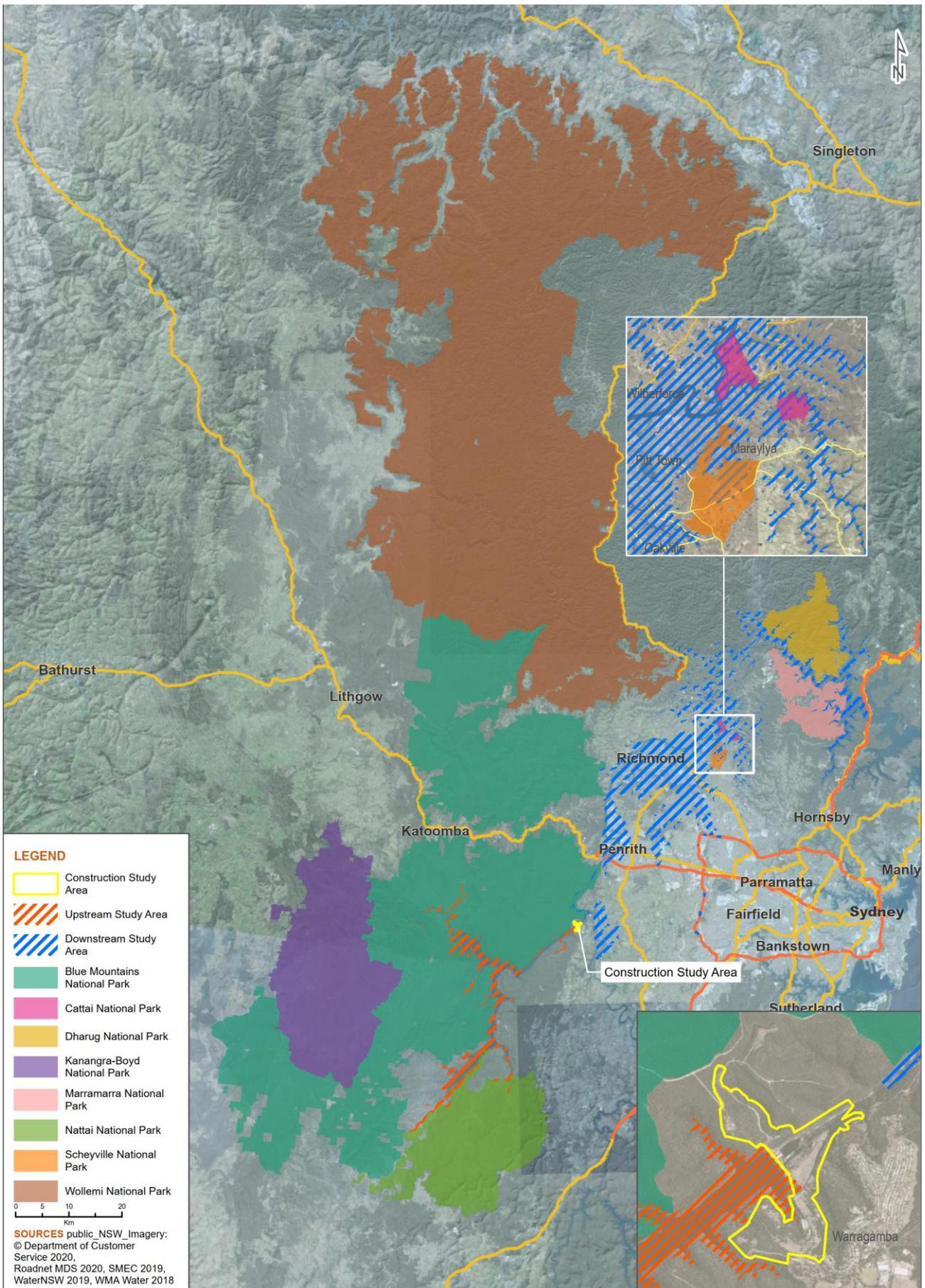
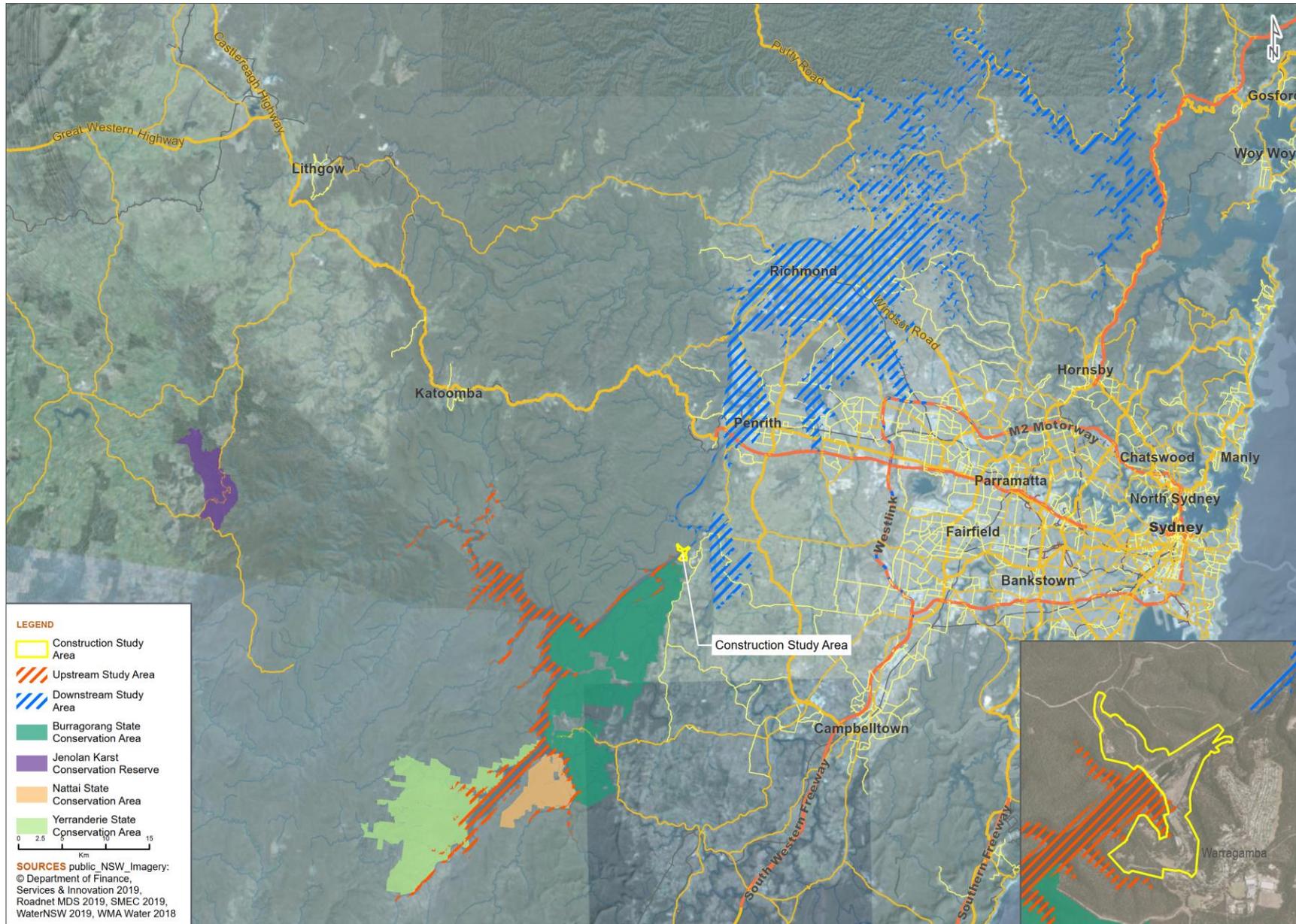


Figure 20-3. State conservation areas and karst conservation reserves adjacent to the Project study area



20.3.4 Wild rivers

Wild rivers can only be declared if they are on land that is reserved under the NPW Act. Rivers must be in near-pristine condition in terms of animal and plant life and water flow and are free from unnatural rates of siltation or bank erosion. They are to be managed to ensure restoration (where possible) and maintenance of the natural biological, hydrological and geomorphological processes associated with wild rivers and their catchments. There are three declared wild rivers within or in proximity to the Project study area: the Kowmung River, Colo River, and Grose River. All are part of the Hawkesbury-Nepean catchment; however, only the Kowmung River is within the upstream catchment that supplies Lake Burragarang. The attributes of these areas are discussed in Table 20-5 and their locations shown in Figure 20-4.

Table 20-5. Wild rivers declared under the NPW Act relevant to the Project study area

Wild river	Attributes
Kowmung River ¹	<p>The Kowmung River and catchment, upstream of Warragamba Dam, comprises about 76,000 hectares, 75 percent of which is within the Kanangra-Boyd National Park. Downstream of the Kanangra-Boyd National Park, the Kowmung River flows through the Blue Mountains National Park and the Warragamba Special Area. Upstream of the Kanangra-Boyd National Park, the Kowmung River flows through rural freehold land and pine plantations (managed by the Forestry Corporation of NSW). The catchment area is characterised by several landforms including high plateaux, steep gorges and rolling hills.</p> <p>The Kowmung River was assessed as a wild river based on its biological, geomorphic and hydrological condition. This area has a high diversity of eucalypt species and provides examples of a range of structural adaptations of the eucalypts to Australian environments. Only the western-most section of the catchment (that is, the area not within protected areas) has undergone significant disturbance. The remainder comprises largely native vegetation. The upper catchment areas are dominated by snow gum (<i>Eucalyptus pauciflora</i>), brown barrel (<i>Eucalyptus fastigata</i>), narrow-leaved peppermint (<i>Eucalyptus radiata</i>) broad-leaved peppermint (<i>Eucalyptus dives</i>), and mountain gum (<i>Eucalyptus dalrympleana</i>). Mid-catchment gorges are dominated by stringybark (<i>Eucalyptus blaxlandii</i> and <i>Eucalyptus eugenioides</i>), ash (<i>Eucalyptus sieberi</i>), grey gum (<i>Eucalyptus punctata</i>), and occasional thickets dominated by wattles including the broad-leaved hickory (<i>Acacia falciformis</i>) and the locally abundant but vulnerable Kowmung wattle (<i>Acacia clunies-rossiae</i>). The deeper gullies and ravines often support depauperate rainforest with stinging trees (<i>Dendrocnide excelsa</i>) and red cedar (<i>Toona ciliata</i>). River oaks (<i>Casuarina cunninghamiana</i>) dominate the banks.</p> <p>The geology and geomorphology of the Kowmung River catchment provide significant evidence of geological processes dating back to the early Palaeozoic Period (400 million years ago). The region comprises part of the Gondwana Shelf, deposits of which now form the outcrops of bedrock that are a feature of the area. Active erosion over ensuing geological time-periods has resulted in the spectacular cliffs and waterfalls characteristic of the Kowmung Valley.</p> <p>The area is known to provide habitat for several plant and animal species that are listed under the BC Act and EPBC Act.</p> <p>The area also has significant Aboriginal cultural heritage values.</p>
Colo River ²	<p>The Colo River and catchment, downstream of Warragamba Dam, consists of the sub-catchments of the Wolgan River, Capertee River, and Wollemi Creek. These are primarily within the Wollemi National Park and the Blue Mountains National Park, overlain by the Wollemi Wilderness. The Colo River catchment (including the above rivers and creeks) covers about 462,900 hectares and comprises one of the largest sandstone canyon systems in Australia.</p> <p>The Colo, Wolgan, Capertee and Wollemi sub-catchments have been assessed for biological, geomorphic and hydrological condition and found to support a high diversity of macroinvertebrate fauna.</p> <p>The dominant vegetation type is the Eucalyptus open forest on steep, sandstone-shale terrain. Over 100 species of eucalypts have been recorded in the broader Wollemi and Blue Mountains National Parks. Dry sclerophyll eucalypt forest with an understorey of evergreen and hard-leaved shrubs predominantly of <i>Hakea</i>, <i>Persoonia</i>, <i>Boronia</i>, and <i>Grevillea</i> genera is the dominant plant community within the Colo sub-catchment. Although in the high areas of the Colo gorge, the forest communities resemble those of the upper Blue Mountains, with species such as the silvertop ash (<i>Eucalyptus sieberi</i>), Sydney peppermint (<i>Eucalyptus piperita</i>), narrow-leaved peppermint (<i>Eucalyptus radiata</i>), and scribbly gum (<i>Eucalyptus sclerophylla</i>).</p> <p>The geology underlying the area has provided the characteristic dissected landscape, deep valleys, canyons, narrow gorges, waterfalls and cliffs. Much of this is the eroded upper strata which has exposed underlying sandstones and claystones. The Colo River valley contains towering cliffs of up to 300 metres.</p>

Wild river	Attributes
	<p>The area is known to provide habitat for several plant and animal species that are listed under the BC Act and EPBC Act.</p> <p>The area also has significant Aboriginal cultural heritage values.</p>
Grose River ³	<p>The Grose River sub-catchment covers an area of approximately 65,000 hectares, with over 80 percent of the sub-catchment within the Blue Mountains National Park. Approximately 57 percent of the Grose River catchment is declared and formally managed as wilderness, with 72 percent of that area in wilderness condition. The Grose River is nearly 60 kilometres long from its headwaters near Mount Victoria to its mouth at the Hawkesbury-Nepean River divide. Over 100 kilometres of drainage lines feed into the Grose River and include Wentworth, Govetts, Hungerfords, Woodford, Burrow, and Linden creeks, and King George Brook. The major tributaries in the catchment are in good geomorphological condition. For much of its length, the river is flanked by massive single and double cliff lines up to 500 metres high.</p> <p>The eastern part of the Grose River catchment is dominated by younger and harder Hawkesbury sandstones, resulting in narrower and more 'V-shaped' valleys than adjacent areas to the west. The youngest geological layers are located at the extreme east of the catchment, consisting of Quaternary alluvial deposits associated with major rivers and structural features such as the Kurrajong fault, exemplified at Burrell Swamp. There is a predominance of sandstone soils which have very low fertility and are highly permeable and erodible. These characteristics, combined with the area's steep terrain, heavy rainfall and frequent intense bushfires, result in high erosion rates and heavy sediment loads in streams and rivers.</p> <p>Most of the area's vegetation consists of dry sclerophyll forests and woodlands dominated by eucalypts, with smaller areas of wet and dry heaths, low woodlands, wet sclerophyll forests and rainforests. Eleven vegetation communities occur in the area.</p> <p>The area is known to provide habitat for several plant and animal species that are listed under the BC Act and EPBC Act.</p> <p>The area also has significant Aboriginal cultural heritage values.</p>

1 Department of Environment and Conservation (DEC) NSW, Kowmung River Kanangra-Boyd National Park Wild River Assessment, June 2005 (DEC 2005b)

2 DECC NSW, Colo River Wollemi and Blue Mountains National Parks Wild River Assessment, April 2008 (DECC 2008a)

3 DECC NSW, Grose River Blue Mountains National Park Wild River Assessment, April 2008 (DECC 2008b)

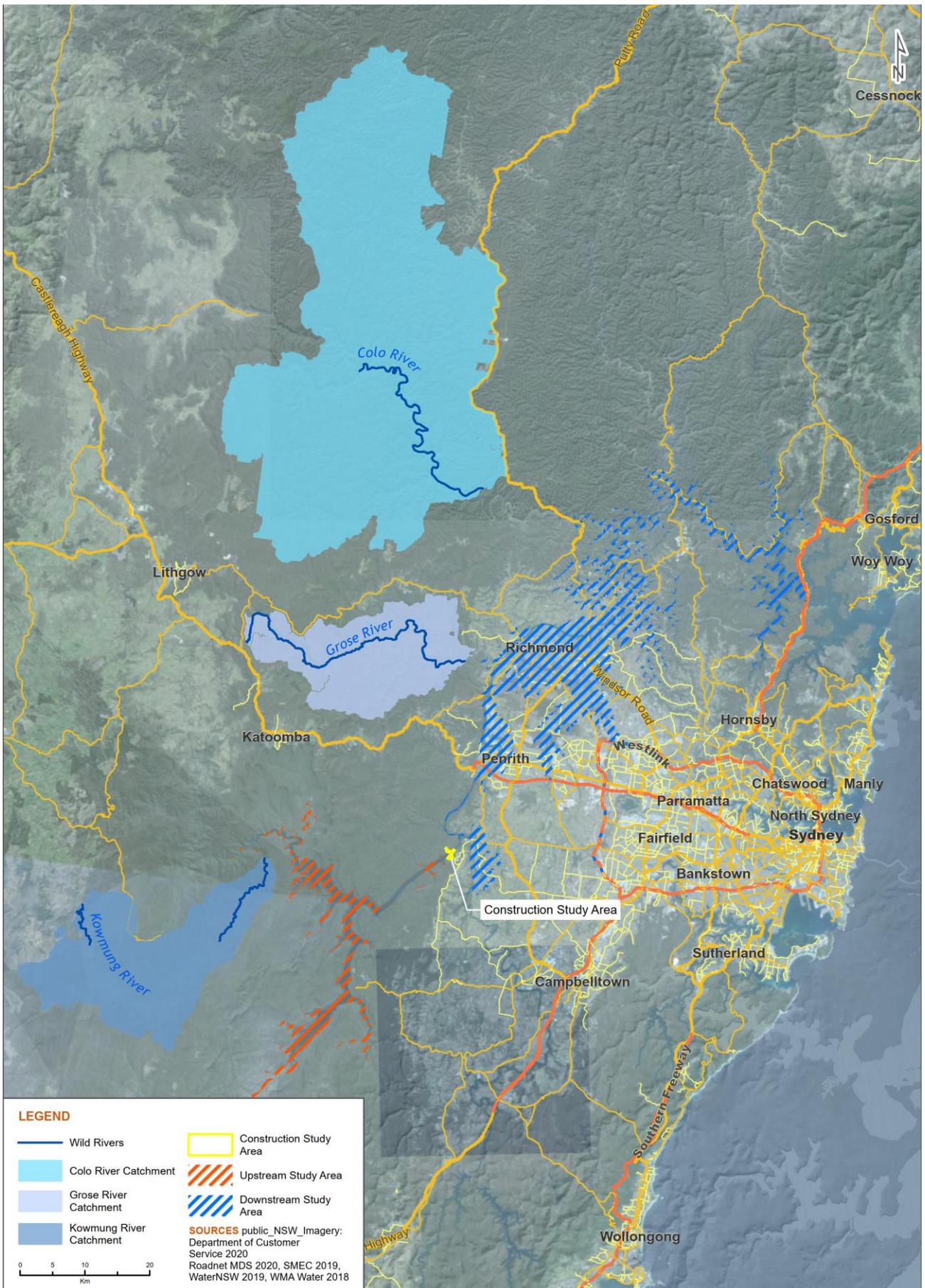
In summary:

- A small section (about 1,250 metres) of the declared wild river section of the Kowmung River is located in the upstream Project study area; an analysis of depth-duration curves for the closest cross section downstream of the declared wild river catchment showed no material difference between the existing situation and with the Project for all flood events up to the 1 in 100 chance in a year event and a very small difference (less than 0.3 metres) up to the 1 in 1,000 chance in a year event. In real world terms, the Project would not impact on the declared wild river section of the Kowmung River.
- The declared wild river sections for the Grose River and Colo River are located outside of the Project study area and would not be affected by the Project.

20.3.5 Areas of outstanding biodiversity value

Areas previously declared under the TSC Act as critical habitat are now declared as areas of outstanding biodiversity value (AOBV) under the BC Act. This includes the Wollemi Pine and Little Penguin declared areas. Other AOBVs include critical habitat for the Gould's Petrel and Mitchell's Rainforest Snail in Stott's Island Nature reserve. The AOBVs for the Little Penguin (Sydney Harbour National Park, Manly Point, Dobroyd Head, NSW), Gould's Petrel (areas around Nelson Bay and Port Stephens, NSW) and the Mitchell's Rainforest Snail (Stott's Island, Banora Point, Byron Bay, Lennox Heads, NSW) were not considered relevant to the Project due to their geographic separation from the upstream and downstream areas of potential impact.

Figure 20-4. Wild rivers declared under the NPW Act relative to the Project study area



The declared AOBV for the Wollemi Pine (*Wollemia nobilis*), comprises about 5,000 hectares (or about one percent) of the about 500,000-hectare Wollemi National Park. The exact location of the Wollemi Pine AOBV has not been disclosed to protect the critical habitat from threats. However, detailed modelling indicates that the proposed flood mitigation zone (FMZ) would result in a decrease in the area of Wollemi National Park inundated by the PMF. A small area of about one hectare near the Colo River would still lie within the Project PMF but as noted previously, the PMF is unlikely to occur in nature given the size of the Warragamba Dam catchment.

Potential impacts to critical habitat or habitat for threatened species or endangered ecological communities in all areas including conservation areas have been assessed in Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment), and Chapter 10 (Biodiversity construction area).

20.3.6 Significant regional ecosystems

The principal values of protected areas primarily relate to biodiversity. As such the EIS has provided a detailed assessment of the vegetation communities in the study area, and those areas that would be affected by increased temporary inundation for various flood events. Desktop assessment and field surveys identified that the vegetation in the study area conforms to 41 plant community types (PCTs). Of these, 18 occur in the upstream study area, 25 in the downstream study area, and four in the construction area. Thirteen are listed as threatened under the EPBC Act, and 20 are listed as threatened under the BC Act. Several State and Commonwealth TECs would potentially be impacted by the Project by an increase in the extent of temporary inundation. This is discussed in Section 20.5.7.

Potential impacts to TECs, threatened flora, threatened fauna, and important fauna habitats associated within protected areas within or near the Project study area are assessed in Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment), Chapter 10 (Biodiversity construction area), and Chapter 12 (MNES – Biodiversity).

20.3.7 Marine estates

There are no designated marine estates within or adjacent to the Project study area. A proposal to gazette parts of the Hawkesbury shelf marine bioregion as a marine park has been lodged and is progressing through the public consultation and assessment process. At the time of preparation of this EIS, no decision had been made on gazettal of the proposed marine park.

There are 12 aquatic reserves in NSW which aim to conserve the biodiversity of fish and marine vegetation while supporting a variety of fishing and collecting activities. Barrenjoey Head Aquatic Reserve is the closest to the Project study area, located at the south of Broken Bay, which is where the Hawkesbury River meets the sea. This would not be affected by the Project as the hydrological modelling indicates that the effects of the Project are minimal beyond Wisemans Ferry.

20.3.8 Critical habitat and key fish habitat

No critical habitat as listed under the FM Act occurs within or adjacent to the Project study area. Much of the Warragamba River catchment upstream, and Hawkesbury-Nepean catchment downstream, including the floodplains of Richmond and Windsor, are designated key fish habitat. The lower Hawkesbury, from Lughtondale to Broken Bay also includes extensive areas of key fish habitat.

20.3.9 Biodiversity offset and private conservation lands

The upstream study area is surrounded by protected areas, and therefore there are no biodiversity offset or private conservation lands within or adjacent to this area. There are two biodiversity offset or private conservation areas close to the construction laydown area and footprint, the closest is within one kilometre of the construction zone. A further 23 biodiversity offset, or private conservation lands were identified within the downstream study area. Biodiversity offset and private conservation lands are shown in Figure 20-5 and Figure 20-6.

Figure 20-5. Biodiversity conservation and private conservation lands – construction study area

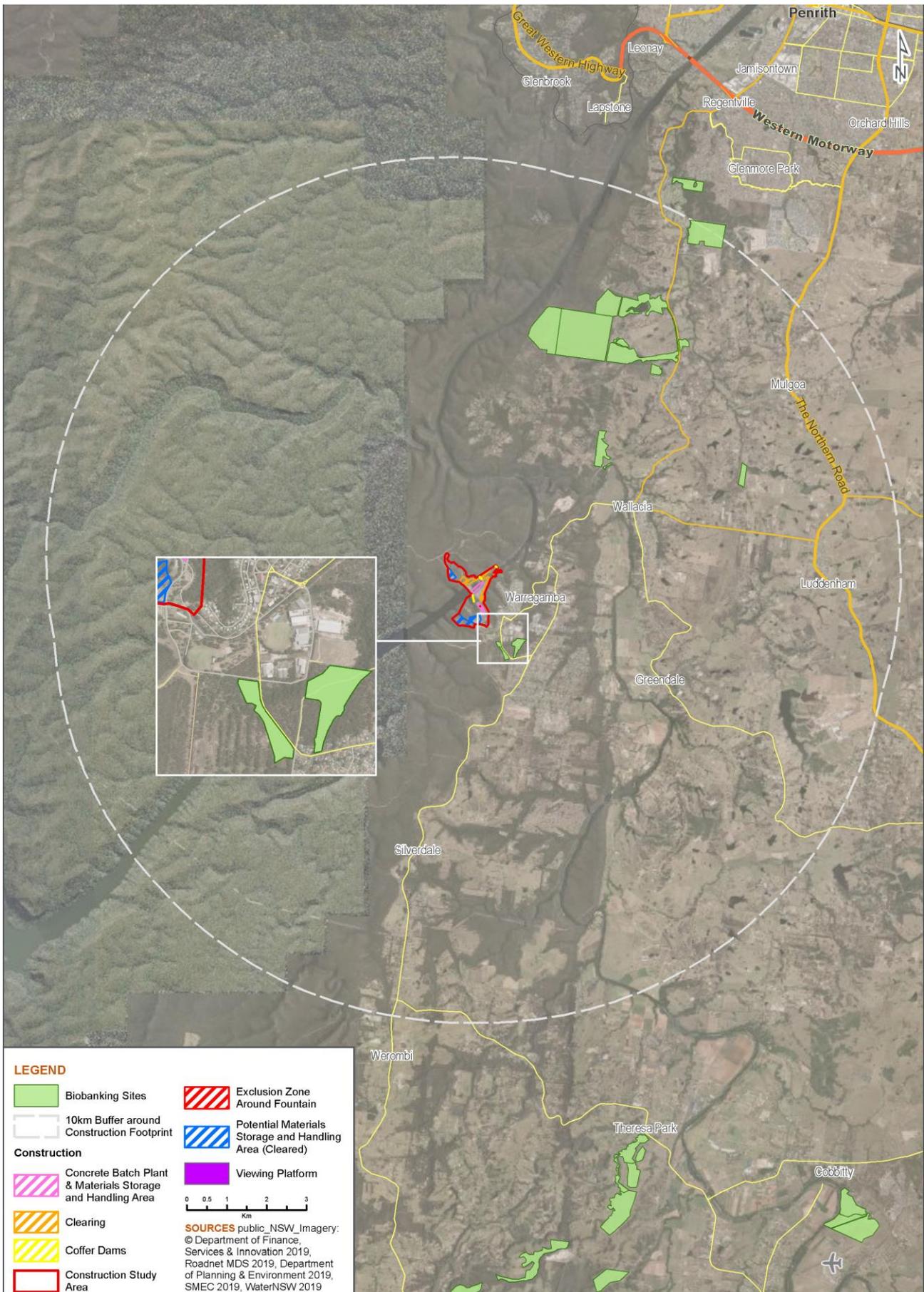
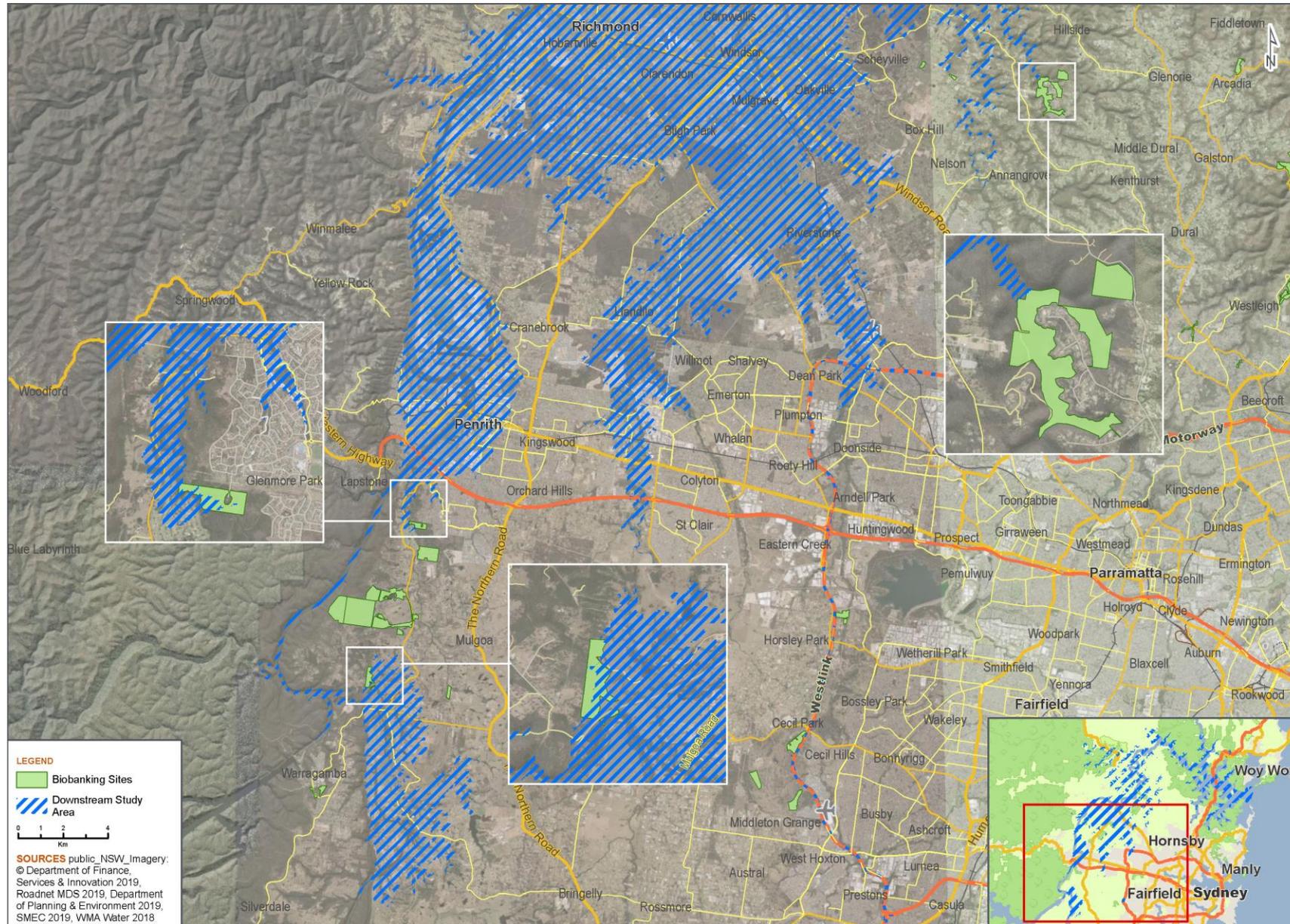


Figure 20-6. Biodiversity conservation and private conservation lands – downstream study area



20.3.10 Warragamba special and controlled areas

The construction of Warragamba Dam commenced in 1948 and the dam formally opened in 1960. The dam and its reservoir (Lake Burragorang) existed before the 1972 World Heritage Convention was ratified by the Australian Government and before the GBMWhA was inscribed onto the World Heritage list in 2000.

To protect the water quality in Lake Burragorang, large areas of the catchment immediately around Lake Burragorang were protected from development through enacting legal protections (Special Areas) which limited further development and allowed for the voluntary resumption of privately-owned land. In the 1970s and 1980s, some areas of the Lake Burragorang catchment were added to various national parks, and management of these areas was undertaken jointly by the NPWS and the dam owner/manager (WaterNSW). In June 2002, the majority of the Special Areas were transferred to NPWS and included in existing national parks or State conservation areas, if they were not already protected lands under the NPW Act.

The Special Areas around Lake Burragorang (Figure 20-7) have been created under the *Water NSW Act 2014* for the purpose of (section 47(2)):

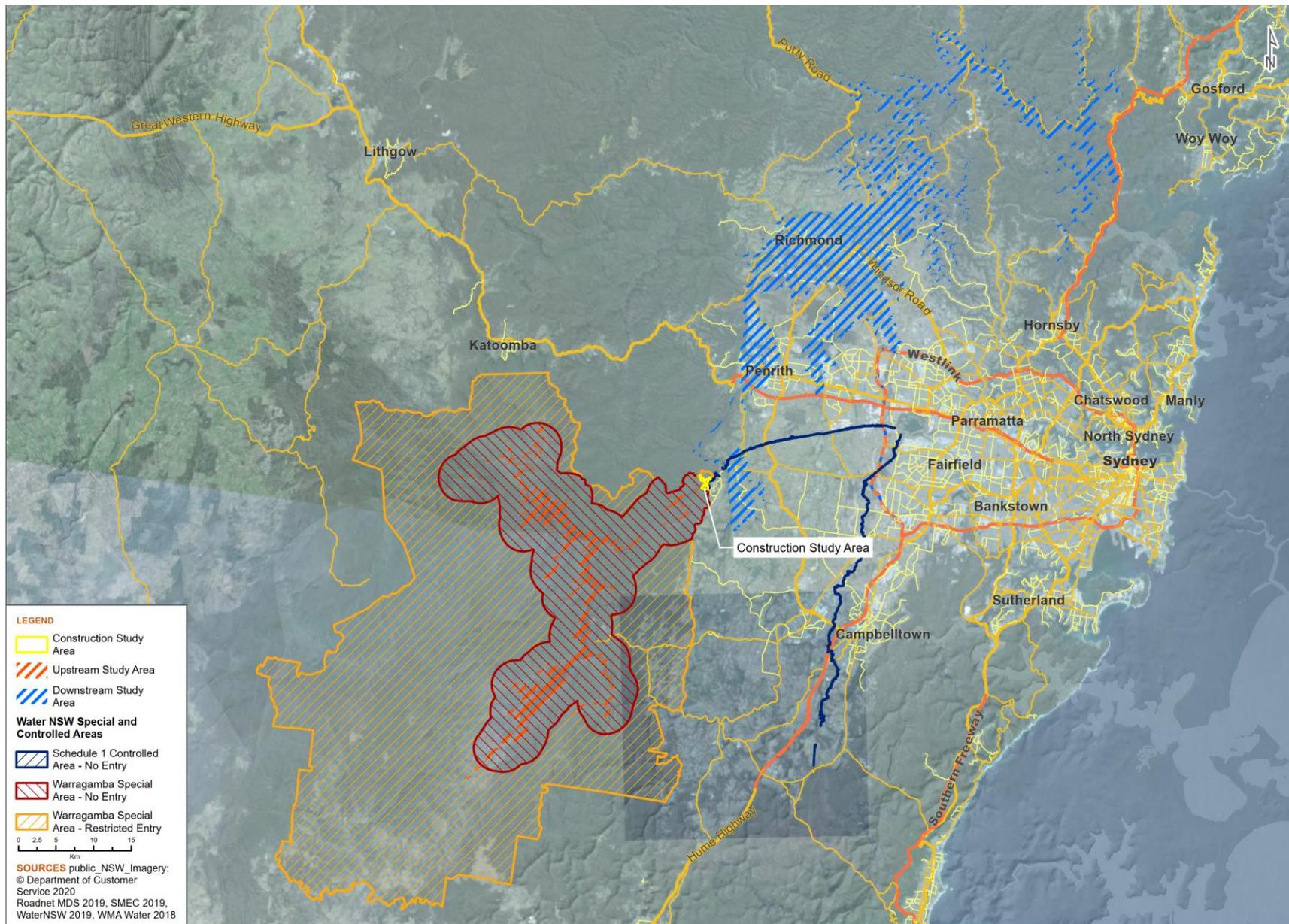
- (a) *protecting the quality of stored waters, whether intended for use for drinking or other purposes*
- (b) *maintaining the ecological integrity of an area of land to be declared to be a special area in a manner that is consistent with Water NSW's objectives.*

Access to the Special Areas around Lake Burragorang is controlled and restricted. There are three types of Special Areas with different levels of access or restrictions as follows:

- Schedule 1 Special Areas: no entry; includes lands immediately surrounding the Warragamba water storage, extending for three kilometres from the top of the full storage level of Lake Burragorang. There is no public access to this area
- Schedule 2 Special Areas: restricted entry; is a secondary protection area surrounding the special area extending from about six kilometres to about 20 kilometres from the shore of Lake Burragorang and its tributaries. Access by foot is permitted to Schedule 2 Special Areas; however, apart from a small number of private landowners on Schedule 2 lands, access via vehicle is not permitted. There are also restrictions on activities that can be undertaken and the requirement not to damage any aspect of the environment in Schedule 2 lands
- Controlled Areas: no entry; includes the land at Warragamba protecting the water supply infrastructure and the land along the Warragamba pipelines and upper canal.

All areas potentially impacted by the Project in the GBMWhA are also Schedule 1 Special Areas, apart from some short reaches of the catchments of the Wollondilly River and Nattai River, which are in Schedule 2 Special Areas.

Figure 20-7. Warragamba Dam special and controlled areas



20.3.11 2019-2020 bushfires

New South Wales, including the catchment of Lake Burratorang, experienced severe wildfire between 2019 and 2020. These bushfires are described as unprecedented in their extent and intensity affecting at least 5.4 million hectares (seven percent of NSW) including 27 percent of national park estate, more than 81 percent of the World Heritage listed Greater Blue Mountains Area and 54 percent of the NSW components of the Gondwana Rainforests of Australia World Heritage property (DPIE 2020). The most affected ecosystems were rainforests (37 percent of their state-wide extent), wet sclerophyll forests (50 percent) and heathlands (52 percent) (DPIE 2020). The fires affecting the study area began in late October 2019 in remote bushland near Lake Burratorang, near Yerranderie, and in Kanangra-Boyd National Park. Due to the extreme isolation of the area and rugged inaccessible terrain, the fire spread and merged to eventually become the Green Wattle Creek Fire on 27 November 2019. This fire rapidly affected the study area where it burnt out of control for at least nine weeks. A total of 278,700 hectares in the Wollondilly area were affected by this fire until it was officially declared as 'contained' on 30 January 2020. The fire was declared as 'extinguished' by the NSW Rural Fire Service (RFS) on 10 February 2020 following a torrential rain event over the preceding week.

The NSW DPIE Remote Sensing and Landscape Science team has, in collaboration with other organisations, developed fire mapping and modelling of the 2019-2020 bushfire event in order to determine the extent, severity, and impact of the bushfires on native vegetation. This has produced the following mapping:

- Google Earth engine burnt area map (GEEBAM), which was developed in collaboration with University of NSW, was developed as a rapid mapping approach which detected how badly the tree canopy had burnt by measuring the change in colour in vegetation before and after fire (DPIE 2020). GEEBAM's rapid assessment of vegetation post-fire made information quickly available on the likely impacts of the fire event on biodiversity, supporting important conservation and environmental management decisions (DPIE 2020).
- Fire extent and severity map (FESM), which was developed in collaboration with RFS, was developed as a semi-automatic approach to mapping fire extent and severity through a machine learning framework based on Sentinel 2 satellite imagery (DPIE 2020). Machine learning uses algorithms and statistical models to understand patterns in the data. FESM has a standardised classification system of fire severity and can predict and compare the severity of fires across different landscapes (DPIE 2020). The finalised version of the FESM for the 2019-2020 bushfire season was produced in April 2020. A further update was issued in December 2020.

The NSW DPIE Remote Sensing and Landscape Science team has recommended that the FESM be used in preference to the rapid GEEBAM product for assessing the impacts of the fire event within the study area. The FESM classifies the fire severity into five burn severity classes. A description of each class, and the approximate extent of each burn severity class within the upstream study area and upstream impact area is provided in Table 20-6. The extent of the fires and the burn severity with regard to the upstream study area and the broader upstream catchment is shown in Figure 20-8.

Table 20-6. FESM burn severity classes and approximate burn extent within the upstream study area and upstream impact area

Severity class	Description	Percent foliage fire affected	% of upstream study area	% of upstream impact area
Unburnt	Unburnt surface with unburnt canopy	0% canopy and understory burnt	26.9%	30.2%
Low	Burnt understory with unburnt canopy	>10% burnt understory >90% green canopy	35.6%	35.4%
Moderate	Partial canopy scorch	20-90% canopy scorch	27.7%	25.4%
High	Full canopy scorch/partial consumption	>90% canopy scorched <50% canopy consumed	5.3%	4.6%
Extreme	Full canopy consumption	>50% canopy biomass consumed	4.5%	4.4%

Figure 20-8. Extent of 2019-2020 bushfires

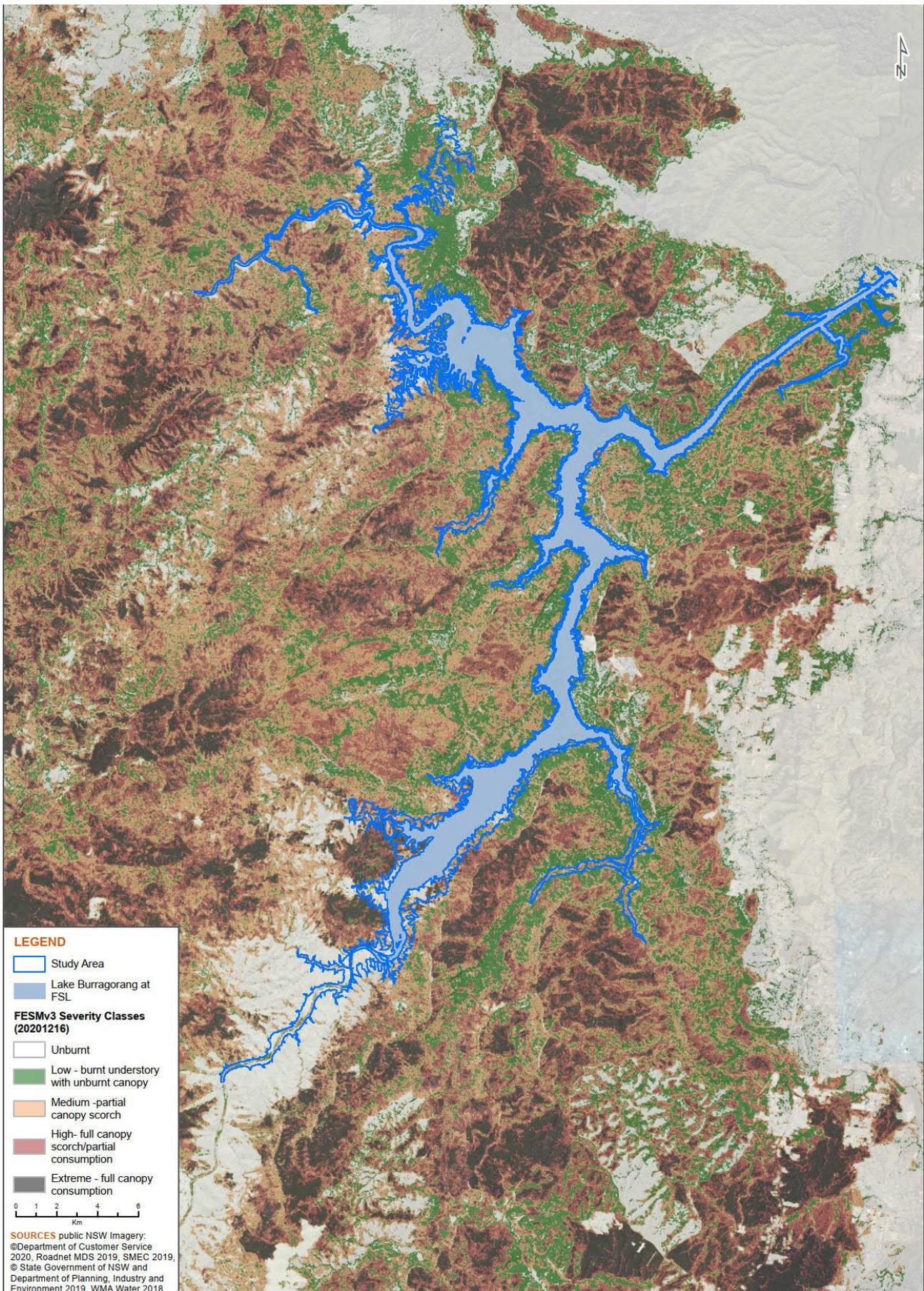


Table 20-7. FESM burn severity classes and approximate burn extent within the GBMWHA

Severity class	Description	Percent foliage fire affected	GBMWHA in upstream study area (ha/%)	GBMWHA in upstream impact area (ha/%)
Unburnt	Unburnt surface with green canopy	0% canopy and understory burnt	358 (28.8%)	98 (32.4%)
Low	Burnt understory with unburnt canopy	>10% burnt understory >90% green canopy	504 (40.5%)	114 (37.5%)
Moderate	Partial canopy scorch	20-90% canopy scorch	237 (19.1%)	56 (18.5%)
High	Complete canopy scorch (+/- partial canopy consumption)	>90% canopy scorched <50% canopy consumed	78 (6.2%)	18 (6.1%)
Extreme	Complete canopy consumption	>50% canopy biomass consumed	67 (5.4%)	17 (5.6%)

The area of the GBMWHA within the upstream study area was relatively unaffected by the 2019-2020 bushfire event. Table 20-7 shows that only about 12 percent of the GBMWHA in the upstream study area experienced 'High' or 'Extreme' burning and almost 70 percent experienced 'Low' or no burning. The area of the GBMWHA within the upstream study was similarly relatively unaffected with only about 12 percent mapped as 'High' or 'Extreme' and about 70 percent mapped as 'Low' or 'Unburnt'.

The 'NPWS Fire History – Wildfires and Prescribed Burns' is a mapping layer released by DPIE on the history of fire in national parks based on data captured by the RFS and Forestry Corporation NSW (DPIE 2020). According to this mapping, the majority of the upstream study area has been affected by wildfire historically and at least 30 percent of the extent has been subjected to a prescribed burn. Wildfires have affected the catchment variably since 1964-65, however, none has been as extensive in size as the 2019-2020 fire. Historically, the catchment has experienced at least four earlier major wildfire events: 1964-65 1994-95 1997-98 and 2001-02 (DPIE 2020).

The effects of the 2019-2020 bushfires on the environment, including the ecological consequences, are not yet fully understood. Though bushfires are not uncommon in Australia, they are usually of a lower scale and intensity that only affect small parts of the overall distribution of ecosystems and habitats (DPIE 2020). Post-fire studies have found that a number of species (both threatened and not currently threatened) have had their entire global populations burnt in the 2019-2020 fires (DPIE 2020). This includes some species and ecological communities that are known to be sensitive to severe fire (DPIE 2020). The long-term fire regime including fire frequency, intensity and seasonality influence the ecosystem in various ways, including having both positive and negative effects. If fires are too frequent, plants may be killed before they have matured or before they have set sufficient seed to ensure population recovery. Alternatively, infrequent fires can impact negatively on plants that rely on fire to regenerate. If fire is too infrequent, these species can grow old and die, and their seeds rot in the soil before germinating. In this way, plant community species richness and composition can be shaped by the fire regime. Some plant species have no or limited natural fire tolerance and may be extirpated or significantly reduced in density over their affected ranges. Other ecological inputs following fire, particular widespread and intense fires, can have additional effects on post-fire ecology. These inputs may include soon recurrent fire, drought, intense rainfall, flood, erosion and predation.

20.4 Assessment of potential Project construction impacts

No construction works are planned within any national park, State conservation area or regional parks. The works related to the raising of the dam and the provision of environmental flow infrastructure would be undertaken only within the Warragamba Special Area. Works undertaken within the Warragamba Special Area are subject to the requirements of the Water NSW Act (refer Chapter 2). Water NSW has authority under the Water NSW Act to undertake works associated with Warragamba Dam, subject to approval under the EP&A Act. Regardless, the safeguards and management measures proposed in various chapters of this EIS would mitigate the risks to protected and sensitive lands.

20.5 Assessment of potential Project operational impacts

20.5.1 Assessment of potential Project impacts to World Heritage listed properties

20.5.1.1 Changes in upstream flood extents and duration in the GBMWHA

Areas of the GBMWHA currently experience temporary inundation during significant rainfall events. In the study area for the Project, temporary inundation is also caused by local catchment inflows, which would occur whether or not Warragamba Dam had been constructed, and also from the effects of the existing dam which causes flood waters to back up along the tributaries. As Warragamba Dam was constructed and was operational before the GBMWHA was World Heritage listed, the existing temporary inundation conditions with the current dam are the baseline for any assessment of impacts.

Table 20-8 presents areas of the GBMWHA in the study area which are currently impacted by temporary inundation and the increase due to the Project for a range of rainfall events. About 304 hectares of the GBMWHA occurs within the upstream impact area. This represents about 0.03 percent of the total area (1,032,649 hectares) of the GBMWHA.

Table 20-8. Area of GBMWHA in the upstream study area potentially impacted by temporary inundation

Flood event (chance in a year)	Existing area in study area impacted by temporary inundation (ha)	Area in study area impacted by temporary inundation with Project (ha)	Change in area (ha)	% increase of GBMWHA affected by temporary inundation due to Project
1 in 5	283	370	87	0.01
1 in 10	344	510	166	0.02
1 in 20	398	691	293	0.03
1 in 100	559	974	415	0.04

For more frequent flood events, the landscape would have less ability to recover to its previous condition and there is potential for changes to the vegetation communities in these areas. A recent review of the environmental impacts of temporary inundation upstream of flood inundation dams in Queensland (Hydrobiology 2019) noted that temporary inundation may impact certain aspects of ecosystem health but that the extent to which this may occur is substantially dependent on a large range of independent variables such as geology, frequency and duration of flooding, geographic setting, ecosystem characteristics, land use, germination from flood-borne seeds, edge effects and similar matters. It further noted that the studies of Queensland dams did not suggest that temporary flood inundation would inevitably cause substantial environmental impact.

The study did, however, note the limitations in extrapolating the findings of limited studies from one system to another, particularly when there are regional differences in (for example) geographic setting, climate, geology, species mix and inundation characteristics. The study also noted the following relevant issues from published literature:

- the duration of inundation can have a significant effect on survival, with naturally riparian species generally able to tolerate longer inundation than naturally up-slope species
- the frequency of inundation can affect soil chemistry and waterlogging, leading to changes in the vegetation supported
- successional changes in vegetation on the margins of dams can take decades to complete.

The vast majority of the additional GBMWHA land temporarily flooded due to the Project would be adjacent to the Wollondilly and Nattai Rivers, with smaller areas along the Kedumba River and creeks catchments which flow directly into Lake Burragorang. The area of additional GBMWHA land temporarily flooded due to the Project along the Coxs and Kowmung Rivers is negligible.

The objective of the Project is to temporarily capture flood inflows and then release them after peak flood levels in the waterways downstream have receded. The temporary storage of flood inflows for up to about two weeks would result in some upstream areas experiencing a greater duration of temporary flooding compared to existing conditions. The time and extent of increased duration of flooding from the Project would depend upon the size of the flood event and the specific location being assessed in relation to the waterway. The increased duration of flooding may range from hours to up to about two weeks.

20.5.1.2 Changes in areas of the GBMWHA downstream from the dam

There are two areas of the GBMWHA downstream of Warragamba Dam that could be potentially impacted by the Project, specifically:

- catchments areas adjacent to the Warragamba River and Nepean River. The GBMWHA area adjacent to the Nepean River extends from its confluence with Warragamba River to Lapstone
- catchment areas of some tributaries of the lower Colo River near its confluence with the Hawkesbury River.

The potential impacts or benefits from the Project on these areas are:

- reduced extent and duration of large floods; overall while there is likely to be some reduction in flood extents and durations in these areas of the GBMWHA, any benefits or impacts to these areas would be minimal (refer Appendix H1 Flooding and hydrology assessment report)
- increased low level flooding impacts due to the discharge of water from the FMZ. The geomorphological assessment (Appendix N2 Geomorphology assessment report) for the Project identified that the sandstone gorge areas in the Warragamba River and Nepean River within the GBMWHA are very stable and would not be impacted by the discharge of water from the FMZ.

Additionally, the provision of infrastructure for environmental flows would benefit the Warragamba River and the reach of the Nepean River immediately downstream of its confluence with Warragamba River (that is, the sections of the river within the GBMWHA). However, as noted elsewhere in the EIS, operation of the environmental flows infrastructure would be subject to a separate assessment and approval process.

20.5.1.3 Assessment of the Project against World Heritage values

As noted in Section 20.3.1, the GBMWHA was inscribed onto the World Heritage list against the following two criteria:

- outstanding examples of ongoing ecological and biological processes
- significant natural habitats for the in situ conservation of biological diversity.

The following discussion provides an assessment of the potential impacts of the Project against the respective values for each criterion.

Outstanding examples of ongoing ecological and biological processes

*Criterion (ix): 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.*

The Project would not impact any primitive species of outstanding significance such as the Wollemi pine and the Blue Mountains pine. The Project could potentially impact nine PCTs in the GBMWHA within the upstream impact area, all of which contain eucalypt species. Most of these PCTs are common and well represented within the GBMWHA and/or the region and therefore the Project would not result in any significant impact to the distribution or survival of these PCTs.

There are three PCTs associated with ecological communities listed under the BC Act and/or the EPBC Act, and which are present within the GBMWHA and potentially impacted by the Project. The potentially impacted PCTs are:

- Forest Red Gum – Yellow Box woodland of dry gorge slopes southern Sydney Basin Bioregion and South Eastern Highlands Bioregion (PCT 840)
- Mountain Blue Gum – Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion (PCT 941)

- Narrow-leaved Ironbark – Forest Red Gum on rocky slopes of the lower Burratorang Gorge Sydney Basin Bioregion (PCT 1401).

The PCT *Forest Red Gum – Yellow Box woodland of dry gorge slopes southern Sydney Basin Bioregion and South Eastern Highlands Bioregion* is known from the Wollondilly, Shoalhaven, Coxs and Jenolan Gorges and also occurs in Bathurst, Bungonia, Burratorang, Ettrema and Kanangra regions. This PCT contains both flood tolerant and intolerant species – however for many of the species within the PCT there is no or limited information on flood tolerance. Given their habitat preferences near waterways, much of the upper storey is likely to be somewhat flood tolerant. Approximately 64 hectares of this PCT occurs within the upstream impact area. As this PCT is relatively well represented in other areas in the GBMWA (and also outside of the GBMWA) and has some flood tolerance, the Project would not result in a significant loss of Eucalypt biodiversity in relation to this PCT.

The PCT *Mountain Blue Gum–Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion* occurs predominantly along the sandy riverbanks of the Georges River and its tributaries, and on gentle, narrowly incised valleys that drain the north-west Woronora Plateau west from the Woronora River. It also occurs in the Lake Burratorang catchment and contains the species Camden White Gum (which is flood tolerant). Most of the other individual species within the PCT are also flood tolerant (See Appendix F1 (Biodiversity assessment report–upstream) to the EIS). Approximately 42 hectares of this PCT occurs in the upstream impact area. As the PCT is relatively flood tolerant and only a small area relative to its extent would be potentially impacted, the impacts on this PCT would not be significant.

The PCT *Narrow-leaved Ironbark – Forest Red Gum on rocky slopes of the lower Burratorang Gorge Sydney Basin Bioregion* is endemic to Burratorang Valley and is predominately found in the Wollondilly and Tonalli River catchments. The majority of the area of this PCT is within the GBMWA. The PCT has some species that are flood tolerant (for example, Forest Red Gum), however many of the mid-storey and groundcover plants are flood intolerant (See Appendix F1 (Biodiversity assessment report-upstream) to the EIS). The total extent of this PCT in the Lake Burratorang catchment is estimated to be about 4,740 hectares based upon previous mapping undertaken by NPWS. Approximately 182 hectares of this PCT occurs in the upstream impact area. While the Project may have some impacts on this PCT, large areas of this PCT would not be affected by the Project.

Two threatened eucalypt species are known to occur in the GBMWA and are potentially impacted by the Project, namely:

- *Eucalyptus benthamii* (Camden White Gum): the largest natural stand of Camden white gum occurs in Kedumba Valley with approximately 15 percent of the area potentially experiencing increased temporary inundation due to the Project in the GBMWA. The species is flood tolerant and based on studies undertaken by the CSIRO, existing mature and juvenile individuals are likely to survive shallow and/or temporary inundation. However, the impact of complete submergence of mature individuals is unknown
- *Eucalyptus glaucina* (Slaty Red Gum): this species is widely distributed through the Burratorang Valley, both inside and outside the Project impact areas. It is likely to be flood tolerant and there is ample evidence of active recruitment. Therefore, the Project is not likely to significantly impact the viability and population of this species.

The principal potential risks of the Project to the ‘*Outstanding examples of ongoing ecological and biological processes*’ value for which the GBMWA was inscribed as a World Heritage site are to the:

- PCT Narrow-leaved Ironbark - Forest Red Gum on rocky slopes of the lower Burratorang Gorge Sydney Basin Bioregion
- Threatened *Eucalyptus benthamii* (Camden White Gum).

Mitigation of potential impacts on biodiversity (and other protected lands values) would be addressed through the Warragamba Offset Program, the cornerstone of which is the Biodiversity Offset Strategy (BOS) required to be prepared under the NSW Framework for Biodiversity Assessment (FBA). The objective of the BOS is to provide a framework for the delivery of offsets for the potential impacts of the Project and to achieve a long-term conservation gain for the threatened species, populations and communities, and biodiversity-related matters with regard to national parks and World Heritage values impacted by the Project. It includes the biodiversity offsets required under the FBA and set out in the SEARs, and offsets addressing potential loss of biodiversity-related World Heritage and national park values.

The Warragamba Offset Program also addresses non-biodiversity matters such as geodiversity, water catchment protection, cultural heritage, landscape, natural beauty and aesthetic values, recreation and visitor use, and social and economic benefits derived from visitation to these areas.

The Warragamba Offset Program will prioritise land suitable for inclusion in the National Park estate, however, additional offsets may be needed through purchase and retirement of biodiversity credits in order to meet the credit requirements for the Project. Any land containing suitable offsets must also be appropriate for the National Park estate and supported by NPWS for this purpose. It is intended that as a minimum the quantum of land required to compensate for impact on National Parks (including the affected part of the GBMWSHA) will be equivalent to or greater than the area impacted (1,400 hectares) and that this would incorporate a minimum area of 304 hectares containing constituent values for the OUV of the GBMWSHA to offset potential impacts to the GBMWSHA.

The mitigation measures identified in Chapter 29, Section 29.7 would contribute to offsetting impacts on protected lands and would support the Warragamba Offset Program.

The separate National Parks Environmental Management Plan (EMP) required to be prepared under the *Water NSW Act 2014* (refer Section 20.7) would complement and support management of potential operational impacts on biodiversity and other protected lands values.

Significant natural habitats for the in situ conservation of biological diversity

Criterion (x): 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 Proteaceae (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 percent 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, Pteris, Lomatia, Dracophyllum, Acrophyllum, Podocarpus and Atkinsonia) and supports many plants of conservation significance including 114 endemic species and 177 threatened species.

The diverse plant communities and habitats support more than 400 vertebrate taxa (of which 40 are threatened), comprising some 52 mammal species, 63 reptile species, over 30 frog species 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 assemblage of cave invertebrate fauna (67 taxa).

The Project would result in the temporary inundation of 15 PCTs and would have varying impacts depending on the location of the PCTs in the landscape (which determines the depth and duration of temporary flooding), the frequency of events and the flood tolerance of individual species within each PCT. As well as the PCTs forming individual ecosystems, they also provide habitat for threatened and non-threatened flora and fauna species.

As noted in Chapter 8 (Biodiversity upstream), 38 threatened fauna species and 76 threatened flora species have either been recorded or have been assumed to occur in the GBMWSHA in the area potentially impacted by the Project. Additionally, these species are assumed to occur within the broader GBMWSHA and within adjacent protected lands.

Apart from Camden White Gum (*Eucalyptus benthamii*), the other known or potential threatened species are found outside of the area of the GBMWSHA potentially impacted by the Project and would be assumed to occur in adjacent areas or other areas in the region. Fauna species are generally motile and while there would be some impacts on their habitat, there would generally not be impacts on their populations. Flora species, however, would experience impacts from the Project.

The key mitigation measures proposed to minimise impacts of the Project on biodiversity (and as summarised in the assessment of the Project on the first outstanding universal value above), would likely reduce or offset the impacts of the Project on biodiversity.

Integrity values

The Statement of Integrity identifies a number of values that individually and holistically contribute to the overall World Heritage value of the GBMWSHA. Comment with regard to these individual values is provided as follows.

Size and extent of the GBMWA

The Statement of Integrity notes that

The seven adjacent national parks and single karst conservation reserve that comprise the GBMA are of sufficient size to protect the biota and ecosystem processes...

The Project would potentially affect an additional area of 304 hectares of the GBMWA upstream of Warragamba Dam or about 0.03 percent of the total area of the GBMWA.

Downstream of Warragamba Dam, there would be a reduction in the area of the GBMWA affected compared to the current situation, equating to about 18 hectares for the PMF event. For the 1 in 100 chance in a year event, the reduction in the affected area would be about 29.5 hectares.

While temporary inundation upstream associated with operation of the FMZ would affect the GBMWA (part of which is already affected by the existing dam), this would not affect the size or extent of the GBMWA.

Wilderness quality

The Statement of Integrity notes that

Most of the natural bushland of the GBMA is of high wilderness quality and remains close to pristine. The plant communities and habitats occur almost entirely as an extensive, largely undisturbed matrix almost entirely free of structures, earthworks and other human intervention. Because of its size and connectivity with other protected areas, the area will continue to play a vital role in providing opportunities for adaptation and shifts in range for all native plant and animal species within it, allowing essential ecological processes to continue.

The areas of the GBMWA potentially affected by the Project are associated mostly with Nattai National Park adjacent to the Wollondilly River and Nattai River. Other small areas potentially affected occur up the Kedumba River, Butchers Creek, Green Wattle Creek and Lacys Creek. All of these areas occur at the fringes of the GBMWA which are already subject to influences from adjoining land uses and would likely not be regarded as areas of significant wilderness value, particularly with reference to the values applying to areas designated as wilderness under the *Wilderness Act 1987*.

Geological structure, geomorphology and water systems

The Statement of Integrity notes that

The area's integrity depends upon the complexity of its geological structure, geomorphology and water systems, which have created the conditions for the evolution of its outstanding biodiversity and which require the same level of protection.

The World Heritage nomination (Government of Australia 1998) identifies geo-diversity as contributing significantly to the unique character of the area, and provides a number of examples of this geo-diversity including:

- extensive dissected sandstone plateaux representing ongoing geological processes
- bottleneck valleys resulting from the downfolding of the resistant Hawkesbury Sandstone at the Lapstone Monocline
- palaeontological 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
- hanging swamps reflecting the relatively low permeability of the Hawkesbury Sandstone and sandstones of the Narrabeen Group.

The additional temporary inundation associated with the Project would occur immediately adjacent to Lake Burragorang and would not affect these areas, and accordingly would not affect geological processes that could change the geological structure of the GBMWA.

The geomorphology assessment carried out for the Project (Appendix N2 Geomorphology Technical Assessment) included consideration of potential erosion risks in the catchment upstream of Warragamba Dam. This identified that the potential for an increase in erosion risk was low and was associated with relatively more frequent flood events such as the 1 in 5 chance in a year and 1 in 10 chance in a year events which for the latter, would affect only about an additional 166 hectares or about 0.02 percent of the total area of the GBMWA upstream of Warragamba Dam. The

geomorphology assessment also identified that the section of the Warragamba River downstream of the dam to the confluence with the Nepean River had a low fragility and moderate recovery potential; about two kilometres metres of this reach borders part of the GBMWA. Overall, the Project is considered unlikely to have a material effect on geomorphological processes that could affect the geomorphology of the GBMWA.

The GBMWA 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 Project would not have a significant impact on water quality in Warragamba Dam or other parts of the Hawkesbury-Nepean River.

Aboriginal cultural heritage

The Statement of Integrity notes that

An understanding of the cultural context of the GBMA is fundamental to the protection of its integrity. Aboriginal people from six language groups, through ongoing practices that reflect both traditional and contemporary presence, continue to have a custodial relationship with the area. Occupation sites and rock art provide physical evidence of the longevity of the strong Aboriginal cultural connections with the land. The conservation of these associations, together with the elements of the property's natural beauty, contributes to its integrity.

About 40 percent of the GBMWA potentially impacted by the Project was surveyed. A synopsis of the findings of the assessment relevant to Aboriginal cultural heritage is presented as follows.

- Forty-three (43) archaeological sites were identified in the GBMWA within the upstream study area (i.e. between FSL and the Project PMF); all sites were identified as being of high cultural significance through consultation with Aboriginal stakeholders
- Twenty (20) sites were identified between FSL and the upstream impact area; three were identified as being of high scientific significance, one as moderate scientific significance, and the remainder as low scientific significance
- Eight (8) sites were identified in the upstream impact area; one was identified as being of high scientific significance and the remainder as low scientific significance
- Fifteen (15) were identified between the upstream impact area and the upstream study area boundary; one was identified as being of high scientific significance and the remainder as low scientific significance
- Thirty-three (33) of the potentially affected sites are open camp sites with 19 of these being located below the upstream impact area, and four of these being of 'High' or 'Moderate' scientific significance; other types of sites are resource gathering, isolated artefacts, axe grinding grooves, shelters with artefacts/deposits and shelters with art
- Art sites are generally the most vulnerable to temporary inundation impacts as the water may degrade the drawing materials; there is only one identified art site in the GBMWA, this being located above the upstream impact area with the archaeological assessment identifying that there would be no loss of value to this site
- The materials at the other sites are generally rock (that is, artefacts, axe grinding grooves) and would not be directly affected by temporary inundation, however indirect impacts such as changes in erosion and deposition of sediments may affect the integrity and access to the sites
- The assessment has identified a potential total loss of value for sites between FSL and the upper extent of the upstream impact area
- There is potential for other sites to occur within areas that have not been surveyed.

As noted, the survey effort for the Project included about 40 percent of the GBMWA within the upstream study area. The Aboriginal Cultural Heritage Assessment (ACHA) report (Appendix K to the EIS) contains an assessment of the number of potential Aboriginal heritage sites based upon the representative survey undertaken and included land outside the GBMWA (refer Appendix K, Annex 1, Section 10.10). As the majority of the GBMWA potentially impacted by the Project is adjacent to the Wollondilly and Nattai Rivers, and the soil landscapes are consistent within the PMF event extents in these locations, the number and type of sites in the area not surveyed would be expected to be consistent with areas surveyed. While there could be additional sites in the GBMWA that may experience temporary inundation due to Project, based on the survey results, these would be generally be of low scientific significance and likely to be open camp sites.

Overall the potential impact of the Project on the integrity value of the Outstanding Universal Value of the GBMWH with regard to Aboriginal cultural heritage is considered to be minor.

20.5.1.4 Assessment against MNES significant impact assessment guidelines

The EPBC Act provides for the making of guidelines to support implementation of the Act, such as in relation to assessment of impacts. With regard to assessing the significance of impacts on World Heritage areas, these are provided in the following table. Further detail is provided in Appendix J (World Heritage Assessment report).

Table 20-9. Assessment of the potential impacts of the Project against World Heritage significant impact criteria

Criterion	Assessment
An action is likely to have a significant impact on the World Heritage values of a declared World Heritage property if there is a real chance or possibility that it will cause:	
One or more of the World Heritage values to be lost	The Project would not result in the loss of one or more World Heritage values. The Project only impacts a small area of the GBMWH and the considerable diversity of Eucalypts, flora and fauna would remain in other areas not impacted by the Project. While there is potential for an incremental impact on Aboriginal cultural heritage in the GBMWH, this would be a diminution rather than a loss of value.
One or more of the World Heritage values to be degraded or damaged	The Project may result in one or more of the World Heritage values being degraded or damaged, namely Criterion x. The biodiversity assessment identified the potential for the loss of biodiversity values but noted uncertainty around the specific nature and degree of impacts. The Warragamba Offset Program and the other mitigation measures detailed in EIS Chapter 29 (EIS synthesis, Project justification and conclusion) would ensure that any degradation or damage to World Heritage values is offset and the overall values of the GBMWH are maintained in the longer term.
One or more of the World Heritage values to be notably altered, modified, obscured or diminished	The Project would not notably alter, modify, obscure or diminish the World Heritage values. The Project would potentially impact only a very small area of the GBMWH and the considerable diversity of Eucalypts, flora and fauna would remain.

20.5.1.5 Assessment of the Project against the Strategic Plan strategic management objectives

World Heritage Convention management objectives

Under Article 5 of the World Heritage Convention, signatories are required to meet six management obligations to protect designated World Heritage areas. While the Project and WaterNSW are not directly responsible for meeting the management obligations as they are not signatories, their actions and impacts may affect the ability of the signatories to meet the management obligations. An assessment of the Project against the six management obligations is presented in Table 20-10.

Table 20-10. Assessment of the Project against World Heritage Convention management objectives

Management objective	Response
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.	Mitigation measures for biodiversity, heritage and other environmental aspects are proposed for the protection, conservation and presentation of the cultural and natural heritage of the GBMWH. These comprise: <ul style="list-style-type: none"> ▪ The Warragamba Offset Program ▪ Other mitigation measures as detailed in the EIS. The Minister (or their delegate) would have approval and input into all mitigation measures to ensure that any risks from the Project to the GBMWH are appropriately addressed and are consistent with this management obligation. The separate National Parks EMP would support and complement the above mitigation measures.
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.	Mitigation measures for biodiversity, heritage and other environmental aspects would be integrated into or complement any relevant comprehensive planning programs for the GBMWH and other MNES. This would also include consultation with relevant stakeholders with a responsibility for any planning programs to ensure that mitigation measures are consistent with World Heritage management obligations.

Management objective	Response
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.	<p>The GBMWhA Advisory and Management Committees and Government departments and agencies such as DAWE, DPIE, EES and NPWS provide services for the protection, conservation, and presentation of the cultural and natural heritage.</p> <p>The GBMWhA Advisory and Management Committees, DAWE, DPIE, EES and NPWS have been consulted and informed during the preparation of the EIS and would be able to provide formal comments during the exhibition of the EIS. Approval under the EP&A Act and EPBC Act would be required for the Project to proceed.</p> <p>The GBMWhA Advisory and Management Committees, NPWS, EES, DAWE and DPIE would be consulted in the development and implementation of mitigation measures in relation to values of the GBMWhA.</p> <p>The interaction of the Project with these services in the development and assessment phases and potentially the development and implementation of mitigation measures, if the Project is approved, is consistent with this management obligation.</p>
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.	<p>The scientific and technical studies and research undertaken for the Project contribute significantly to the knowledge of the GBMWhA and would be provided to Advisory Committee and NPWS to assist in the management of the GBMWhA.</p> <p>The EIS provides a comprehensive assessment of the potential dangers of the project and details mitigation measures that counteract threats to cultural and natural heritage of the GBMWhA.</p> <p>The scientific and technical studies undertaken to support the EIS and the proposed additional studies are consistent with this management obligation.</p>
Take appropriate legal, scientific, technical, administrative and financial measures to ensure the identification, protection, conservation, presentation and rehabilitation of this heritage.	<p>The studies undertaken for the Project contribute to the identification of the heritage and other values of the GBMWhA. Mitigation measures for biodiversity, heritage and other environmental aspects have been developed to ensure the protection, conservation, presentation and rehabilitation of the heritage of the GBMWhA. These comprise:</p> <ul style="list-style-type: none"> ▪ The Warragamba Offset Program ▪ Other mitigation measures as detailed in the EIS. <p>DAWE (and other NSW government agencies with responsibility for regulation and management of matters concerning the GBMWhA) have been consulted during the preparation of the EIS. The Project and EIS have been developed in compliance with relevant Australian and NSW guidelines, policies and legislation.</p> <p>The requirement for the Project to obtain approval from both the NSW Minister for Planning and the Australian Government Minister for the Environment provides the opportunity for both levels of Government to impose approval conditions which detail appropriate legal, scientific, technical, administrative and financial measures to ensure the identification, protection, conservation, presentation and rehabilitation of GBMWhA</p>
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. UNESCO (1972).	<p>This obligation is beyond the scope of the Project and is a NSW and Australian Government responsibility.</p> <p>The Project would not affect either level of Government's ability to implement this management obligation.</p>

GBMWhA Strategic Plan strategic management objectives

The Strategic Plan identifies seven strategic management objectives for the GBMWhA. These have been derived from the World Heritage Convention and its Operational Guidelines, and provide guidance for the formulation of operational management strategies (DECC 2009a). An assessment of the Project against these strategic management objectives is presented in Table 20-11.

Table 20-11. Assessment of the Project against the GBMWHA Strategic Plan strategic management objectives

Strategic management objectives	Response
Strategic objectives for management of the GBMWHA are to:	
Identify, protect, conserve, present, transmit to future generations and, where necessary, rehabilitate the World Heritage values of the GBMWHA	The Project impacts a small area (an additional 0.03 percent) of the GBMWHA. This notwithstanding, mitigation measures have been identified to offset the impacts of the Project and these would support maintenance of the World Heritage values of the GBMWHA.
Integrate the protection of the GBMWHA into a comprehensive planning program	This is outside of the scope of the Project, however, the mitigation measures identified to offset the impacts of the Project would support any such planning program to protect the GBMWHA.
Give the GBMWHA a function in the life of the Australian community	This objective is beyond the scope of the Project, and is a NSW Government and Australian Government responsibility.
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	This objective is beyond the scope of the Project, and is a NSW Government and Australian Government responsibility. However, the studies carried out for the Project have added to knowledge and understanding of the environmental values of the Project study area
Take the appropriate scientific, technical, legal, administrative and financial measures necessary for implementing these principles	This objective is beyond the scope of the Project, however, the studies undertaken for the Project would support this objective.
Provide for continuing community and technical input in managing the GBMWHA	This objective is beyond the scope of the Project, and is a NSW Government and Australian Government responsibility.
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	This objective is beyond the scope of the Project, and is a NSW Government and Australian Government responsibility.

The Strategic Plan notes that in common with many protected areas, the GBMWHA faces a range of threats to its immediate and long-term integrity. These threats vary in scale from incompatible land use on an adjoining property through to global climate change. The management strategies for the GBMWHA address primarily those threats that are of strategic importance to the overall integrity of the GBMWHA's World Heritage values and, therefore, require a strategic, coordinated, and consistent approach by the management agencies. Threatening processes that are specific to particular locations will, more appropriately, be dealt with in the context of management planning for each reserve. Whilst the origins and causes of human enhanced climate change are beyond the scope of this document, there are some management actions that may reduce the potential and existing impacts of that change (DECC 2009a).

Consideration of the threats identified in the GBMWHA Strategic Plan with regard to likely and potential impacts of the Project is provided in Table 20-12.

Table 20-12. Threats identified in the GBMWH Strategic Plan and potential impacts of the Project

Threat	Response
Uncontrolled or inappropriate use of fire	The Project would not result in any increased threat of uncontrolled or inappropriate use of fire.
Inappropriate recreation and tourism activities, including the development of tourism infrastructure, under the increasing visitor pressure from Australian, overseas, and commercial ventures	The Project would not result in any inappropriate recreation and tourism activities.
Invasion by pest species including weeds and feral animals	The Project may result in increased invasion of weeds and feral species due to loss of soil and vegetation in the new inundation areas – and the recolonisation by weed species. Specific mitigation measures have been proposed to mitigate impacts including the National Parks EMP.
Loss of biodiversity and geodiversity at all levels	The Project would not impact upon geodiversity (refer Table 9 2), however, it may have impacts on flora and fauna within the World Heritage area. This would be offset where possible and other mitigation measures are proposed to minimise impacts with the Warragamba Offset Program. While there may be loss of some biodiversity, this would not significantly impact the GBMWH as a whole.
Impacts of human enhanced climate change	The Project would not result in increased impacts of human enhanced climate change.
Lack of understanding of heritage values	The Project would result in increased understanding of heritage values through the studies undertaken for the EIS. An assessment of the Project's impact on heritage values is presented in this section and further detail is provided in Chapter 17 (Non-Aboriginal heritage), Chapter 18 (Aboriginal cultural heritage) and the respective specialist investigations (Appendices I and K respectively).

Further details on the how the Project may impact the objectives of the Strategic Plan are provided in Appendix J to the EIS.

20.5.1.6 Assessment of the Project against the principles of the EPBC Act relevant to World Heritage

As required under Schedule 5A to the EPBC Regulations, the potential impacts of the Project have been assessed against the General Principles of World Heritage property management in Table 20-13.

Table 20-13. Assessment of the Project against the general principles of World Heritage property management

General principles	Assessment of the Project
1. General principles	
1.01: The primary purpose of management of natural heritage and cultural heritage of a declared World Heritage property must be, in accordance with Australia's obligations under the World Heritage Convention, to identify, protect, conserve, present, transmit to future generations and, if appropriate, rehabilitate the World Heritage values of the property.	The Project has been developed to minimise impacts on the GBMWH, wherever possible. Mitigation measures have been developed for biodiversity, Aboriginal heritage and other relevant environmental aspects. The National Parks EMP (refer Section 20.7) would include all areas in the GBMWH potentially impacted by the Project and would contain additional mitigation measures developed in conjunction with NPWS.
1.02: The management should provide for public consultation on decisions and actions that may have a significant impact on the property.	In the development of the Project and the preparation of the EIS there has been public and stakeholder consultation (see Chapter 6 of the EIS). The EIS for the Project would also have a public exhibition period where stakeholders and the public would have the opportunity to make formal submissions on the Project
1.03: The management should make special provision, if appropriate, for the involvement in managing the property of people who: (a) have a particular interest in the property	Neither of these matters are directly relevant to the Project; however, it is noted that Aboriginal stakeholders and the NPWS would be involved in the development of the National Parks EMP.

General principles	Assessment of the Project
(b) may be affected by the management of the property.	The Advisory Committee has been consulted during preparation of the EIS.
1.04: The management should provide for continuing community and technical input in managing the property.	This is not directly relevant to the Project; however, it is noted that Aboriginal stakeholders, the Advisory Committee and the NPWS would be involved in the development of the National Parks EMP.
2. Management planning	
2.01: At least 1 management plan should be prepared for each declared World Heritage property.	The GBMWhA Strategic Plan (DECC 2009a) is the overarching plan for the management of the GBMWhA. Also, the National Parks EMP would include all areas in the GBMWhA potentially impacted by the Project and would contain additional mitigation measures developed in conjunction with NPWS.
<p>2.02: A management plan for a declared World Heritage property should:</p> <ul style="list-style-type: none"> (a) state the World Heritage values of the property for which it is prepared (b) include adequate processes for public consultation on proposed elements of the plan (c) state what must be done to ensure that the World Heritage values of the property are identified, conserved, protected, presented, transmitted to future generations and, if appropriate, rehabilitated (d) state mechanisms to deal with the impacts of actions that individually or cumulatively degrade, or threaten to degrade, the World Heritage values of the property (e) provide that management actions for values, that are not World Heritage values, are consistent with the management of the World Heritage values of the property (f) promote the integration of Commonwealth, State or Territory and local government responsibilities for the property (g) provide for continuing monitoring and reporting on the state of the World Heritage values of the property (h) be reviewed at intervals of not more than 7 years. 	<p>The GBMWhA Strategic Plan (DECC 2009a) is the overarching plan for the management of the GBMWhA.</p> <p>The National Parks EMP would include all areas in the GBMWhA potentially impacted by the Project and would comply with requirements of 2.02 a-h.</p>
3. Environmental impact assessment and approval	
3.01: This principle applies to the assessment of an action that is likely to have a significant impact on the World Heritage values of a property (whether the action is to occur inside the property or not).	Noted.
3.02: Before the action is taken, the likely impact of the action on the World Heritage values of the property should be assessed under a statutory environmental impact assessment and approval process.	The World Heritage assessment report (Appendix J) and the Project EIS are being prepared to meet the statutory environmental impact assessment and approval processes under the NSW EP&A Act and the Commonwealth EPBC Act. These would be considered by the relevant approval authorities in both jurisdictions and a decision would be made whether to approve the Project or not.

General principles	Assessment of the Project
3.03: The assessment process should:	
(a) identify the World Heritage values of the property that are likely to be affected by the action	This report and the Project EIS identify the World Heritage values of the property that are likely to be affected by the action.
(b) examine how the World Heritage values of the property might be affected	This report and the Project examine how the World Heritage values of the property might be affected.
(c) provide for adequate opportunity for public consultation.	In the development of the Project and the preparation of the EIS there has been public and stakeholder consultation (see Chapter 6 of the EIS). The EIS for the Project would also have a public exhibition period where stakeholders and the public would have the opportunity to make formal submissions on the Project.
3.04: An action should not be approved if it would be inconsistent with the protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.	Based on the impact assessment and the proposed mitigation measures, the Project is considered consistent with the protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.
3.05: Approval of the action should be subject to conditions that are necessary to ensure protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.	If the Project is approved, it is likely that both the Australian and NSW Governments would provide conditions of approval that are necessary to ensure protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.
3.06 The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions of the approval.	The Warragamba Offset Program provides for the auditing of compliance with enhancing World Heritage values and the integrity of the GBMWHA. The responsibility for monitoring will sit with the relevant regulatory authorities.

20.5.1.7 Australian Convict Sites World Heritage Property – Old Great Northern Road

There would be no material change to the extent of inundation of the World Heritage listed Australian Convict Sites - Old Great Northern Road property for flood events up to the 1 in 100 chance in a year as shown in Table 20-14. There would be a reduction in the area of potential inundation from the PMF with the Project (but noting that this event is unlikely to ever occur in reality as previously noted. Accordingly, the Project would not impact this property.

Table 20-14. Change in flooding extent on the Australian Convict Sites World Heritage Property - Old Great Northern Road

Flood event (chance in a year)	Existing area flooded in the study area (ha)	Area flooded in the study area with Project (ha)	Change in area (ha)
1 in 5	0.0	0.0	0.0
1 in 10	0.0	0.0	0.0
1 in 20	0.0	0.0	0.0
1 in 100	0.0	0.0	0.0
PMF	1.1	0.6	-0.4

20.5.2 Assessment of potential Project impacts to national heritage listed places

As required under Schedule 5B to the EPBC Regulations, the impacts of the Project have been assessed against the General Principles of National Heritage property management in Table 20-15.

Table 20-15. Assessment of the Project against the national heritage management principles

Management principles	Assessment of the Project
1. The objective in managing National Heritage places is to identify, protect, conserve, present and transmit, to all generations, their National Heritage values	The Project has been developed to minimise its impacts on the GBMWHA, wherever possible. Mitigation measures have been developed for biodiversity, Aboriginal heritage and other relevant environmental aspects. Also, the National Parks EMP would include all areas in the GBMWHA potentially impacted by the Project and would contain additional mitigation measures developed in conjunction with NPWS.
2. The management of National Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their National Heritage values.	The National Parks EMP would include all areas in the GBMWHA potentially impacted by the Project and would contain additional mitigation measures developed in conjunction with NPWS, the Advisory Committee and other relevant technical experts and stakeholders.
3. The management of National Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places.	All management measures developed would respect the heritage values of the GBMWHA and would integrate with existing State and Commonwealth responsibilities.
4. The management of National Heritage places should ensure that their use and presentation is consistent with the conservation of their National Heritage values.	All management measures developed would aim to ensure that their use and presentation is consistent with the conservation of their National Heritage values.
5. The management of National Heritage places should make timely and appropriate provision for community involvement, especially by people who: 5(a) have a particular interest in, or association with, the place; and 5(b) may be affected by the management of the place.	This is beyond the scope of the Project. However, the National Parks EMP would include all areas in the GBMWHA potentially impacted by the Project and would contain additional mitigation measures developed in conjunction with NPWS, the Advisory Committee and other relevant technical experts and stakeholders.
6. Indigenous people are the primary source of information on the value of their heritage and the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values.	Registered Aboriginal Parties (RAPs) who hold cultural knowledge have been involved in heritage surveys and have provided input into Aboriginal Cultural Heritage Assessment report for the Project. The Gundungurra ILUA has also been reviewed.
7. The management of National Heritage places should provide for regular monitoring, review and reporting on the conservation of National Heritage values.	Responsibility for monitoring of National Heritage places does not sit with WaterNSW. However, the Warragamba Offset Program would support monitoring related to management of the GBMWHA.

20.5.3 Potential Project inundation impacts to protected areas

Potential impacts from the operation of the Project relate to the increased area of temporary inundation of protected areas. As there would be no change to the full supply level (FSL), there would only be a change in the temporary storage of flood waters above the existing FSL based on a raised dam wall and the operation of the FMZ.

Table 20-16 shows the areas of affected protected areas that occur within the upstream impact area.

Table 20-16. Extent of protected areas within upstream impact area

Protected area	Total area (ha)	Area within upstream impact area	
		(ha)	(% of total area)
Greater Blue Mountains World Heritage Area	1,032,649	304	0.03
Blue Mountains National Park	269,401	535	0.20
Nattai National Park	17,725	284	0.90
Burraborang State Conservation Area	51,032	159	0.56
Nattai State Conservation Area	3,266	51	1.56
Yerranderie State Conservation Area	12,423	274	2.21

Figures 20-9 to 20-15 inclusive show the upstream impact area relative to the above protected areas. These areas of additional inundation associated with the Project are within the Warragamba Special Areas (refer Section 20.3.10).

Figure 20-9. Area of potential additional inundation of the GBMWHA for the upstream impact area

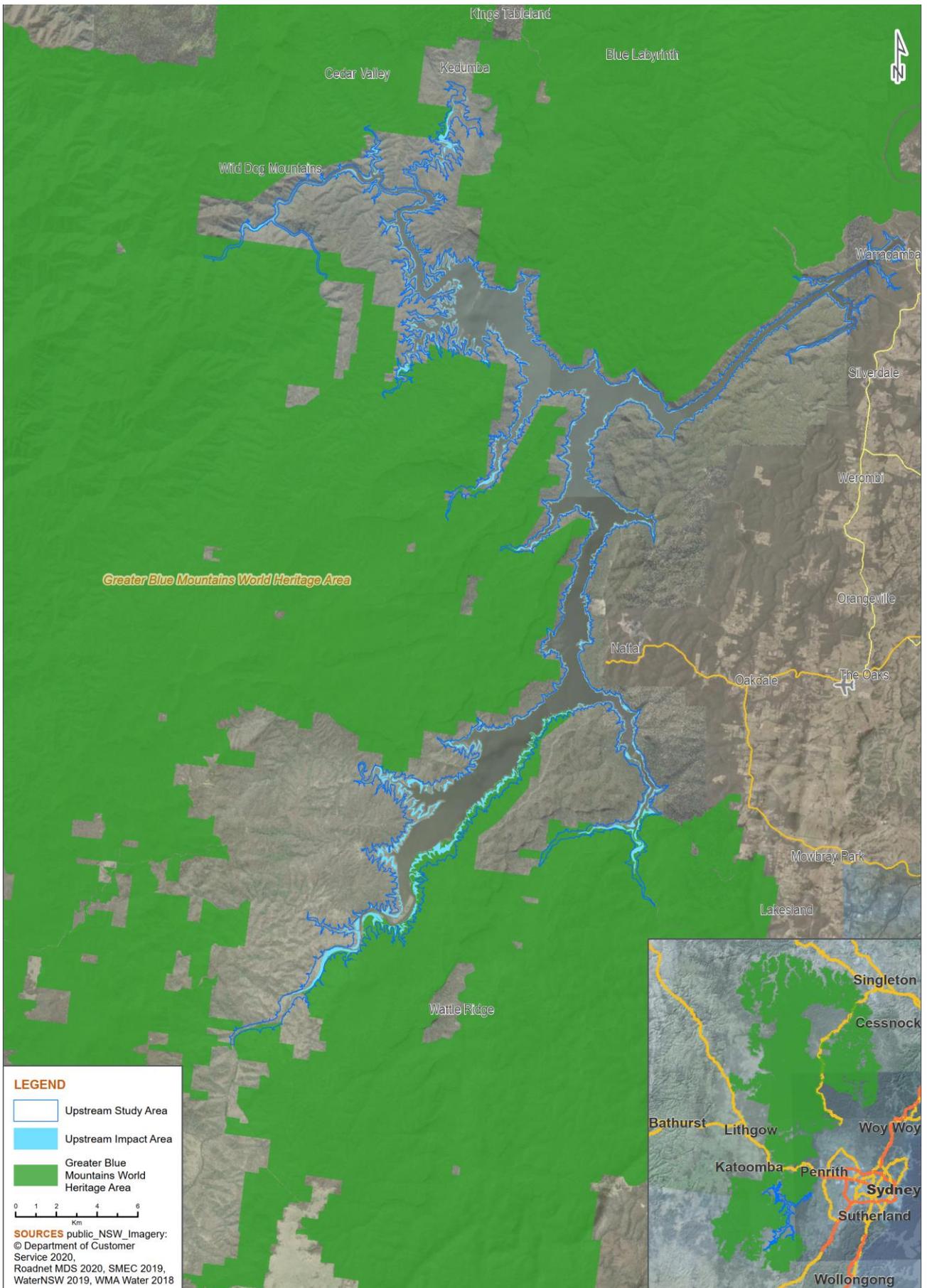


Figure 20-10. Location of upstream impact area in relation to Blue Mountains National Park

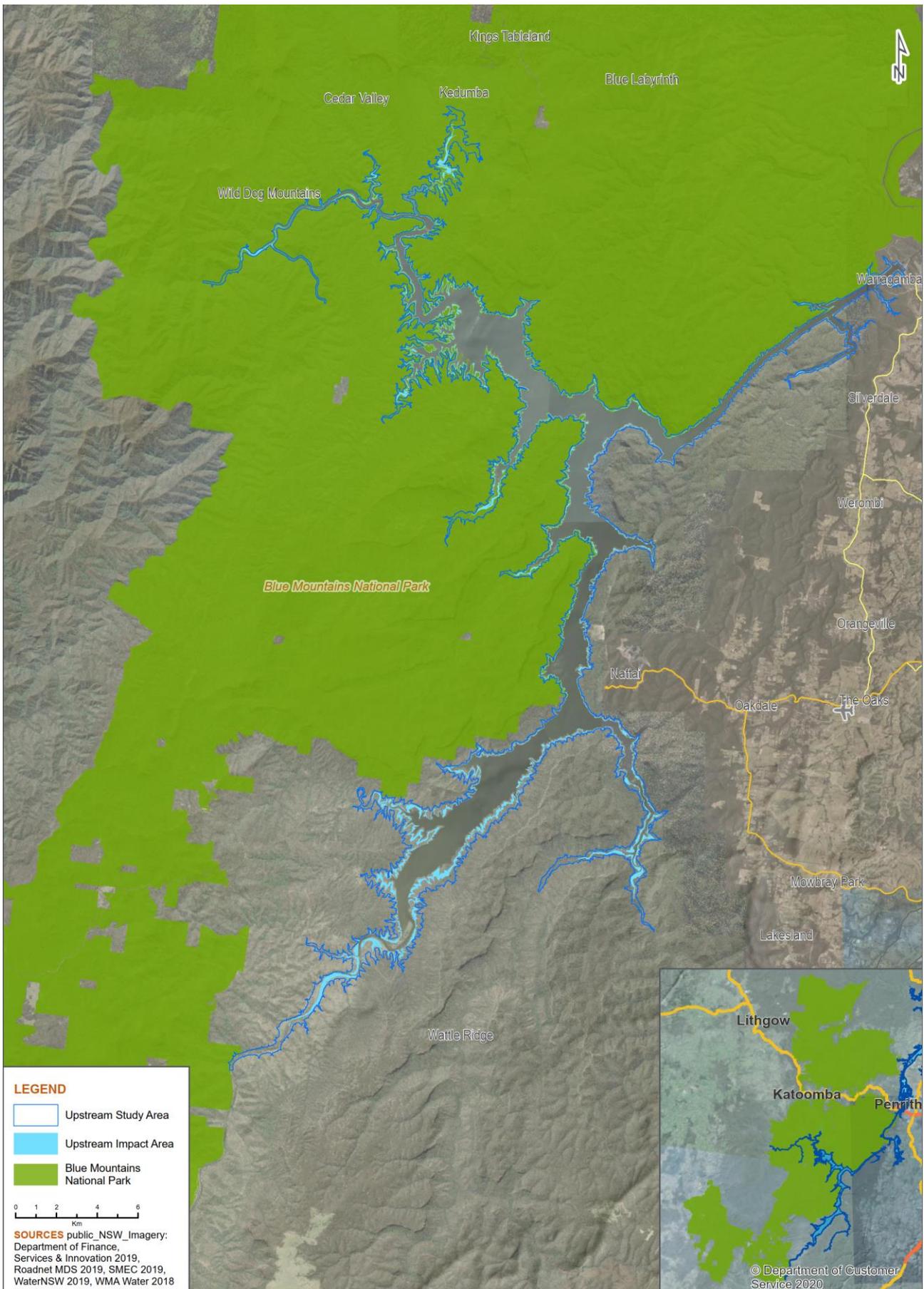


Figure 20-11. Location of upstream impact area in relation to Kanangra-Boyd National Park

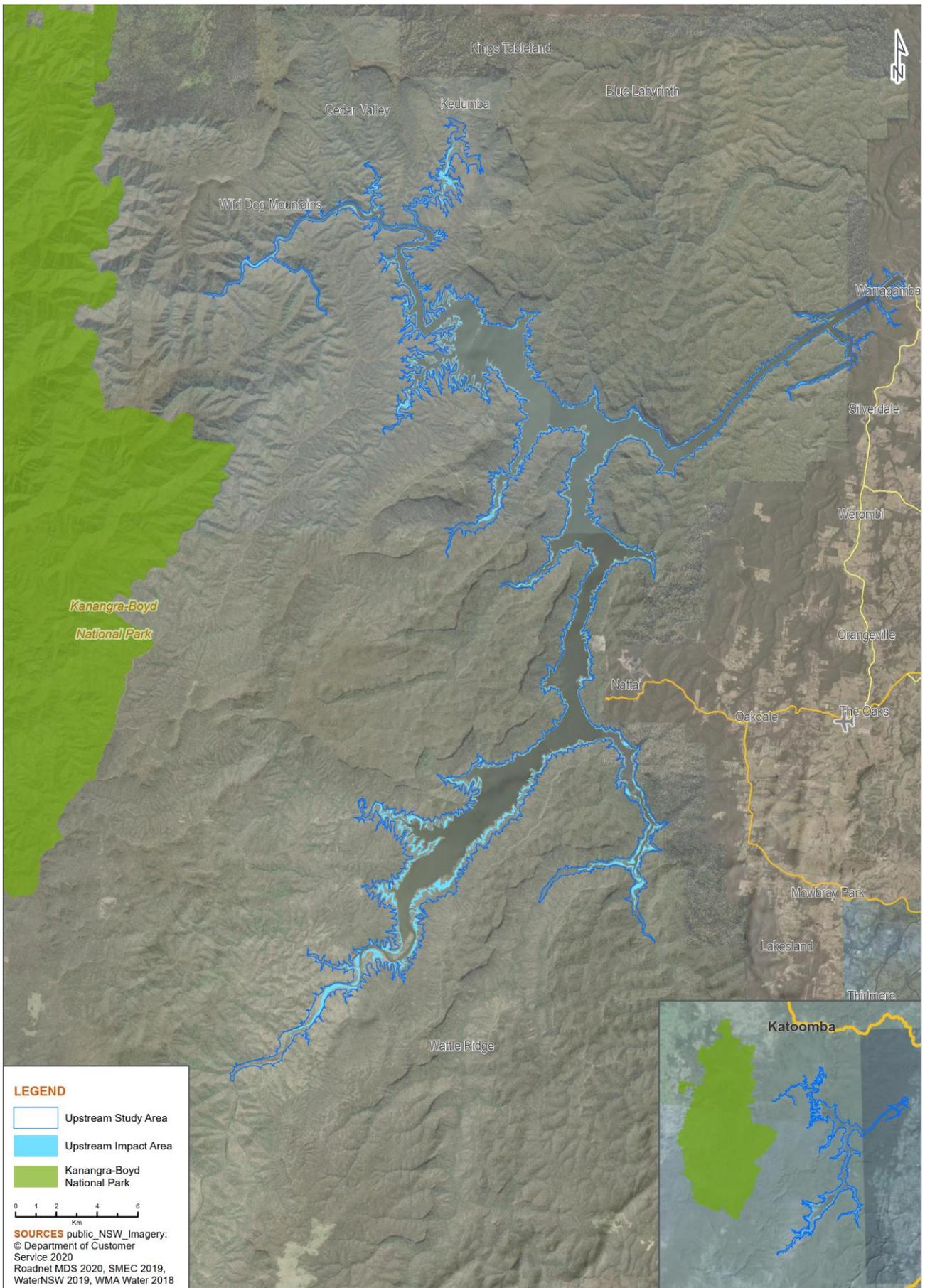


Figure 20-12. Location of upstream impact area in relation to Nattai National Park

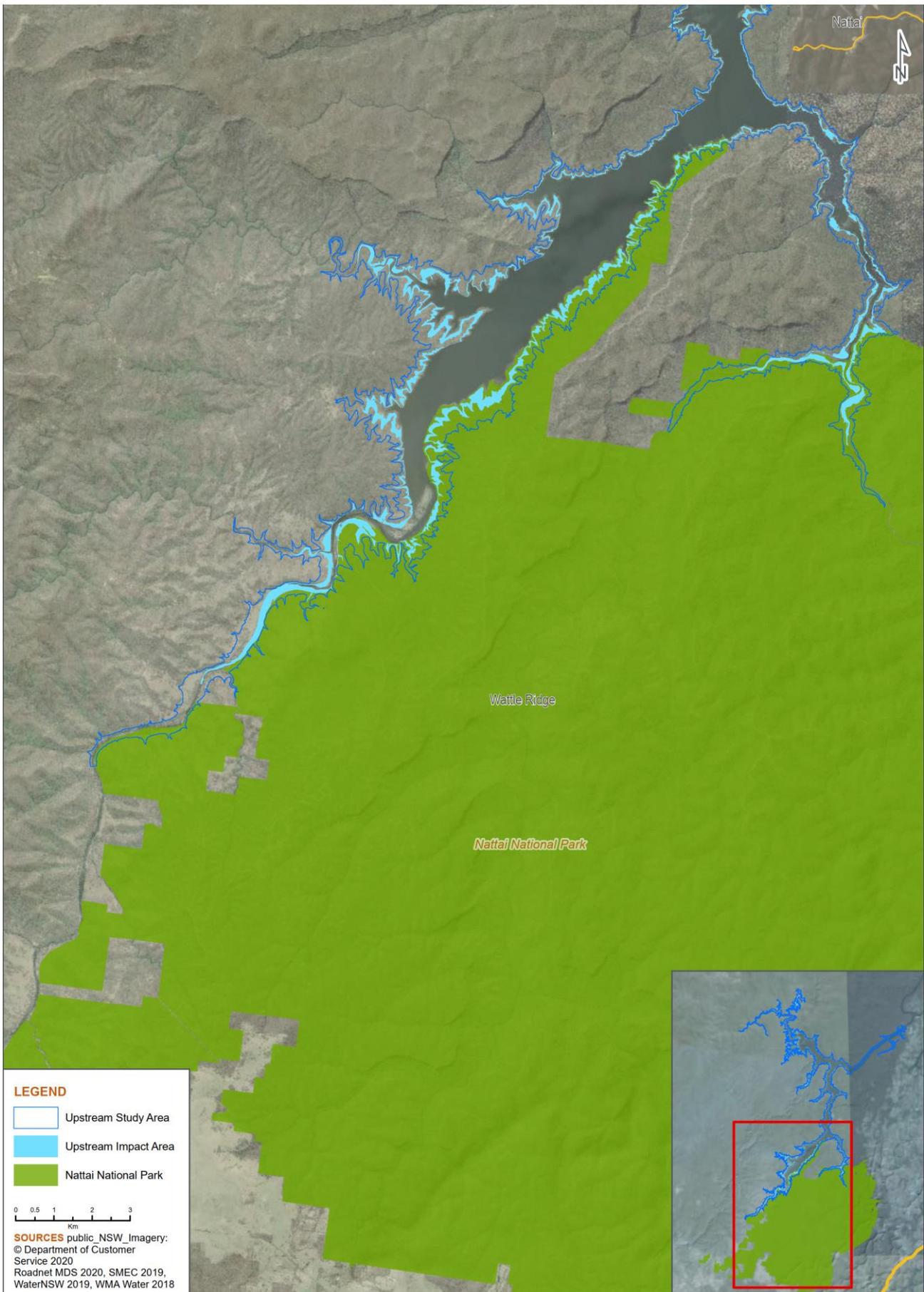


Figure 20-13. Location of upstream impact area in relation to the Burragorang State Conservation Area

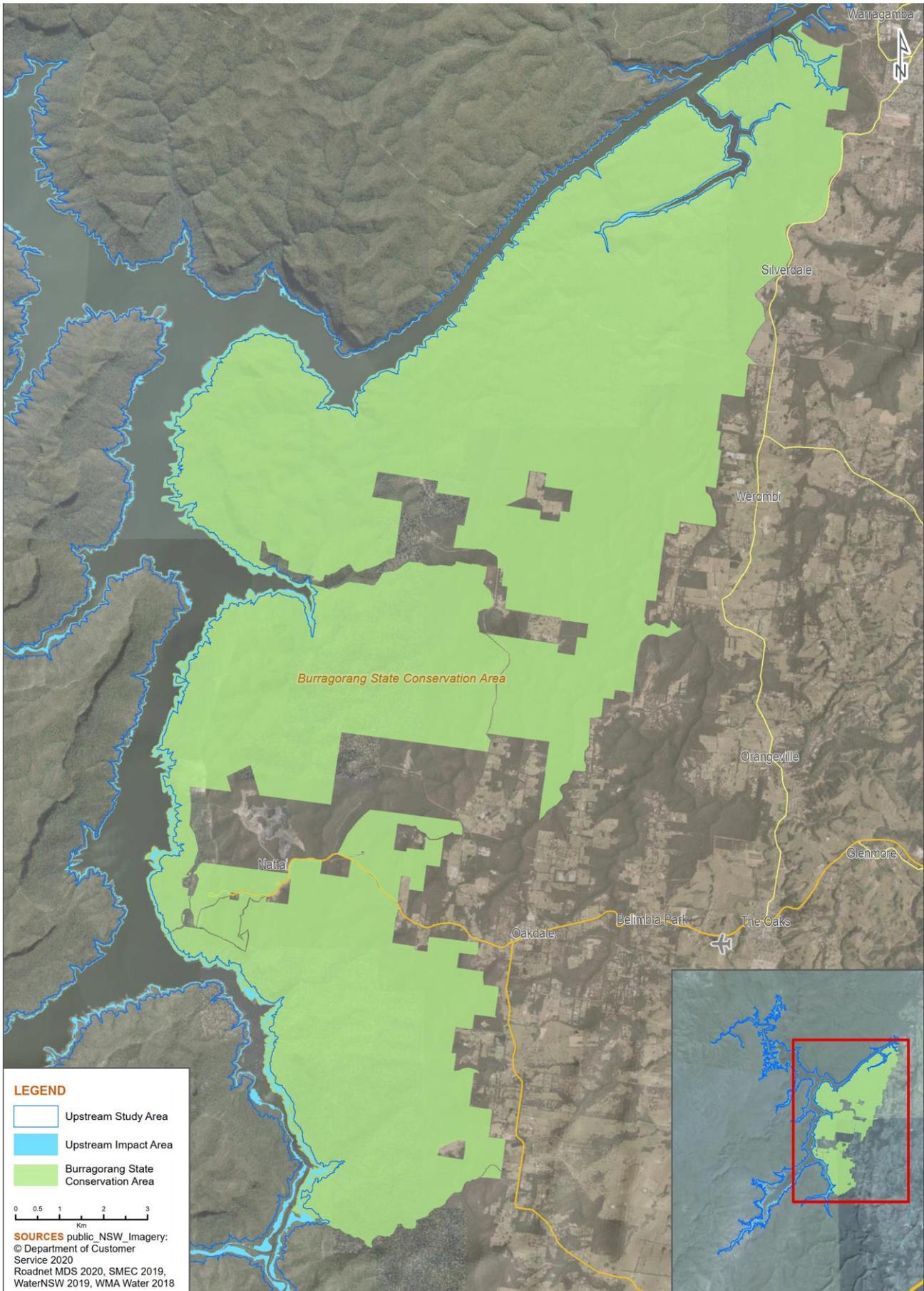


Figure 20-14. Location of upstream impact area in relation to the Nattai State Conservation Area

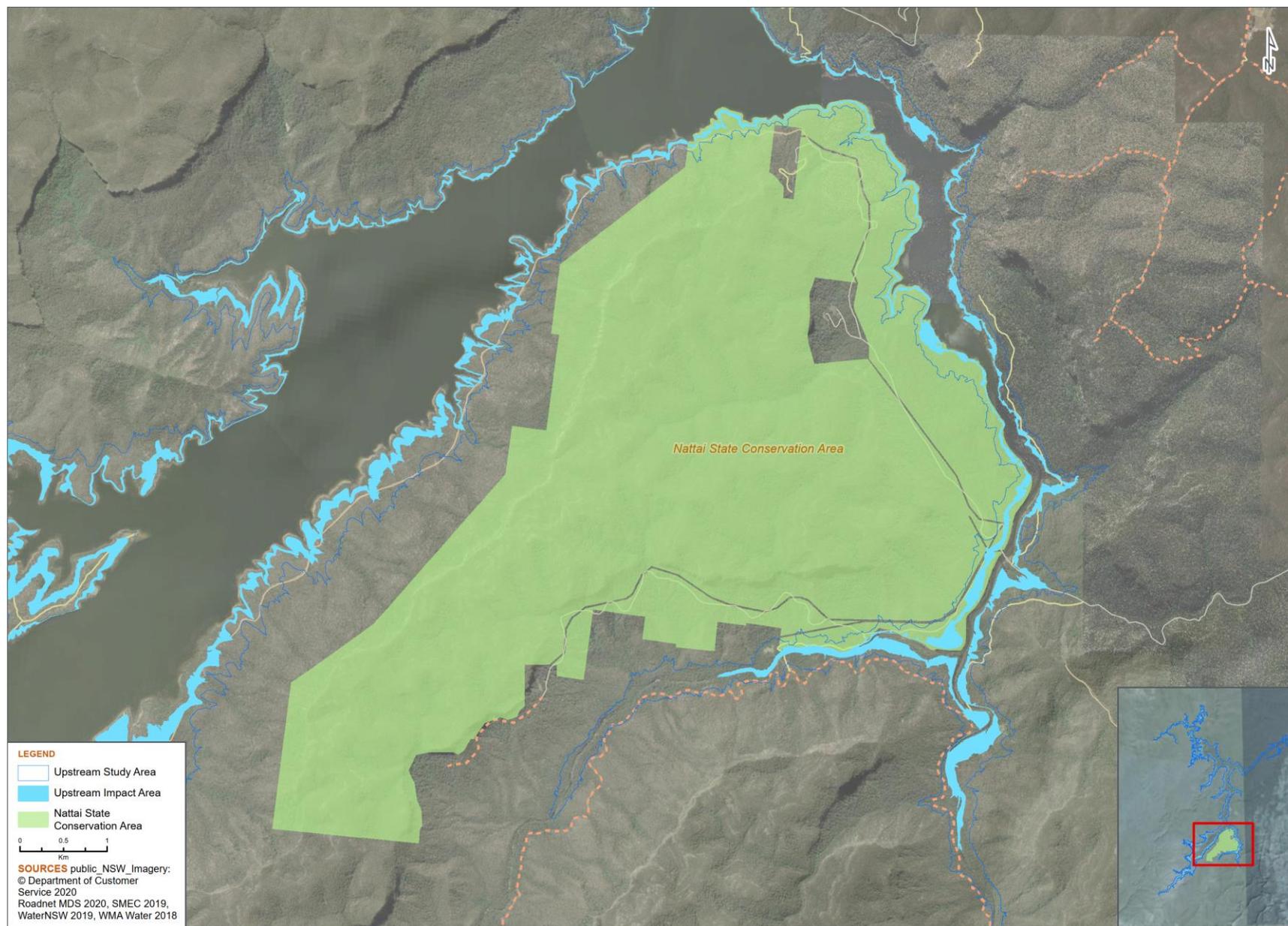
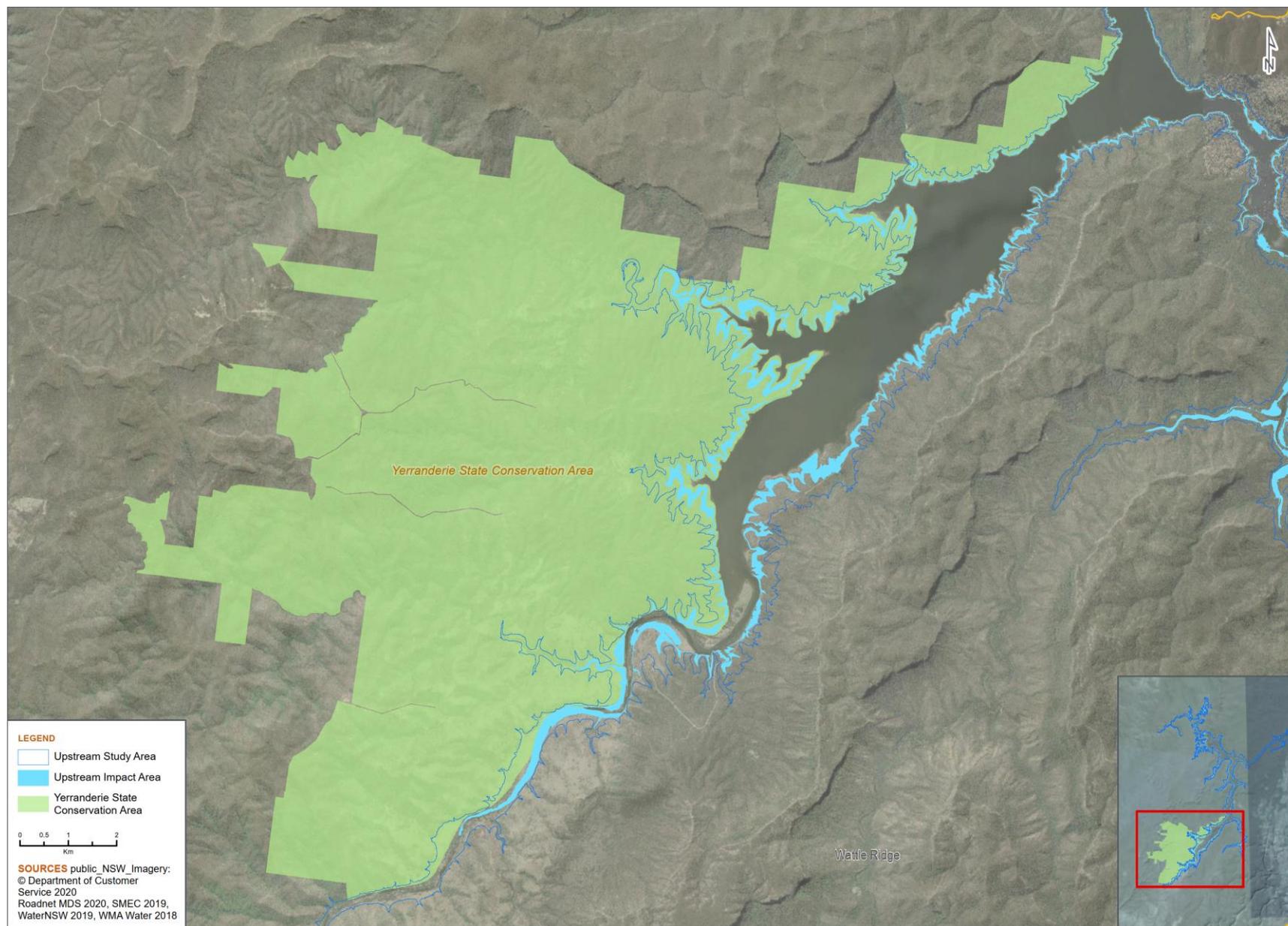


Figure 20-15. Location of upstream impact area in relation to the Yerranderie State Conservation Area



20.5.4 Assessment of other potential Project impacts to lands reserved under the NPW Act

20.5.4.1 Assessment of potential Project impacts to biodiversity within NPW Act estates

Desktop assessments and field surveys identified that the vegetation in the study area conforms to 41 PCTs. Of these, 18 occur in the upstream study area, 25 occur in the downstream study area, and four occur in the construction area. Of these, 13 are listed as threatened under the EPBC Act and 20 are listed as threatened under the BC Act, and of these, three may be impacted by temporary inundation with the Project. These are discussed in Section 20.5.6.

Thirty threatened fauna species and 76 threatened flora species have either been recorded or have been assumed to occur in the GBMWA in the area potentially impacted by the Project. Potential significant impacts to fauna species are considered low, as the majority of species are motile and can move from areas of potential temporary inundation to adjacent habitats. The connectivity of protected areas in the upstream study area would facilitate this. There would be some significant impacts to threatened flora communities and species. Many of these communities and species are well represented in the region and therefore, given the small spatial extent of potential inundation, impacts to these are not considered significant. Some species however, either have restricted geographic extent, or their tolerance to temporary inundation is poorly understood. Further investigation is required to better characterise the nature of potential impacts to these communities and/or species.

Potential Impacts to threatened ecological communities, threatened flora, threatened fauna, and important fauna habitats associated within protected areas within or near the Project study area were assessed in Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment), Chapter 10 (Biodiversity construction area), and Chapter 12 (MNES – Biodiversity).

20.5.4.2 Assessment of potential Project impacts to cultural heritage within NPW Act estates

The Greater Blue Mountains Area (WHL Place ID 105127, NHL Place ID 105999) would be impacted in areas upstream of the dam that are within the potential inundation extents. These upstream areas of the item's curtilage would be directly impacted by the temporary retention of flood waters at an increased level in some areas. A portion of The Greater Blue Mountains Area - Additional Values (NHL Place ID 105696) listing would also be impacted by the Project as the curtilage extends down to the current full supply level around the dam.

Many cultural heritage items downstream of the dam would benefit from the Project, as these are in areas where flood extents would be reduced. Potential Project impacts to non-Aboriginal cultural heritage are assessed in detail in Chapter 17 (Non-Aboriginal heritage).

Submersion of a site can result in varying impacts depending on site type, for example:

- stone artefact sites will be subject to changed ground conditions such as waterlogging or erosion
- sandstone shelter sites will be subject to altered conditions that may detrimentally effect deposits and/or rock art
- scarred trees will be subject to more frequent flooding upstream
- axe grinding grooves and engravings will be more frequently submerged, altering natural conditions and possibly their preservation
- Aboriginal ceremony and dreaming sites, and Aboriginal resource and gathering sites will have their accessibility altered, and physical aspects of the sites may also change.

The RAPs have advised through the consultation process that all sites have high cultural significance. Detailed RAP submissions are presented in the ACHA (Appendix K to the EIS).

- some RAPs consider that potential impacts on cultural heritage values are acceptable if the management and mitigation measures presented in the ACHA (Appendix K to the EIS) are applied
- several of the RAPs consider the Project is an unacceptable impact to Aboriginal cultural heritage values and submit that the Project should not proceed.

Potential Project impacts to Aboriginal cultural heritage are assessed in detail in Chapter 18 (Aboriginal cultural heritage).

20.5.4.3 Assessment of potential Project operational impacts on NPWS assets

Table 20-17 provides a summary of the number and type of NPWS assets currently affected by various flood events up to the 1 in 100 chance in a year event, and the additional number potentially affected by the Project. As may be seen, roads and fire trails are the two types of assets most potentially affected. Temporary inundation is considered unlikely to result in material impacts to roads and fire trails, with damage and erosion due principally to inflow events, as currently occurs. Rising floodwaters would create a backwater effect in tributaries potentially contributing to a reduction in flow velocities thereby reducing the risk of erosion at the local level.

Table 20-17. NPWS assets potentially impacted by the Project

Asset type	1 in 20 chance in a year		1 in 50 chance in a year		1 in 100 chance in a year	
	Existing	Project	Existing	Project	Existing	Project
Roads	29	40	32	44	34	45
Tracks	0	0	0	0	0	0
Special Areas fire trails	28	36	29	44	34	46
Buildings	0	0	0	0	0	0
Camp huts	0	0	1	1	1	1
Gates	0	0	0	0	0	0

The number of assets (by type) in the upstream impact area is as follows:

- Roads: 34
- Tracks: nil
- Special Areas fire trails: 31
- Buildings: nil
- Camp huts : 1
- Gates: nil.

20.5.4.4 Assessment of potential Project inundation effects on access to NPW Act estates

Additional temporary areas of inundation would occur upstream of the dam when the FMZ is operational. Indirect impacts of temporary inundation are considered unlikely. Temporary inundation would not restrict access to any areas of NPW Act estate, as areas of temporary inundation are all within the Warragamba Special Areas, within which access is restricted.

20.5.4.5 Assessment of potential Project impacts to visual amenity of NPW Act estates

Identifiable impacts to landscape character zones within NPW Act estates was assessed as moderate due to a greater length of shoreline for both Lake Burragorang and tributaries that would be inundated by the Project; however, the extent of these areas within the scale and expanse of the landscape character zone is relatively small. Similarly, the two upstream viewpoints would have very limited visibility of portions of the upstream impact area and other locations within the FMZ. If inundation leads to degradation of vegetation, visual amenity may be impacted.

20.5.4.6 Assessment of potential Project construction impacts to NPW Act estates

The Construction Area borders the Blue Mountains National Park. No new permanent infrastructure is proposed in NPW Act estates. No access restrictions for NPW Act estates would result from construction or operation of the Project.

20.5.4.7 Assessment of need for revocation/de-listing of land reserved under the NPW Act

The NSW Government's *Revocation, Recategorisation and Road Adjustment Policy* (OEH 2014) notes that from time to time, circumstances may arise which require the revocation, recategorisation or adjustment of boundaries of lands reserved under the NPW Act. The policy identifies a number of scenarios where this may be required with regard to a proposed development or other circumstances. These are listed in the following table and comment provided as to their respective applicability to the Project. It is considered unlikely that the Project would trigger the need for revocation and/or recategorisation of lands reserved under the NPW Act.

Table 20-18. Consideration of NSW Government's Revocation, Recategorisation and Road Adjustment Policy

Policy matter	Comment
Boundary errors	Relates to errors in definition of boundaries of lands reserved under the NPW Act; not considered relevant to the Project.
Boundary encroachments	The Project would result in an increase in the upstream inundation area for the PMF which in some areas would extend further into some areas of land reserved under the NPW Act (Blue Mountains National Park, Nattai National Park). It is noted that this is an existing (temporary) impact and it is considered the incremental impact of the Project would not be regarded as a boundary encroachment.
Development proposals that require revocation	The Project does not require physical works or the permanent use of land reserved under the NPW Act; as such it is not anticipated that it would be necessary for revocation of any such lands.
Recategorisations	The policy indicates that recategorisations are usually proposed on the basis of improved knowledge of the natural, cultural and historic values and recreational activities in the particular national park/reserve, or consideration of the future strategic directions for the national park/reserve. The investigations carried out for the Project may contribute to increased understanding of these values of surrounding lands reserved under the NPW Act, however, it is not anticipated that the incremental impacts associated with the Project would require recategorisation of lands reserved under the NPW Act.
Road adjustments	The Project does not include any road adjustments that would affect lands reserved under the NPW Act.
Plans of management	Relates to preparation or modification of plans of management; not considered relevant to the Project.

20.5.5 Assessment of potential Project impacts on wild rivers

As noted in Section 20.3.4, there are three declared wild rivers within or in proximity to the Project study area, these being the Kowmung, Colo and Grose Rivers. The latter two rivers and their catchments are downstream of Warragamba Dam and lie outside the downstream study area, and would not be affected by the Project.

A short section (about 1,285 metres) of the Kowmung River that has been declared a wild river lies with the upstream Project study area. This section is at the lower end of the declared wild river catchment. An analysis of depth-duration curves for the closest cross section downstream of the declared wild river catchment showed no material difference between the existing situation and with the Project for all flood events up to the 1 in 100 chance in a year event and a very small difference (less than 0.3 metres) up to the 1 in 1,000 chance in a year event. In real world terms, the Project would not impact on the declared wild river section of the Kowmung River.

20.5.6 Assessment of potential Project impacts to areas of outstanding biodiversity value

The Wollemi Pine AOBV is the closest AOBV to the Project study area, but not within the study area. The Wollemi Pine AOBV is within Wollemi National Park on the Central Tablelands of NSW. The Wollemi Pine occurs as a single population in deep sandstone gorge formations (DEC 2007). Flood modelling shows there would be a decrease in the extent of floods in the Wollemi National Park with the Project. About one hectare of the Wollemi National Park near the Colo River would remain within the PMF extent for the Project; in real world terms, there would be no impact to the Wollemi Pine AOBV.

20.5.7 Assessment of potential Project impacts to significant regional ecosystems

Significant regional ecosystems were discussed in Section 20.3.5. Of the 41 plant communities observed in the study area, three of these that generally conform to TECs listed under the TSC Act (BC Act) and/or EPBC Act occur within the upstream impact area and upstream study area. These are listed in Table 20-19.

For the purpose of offsetting potential impacts, the Project has assumed there would be a total loss of biodiversity values within the upstream impact area, and this has been used to calculate species credits and ecosystem credits.

Impacts on these PCTs would be offset/managed through the Biodiversity Offset Strategy (refer Section 8 of Appendix F1 Biodiversity assessment report – upstream). The National Parks EMP required to be prepared under the *Water NSW Act 2014* would complement and support management of potential operational impacts on these PCTs.

Table 20-19. High conservation value PCTs within the upstream impact area and upstream study area

PCT code	Plant community type	Conservation status ¹	Impact area (ha)	Study area (ha)
PCT 840	Forest Red Gum–Yellow Box woodland of dry gorge slopes southern Sydney Basin Bioregion and South Eastern Highlands Bioregion	CE - EPBC Act E - TSC Act	64.17	490.47
PCT 941	Mountain Blue Gum–Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion	E - TSC Act	42.16	378.04
PCT 1401	Narrow-leaved Ironbark–Forest Red Gum on rocky slopes of the lower Burragarang Gorge Sydney Basin Bioregion	CE - EPBC Act E - TSC Act	182.44	957.26

¹ E: Endangered; CE: Critically Endangered

20.5.8 Assessment of potential Project impacts to marine estates

There are no marine estates within or adjacent to the Project study area, although there is a proposal for the creation of a marine estate at the mouth of the Hawkesbury River. Regardless, there would be no impacts to marine estates as they occur downstream of the Project study area, and beyond the influence of the Project which ceases around Wisemans Ferry.

20.5.9 Assessment of potential Project impacts to critical habitat and key fish habitat

The study area includes extensive waterways that are designated key fish habitat under the FM Act. These include Lake Burragarang and the streams that feed into Lake Burragarang that are within the FMZ. As such areas of key fish habitat may be impacted by temporary inundation when the FMZ is in use.

Schedule 6 to the FM Act defines key threatening process as they relate to fish habitat management and conservation. Those of potential relevance to the Project are:

- degradation of native riparian vegetation along New South Wales water courses
- installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.

The Project would result in the temporary inundation of vegetation in the upstream study area, some of which would be considered riparian (and noting there is already an existing impact for vegetation at or below the full supply level. The types and extents of plant communities that would be temporarily inundated are listed in Impacts on these PCTs would be offset/managed through the Biodiversity Offset Strategy (refer Section 8 of Appendix F1 Biodiversity assessment report – upstream). The National Parks EMP required to be prepared under the *Water NSW Act 2014* would complement and support management of potential operational impacts on these PCTs.

Table 20-19. How frequently temporary inundation of vegetation in the FMZ would occur is difficult to determine. The FMZ would only be required when Lake Burragarang experiences inflows from a significant rainfall event with the duration of inundation would vary depending on the size and frequency of the individual flood events and antecedent conditions, such as soil moisture. For example, the fringes of the inundation extents would only be inundated for short periods (hours to up to two days), and to low depths (for example, less than two metres). Riparian vegetation occurring in the inundation extents closest to FSL, would be tolerant of infrequent inundation. As the FMZ would operate infrequently, degradation of native riparian vegetation is not expected to be significant. However, if the frequency of inundation events increases, this may lead to the degradation of native riparian vegetation in the upstream catchment.

Much of the riparian habitat in the downstream study area is significantly degraded or highly modified due to historical land use practices and urbanisation. Inundation extents downstream would decrease with operation of the FMZ. However, the duration of flooding may increase in some areas. The magnitude of this increase in duration is expected to be in the order of a few days up to two weeks. An increase in the duration of flooding in some downstream areas may lead to the degradation of native riparian vegetation; however, as riparian species are generally flood tolerant and the duration isn't anticipated to increase substantially, impacts should be minimal. Some areas downstream may also be subject to increased erosion potential, as identified by the geomorphology assessment (refer Appendix N2, Geomorphology assessment report). However, areas at risk are likely to be those with existing compromised riparian habitat rather than established riparian habitats, as flood velocities downstream are not expected to alter.

Warragamba Dam already affects the natural flow regimes. WaterNSW currently operates an environmental flows regime, releasing water systematically from the dam when possible to provide benefits to downstream aquatic habitats. The installation of temporary instream structures would be unavoidable during construction to raise the dam; however, this would be managed to ensure minimal disruption to downstream flows. New environmental flows infrastructure is proposed to be included in the Project works. A new environmental flows regime would be implemented with this being subject to a separate assessment and determination process.

20.5.10 Assessment of potential Project impacts to biodiversity offset and private conservation lands

Biobanking and private conservation areas in the study area only occur downstream of Warragamba Dam. Several of these sites are within the existing floodplain, and existing flood extents. The Project would reduce the flooding extent downstream; however, the duration of flooding in some areas would increase. The biodiversity conservation or private conservation lands that are within the downstream Project PMF extent are at the fringes of this area. In these areas, flooding duration is not expected to increase significantly, and flood depths would likely be minor.

20.6 Summary of potential Project impacts on protected and sensitive lands

A summary of the assessment of impacts on protected and sensitive lands is provided in Table 20-20.

Table 20-20. Assessment of impact of protected and sensitive lands

Protected area	Assessment of impact
World Heritage	<p>About 304 hectares of the upstream impact area occurs within the GBMWWHA, which is about 0.03 percent of the total area of the GBMWWHA. The 1 in 100 chance in year flood event would increase the area of potential inundation in the GBMWWHA by about 0.04 percent to 0.07 percent.</p> <p>This increase in inundation area does not constitute a significant change. Inundation would only occur when the dam is above FSL and, when it does occur, would be temporary for up to two weeks per flood event. This is not likely to have an impact to the World Heritage values of this area. Impacts to the World Heritage area are discussed further in Appendix J to the EIS (World Heritage assessment report).</p> <p>Chapter 17 (Non-Aboriginal heritage) provides an assessment of potential heritage impacts from the Project, including those to the Australian Convict Sites World Heritage Property - Old Great Northern Road. The assessment states that the potential impact of the Project to the Australian Convict Sites (Old Great Northern Road) is not considered to be significant as the potential PMF associated with the dam raising would only marginally encroach on the heritage curtilage, and the affected sections are not associated with significant elements or components of the item. A small portion of the item's buffer zone would potentially be impacted by extended periods of inundation by flood waters, but it is likely this would be minimal. The main area of the items curtilage within the buffer zone would not be impacted by a 1 in 100 chance in year flood event, nor by a PMF event.</p>
National Parks and Wildlife estates	<p>Increase in potential area of inundation of the National Parks and Wildlife Estates by 7.4 percent for a 1 in 100 chance in a year flood. The largest increase in potential inundation is for the Yerranderie State Conservation Area (3.2 percent for a 1 in 100 chance in a year flood) which borders Lake Burrangorang.</p> <p>The extents of protected areas in the upstream impact area are very low on a percentage basis, the largest being for the Yerranderie State Conservation Area (2.21%).</p> <p>There are 66 NPWS assets in the upstream impact area (34 roads, 31 Special Areas fire trails and one building).</p> <p>Inundation would only occur when the dam is above FSL and would only be temporary for up to two weeks per flood event. This is not likely to have a material impact on the values of national parks and wildlife estates in this area.</p> <p>Impacts to biodiversity due to temporary inundation are discussed in Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment) and Chapter 10 (Biodiversity construction area). Impacts to geomorphology due to temporary inundation and release of flood waters are discussed in Chapter 22 (Soils).</p>

Protected area	Assessment of impact
Wild rivers	Three declared wild rivers occur within or in proximity to the Project study area: the Colo River, the Grose River and the Kowmung River. There would be no impact to areas of the Colo River or Grose River that are declared as wild rivers. A 1,285 metre section of the Kowmung River that has been declared a wild river is located within the upstream study area. An analysis of depth-duration curves for the closest cross section downstream of the declared wild river catchment showed no material difference between the existing situation and with the Project for all flood events up to the 1 in 100 chance in a year event and a very small difference (less than 0.3 metres) up to the 1 in 1,000 chance in a year event. In real world terms, the Project would not impact on the declared wild river section of the Kowmung River.
Areas of outstanding biodiversity value	There is one AOBV adjacent to the Project study area: the Wollemi Pine AOBV. There would be a decrease in area of potential inundation of Wollemi National Park in the downstream study area due to the Project, as such there would be no impacts to the Wollemi Pine AOBV.
Marine estates	There are no marine estates within the Project study area and therefore no impacts to marine estates would occur due to the Project.
Key fish habitat	There is expected to be no material changes in inundation of key fish habitat downstream of Warragamba Dam. The raising of the dam reduces the extent of downstream inundation, but environmental flows are expected to remain generally unchanged.
Biodiversity offset and private conservation lands	There is expected to be no material changes in inundation of biodiversity offset sites or private conservation lands downstream of Warragamba Dam. The raising of the dam would reduce the extent of downstream inundation.

The impacts of any changes in inundation and flooding due to the Project on conservation and other relevant aspects are assessed in Chapter 8 (Biodiversity upstream), Chapter 9 (Downstream ecological assessment), and Chapter 10 (Biodiversity construction area), Chapter 15 (Flooding and hydrology), Chapter 17 (Non-Aboriginal heritage), and Chapter 21 (Socio-economic, land use and property).

20.7 Environmental management measures

Safeguards and management measures for protected and sensitive lands would be primarily achieved through those detailed in parts of this EIS, including:

- Chapter 8 – Biodiversity upstream
- Chapter 9 –Downstream ecological assessment
- Chapter 10 – Biodiversity construction area
- Chapter 11 – Aquatic ecology
- Chapter 15 – Flooding and hydrology
- Chapter 17 – Non-Aboriginal heritage
- Chapter 18 – Aboriginal cultural heritage
- Chapter 21 – Socio-economic, land use and property
- Chapter 27 – Water quality
- Appendix J – World Heritage Assessment report.

These mitigation and management measures have been incorporated in the consolidated environmental management measures in Chapter 29.

Warragamba Offset Program

Mitigation of potential impacts on biodiversity (and other protected lands values) would be addressed through the Warragamba Offset Program, the cornerstone of which is the BOS. The objective of the BOS is to provide a framework for the delivery of offsets for the potential impacts of the Project and to achieve a long-term conservation gain for the threatened species, populations and communities, and biodiversity-related matters with regard to national parks and World Heritage values impacted by the Project. It includes the biodiversity offsets required under the FBA and set out in the SEARs, and offsets addressing potential loss of biodiversity-related World Heritage and national park values.

The Warragamba Offset Program also encompasses non-biodiversity matters such as:

- geodiversity
- water catchment protection
- cultural heritage
- landscape, natural beauty and aesthetic values
- recreation and visitor use
- social and economic benefits derived from visitation to these areas.

The Warragamba Offset Program will prioritise land suitable for inclusion in the National Park estate, however, additional offsets may be needed through purchase and retirement of biodiversity credits in order to meet the credit requirements for the Project. Any land containing suitable offsets must also be appropriate for the National Park estate and supported by NPWS for this purpose. It is intended that as a minimum the quantum of land required to compensate for impact on National Parks (including the affected part of the GBMWHA) will be equivalent to or greater than the area impacted (1,400 hectares) and that this would incorporate a minimum area of 304 hectares containing constituent values for the OUV of the GBMWHA to offset potential impacts to the GBMWHA.

With regard to prioritising land that improves or supports the OUV for the GBMWHA, this would include consideration of, as appropriate:

- Wilderness areas
- Aboriginal cultural heritage
- plant communities identified in the OUV statement
- threatened flora species
- habitat of threatened fauna species
- Eucalyptus species
- other biodiversity related matters such as scleromorphic species, ant-adapted plants, diversity and characteristics of the flora as a whole, species diversity, vertebrates and invertebrates identified in the OUV statement
- visual amenity
- users of the GBMWHA
- geological structure, geomorphology and water systems.

This would be informed by the detailed assessment provided in Appendix J (World Heritage Assessment Report).

The Warragamba Offset Program will include the establishment of an advisory committee which would comprise a group of core representatives from DAWE, DPIE, NPWS, Local Land Services, Biodiversity Conservation Trust, Greater Blue Mountains World Heritage Area Management Committee, WaterNSW, and Infrastructure NSW, and would involve other parties such as local council and relevant subject matter experts where required. The advisory committee would be overseen by an independent chairperson.

The advisory committee would provide input into:

- consideration of compensatory options for both downstream and upstream that adhere to the NSW Biodiversity Offsets Policy for Major Projects, EPBC Environmental Offsets Policy, and OEH's Principles for the use of biodiversity offsets in NSW
- identification and prioritisation of potential compensatory options
- selection of final suite of biodiversity compensation package
- determining allocation of compensation funds to each action
- an annual Implementation Report to be issued to NSW and Commonwealth Governments outlining the actions taken and how compensatory obligations are being fulfilled.

The mitigation measures identified in Chapter 29, Section 29.7 would contribute to offsetting impacts on protected lands and would support the Warragamba Offset Program.

National Parks Environmental Management Plan

WaterNSW is required to prepare an EMP under Part 5A of the *Water NSW Act 2014* before the temporary inundation of any land protected by the *National Parks and Wildlife Act 1974* can occur. The EMP would be separate to the environmental management measures identified for the Project but would complement and support these measures.

The scope and content of the EMP has yet to be defined but would be consistent with the existing management plans for the national parks and the GBMWHA. The EMP would contribute to the maintenance and strengthening of protected lands values.

The EMP would be prepared in consultation with the NPWS (and require approval from the Minister administering the NPW Act) and other relevant stakeholders. Funding for the EMP would be additional to the current funds used for management activities and would be agreed once the scope and requirements of the EMP are determined.

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